

Scope of Updates to Mars Outpost License

The overall goal of the Mars Outpost experiment, is to demonstrate metal cutting in space, to explore the feasibility of reusing abandoned space vehicles.

The experiment will be launched on the second stage of a SpaceX Falcon 9 launch vehicle ("Stage 2"), from Cape Canaveral, FL, no earlier than December 1, 2021, on a dedicated sun-sync rideshare mission. The experiment remains attached to the second stage throughout the mission and during de-orbit. Stage 2 will be inserted into a circular orbit at about 545 km, 97.5 degrees inclination.

This mission is currently licensed under STA 0022-EX-ST-2021. Because of the very short window of time available to download the data from the experiment, it is desired to add more ground stations to the communications plan. This will reduce the risk that all data would not be downloaded before the second stage is de-orbited.

This application is for a new license that identifies those ground stations. This application does not include licensing those ground stations; they are all owned and operated by others.

The only changes that are sought compared with the original license, is

- 1) To communicate with this larger set ground stations. No changes to the frequency plan, and no changes to the construction of the experiment, or the execution of the experiment, or the mission lifetime, are requested.
- 2) To change the STA to start November 1, 2021, to reflect slips in the launch schedule.

Experiment Plan and Communications Plan

Experiment initiation will be enabled by the Stage 2 on board computer after orbital insertion.

Transmission initiation will be enabled as a timed event by the Stage 2 on board computer to allow the first downlink to the McMurdo station. During that period there will be S-Band & X-Band downlinks, and an S-Band uplink from McMurdo will be available for positive transmission control.

After passing McMurdo, transmission will cease until the second downlink opportunity over the US (between these downlink windows SpaceX will be launching their payloads and we are prohibited from transmitting). Once the US downlink sites are in range, they will collect S-Band data, while providing capability for positive control of the transmissions, through the S-Band uplinks available at two of the stations. Once this window passes, transmissions from the satellite will cease. Then, over the south Pacific, the second stage, carrying the experiment, will de-orbit.

The following table lists the 6 stations and summarizes their operating characteristics. 3 support uplinks and downlinks, and 3 are downlink only.

1. NEN McMurdo	S Band Rx X Band Rx S-Band Tx
Official Name of Ground Station	MGS
Name of owner / operator	NASA NEN
Antenna Gain	S-Band=45 dBi; X-Band=56 dBi
Antenna Beamwidth	S-Band=0.91°; X-Band=0.26°
Dish Diameter	10 m
Antenna efficiency for parabolic antennas	60%
Lat and Long	77° 50' 21" S/ 166° 40' 01"E
State – Country	Ross Island, Antarctica
Tx Power if they Tx	S-Band 80 W
2. NEN White Sands	S Band Rx S Band Tx
Official Name of Ground Station	WS1
Name of owner / operator	NASA NEN
Antenna Gain	S-Band=49 dB
Antenna Beamwidth	S-Band=0.56°
Dish Diameter	1 8.3 m
Antenna efficiency for parabolic antennas	60%
Lat and Long	32 ° 32' 27" N / 106 ° 36' 44" W
State – Country	New Mexico, USA
Tx Power if they Tx	S-Band 300 W
3. US Army SMDC Mobile CubeSat Command and Control (MC3) Ground Station	S Band Rx X Band Rx S Band Tx
Official Name of Ground Station	SMDC
Name of owner / operator	US Army Space and Missile Defense Command
Antenna Gain	S-Band=31 dB; X-Band= 45 dB
Antenna Beamwidth	S-Band=3°; X-Band= 0.75°
Dish Diameter	3.7 m
Antenna efficiency for parabolic antennas	60%
Lat and Long	34.632413/ -86.595497
State – Country	Huntsville, Alabama, USA
Tx Power if they Tx	S-Band 30 W

4. DoD Human Spaceflight Program MC3	S Band Rx X Band Rx
Official Name of Ground Station	MC3
Name of owner / operator	DoD Human Spaceflight Program
Antenna Gain	S-Band=31 dB; X-Band= 45 dB
Antenna Beamwidth	S-Band=3°; X-Band= 0.75°
Dish Diameter	3.7 m
Antenna efficiency for parabolic antennas	60%
Lat and Long	29.560857, -95.092188
State – Country	Texas, USA
5. UNM Ground Station	S Band Rx X Band Rx
Official Name of Ground Station	UNM
Name of owner / operator	University of New Mexico
Antenna Gain	S-Band=31 dB; X-Band= 45 dB
Antenna Beamwidth	S-Band=3°; X-Band= 0.75°
Dish Diameter	3.7 m
Antenna efficiency for parabolic antennas	60%
Lat and Long	35.084318, -106.619781
State – Country	New Mexico, USA
6. Atlas Space Operations Albuquerque, NM	X Band Rx
Official Name of Ground Station	Atlas
Name of owner / operator	Atlas Space Operations
Antenna Gain	X-Band= 52 dB
Antenna Beamwidth	X-Band= 0.4°
Dish Diameter	6.1 m
Antenna efficiency for parabolic antennas	60%
Lat and Long	35°02'22.6"N 106°34'14.2"W
State – Country	New Mexico, USA