Mars And Lunar Lander Engineering Team [MALLET] EEV and Rover

Sam Bayer, Alexander Benvenuti, Jared Chown, Christian King, Angela Lalovic, Matthew Snyder,
Justin Rauchwarg, Rodolfo Rodriguez, Daniel Rossman, Sierra Vidales

UF UNIVERSITY of FLORIDA

Mission Plan and Spacecraft Systems

Mission Overview/Trajectory Design

- Mission duration: January 1st - January 27th, 2040
- Transfer from parking orbit to Deimos on January 3rd, 2040: Total Δv = 0.69 km/s
- Transfer from Deimos to Phobos on January 13th, 2040: Total Δv = 2.27 km/s
- Rendezvous with DST on January 27th, 2040: Total Δv = 1.26 km/s

Propulsion System

- The EEV Service Module has one SpaceX Merlin D Vacuum Engine for propulsion from Mars orbit to Deimos, then Phobos, and back to the DST. The Merlin D weighs 470 kg, has an ISP of 348 seconds, and costs under 1 Million USD.
- SpaceX's Starship system will be used to transport the EEV from Earth to the Mars parking orbit.

Docking System

- International Docking System Standard
- Fully androgynous system to allow for initiation and receiving during docking.

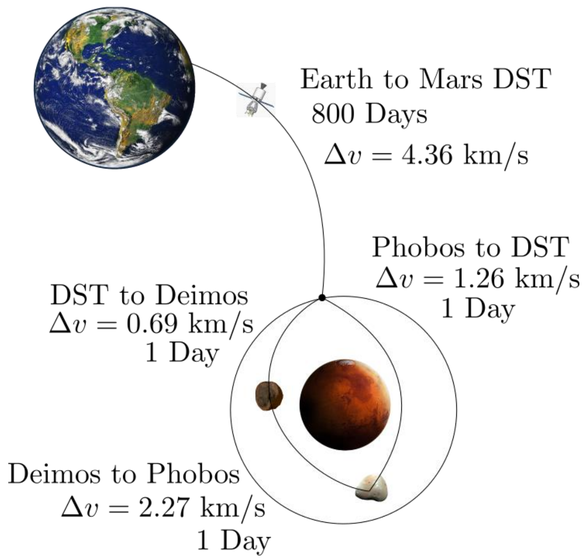
Life Support

- Pure oxygen environment at 0.3 atm.
- Lithium hydroxide canisters to remove CO_2.
- Meals Ready to Eat (MRE) for crew.
- Water recovery using a multifiltration process.
- Waste bags to dispose of solid and liquid waste.
- Radiation shelter to protect crew from harmful radiation.
- Exercise device for crew.

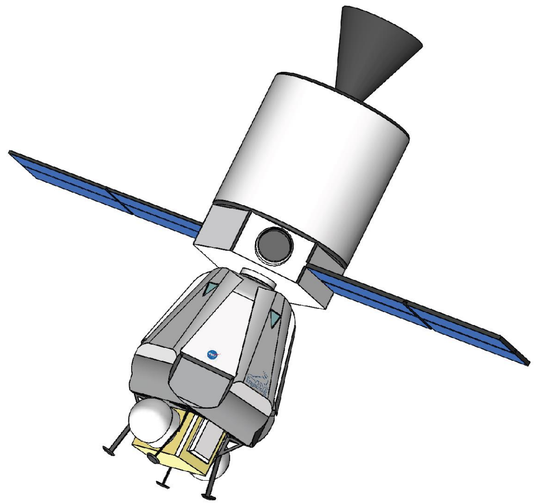
Thermal Control

- Body Mounted Radiators with Thermal Louvers to expel excess heat.
- Heaters to heat systems and components.
- Multilayer Insulation.
- White exterior coating to reflect sunlight.

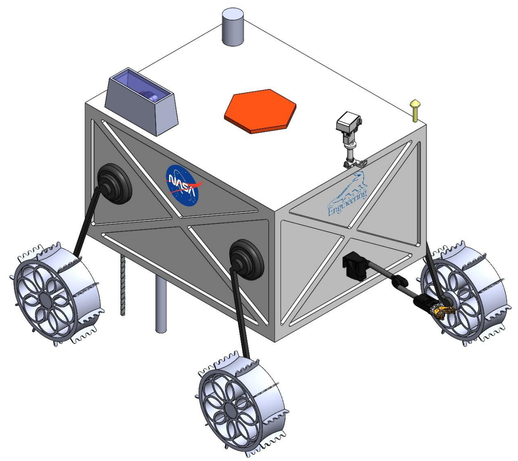
Trajectory



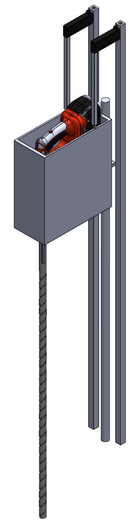
EEV – Lander and Service Module



Surface Rover



TRIDENT Drill Sample Retrieval



EEV Systems

Telecommunications

- EEV will utilize direct and relay transmissions to communicate with Earth. Three types of antennas will be used to transmit and receive data: Ultra High Frequency, X-band Low Gain, and X-band High Gain.
- Orbiters in the Mars Relay Network will be used in relay transmissions. The Deep Space Network on Earth will be used to receive direct transmissions from the EEV and relay transmissions from the Mars Relay Network.

Structures

- EEV is in two main parts – the Lander and the Service Module. The rover is stored in and deployed from the lander.

Surface Rover and Sample Retrieval

- Rover will be used to carry out scientific investigations concerning the elemental/mineral compositions, internal structure, and formation/origin of the moons.
- Surface element composition will be identified using the PIXL instrument. Geologic features up to 10 m below the surface will be identified using the RIMFAX instrument.
- Sample collection and retrieval up to 1 m below the surface will be performed using the fully autonomous TRIDENT drill. Sample retrieval will take roughly 60 minutes at Deimos and 75 minutes at Phobos.
- Rover will use three types of antennas to transmit and receive data: Ultra High Frequency, X-band Low Gain, and X-band High Gain.

Power Systems

- Designed to deliver 8kW of power.
- Utilizes a photovoltaic–battery system to generate and store power.
- Uses roll up solar arrays (ROSA) to save mass and lower volume during launch.
- Features a deployed area of near 200 square meters on an articulating array.
- Photovoltaic cells are connected directly to the main BUS and batteries for efficient power transfer and monitoring.