Demonstrating the Lunar Ark Power Systems

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SpaceTREx

Motivation

The Earth is experiencing new abnormal events which are being escalated by the growing population. These events are in turn damaging the rich biodiversity. Reserving the Earth's valuable diversity is crucial in protecting our planet from unseen events.

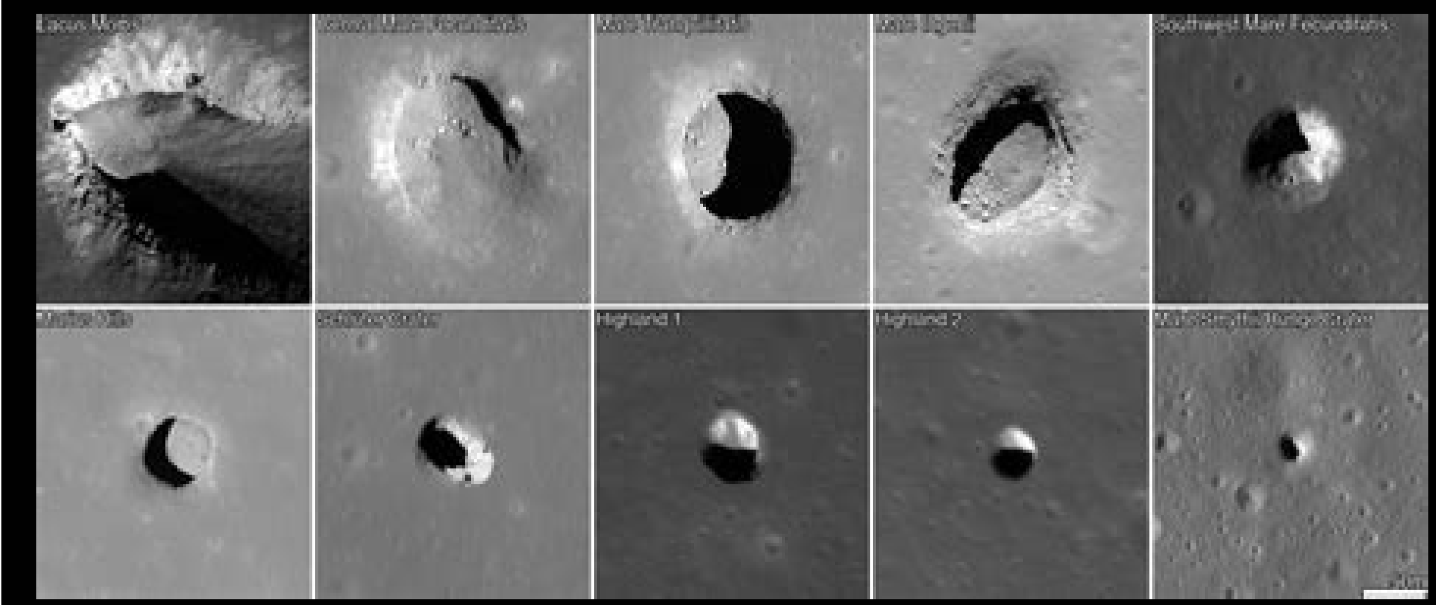


Figure 1: Lunar lava tube cites

Mission Objectives

Primary: Gather data of the behavior of lunar lava tubes and the requirements of creating a facility for cryo-preserving species. Research and development of a high longevity, low maintenance renewable energy power system.

Secondary: Test the behavior of cryo-frozen species in microgravity. Prepare a 6U Cubesat for the mission and determine a sufficient battery supply for the cryocooler.

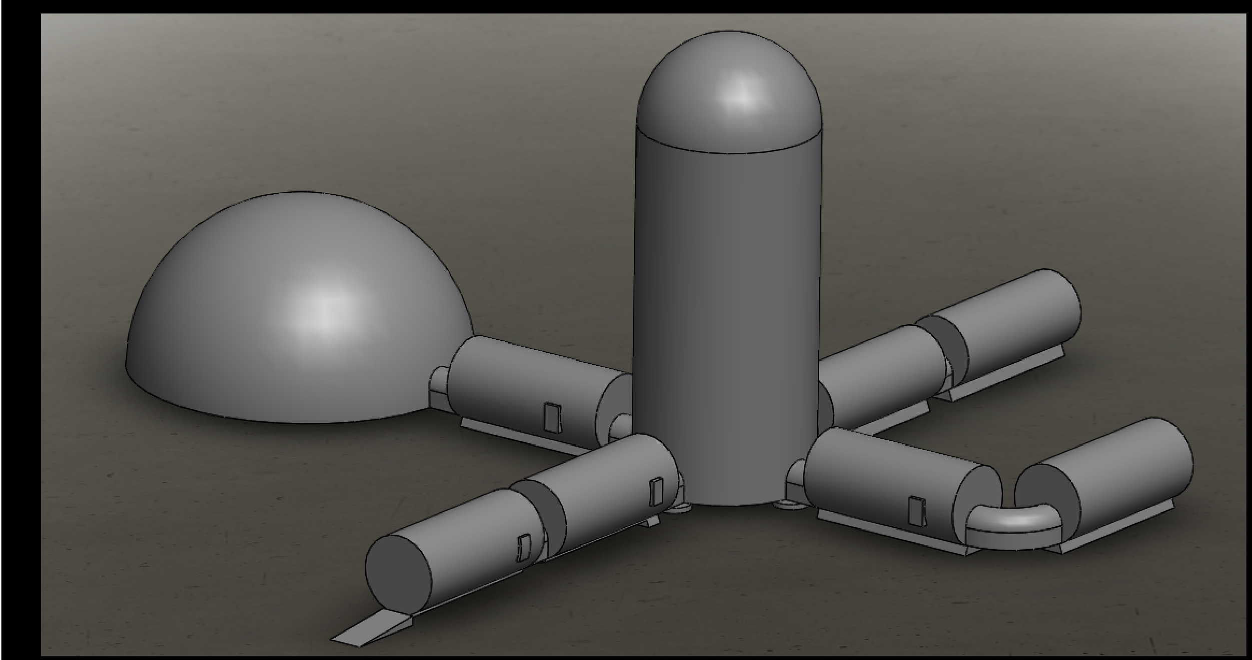


Figure 2: Lunar ark model

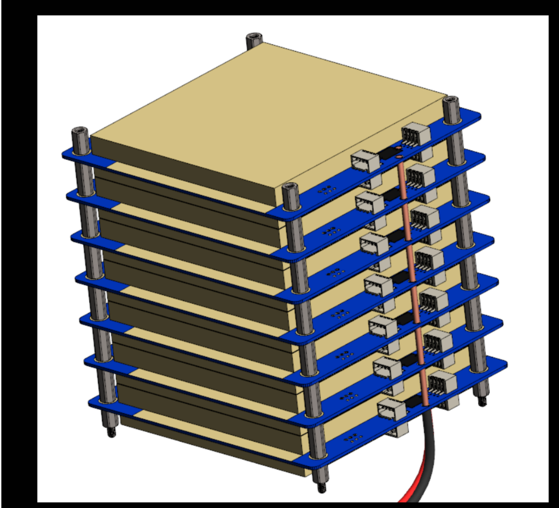


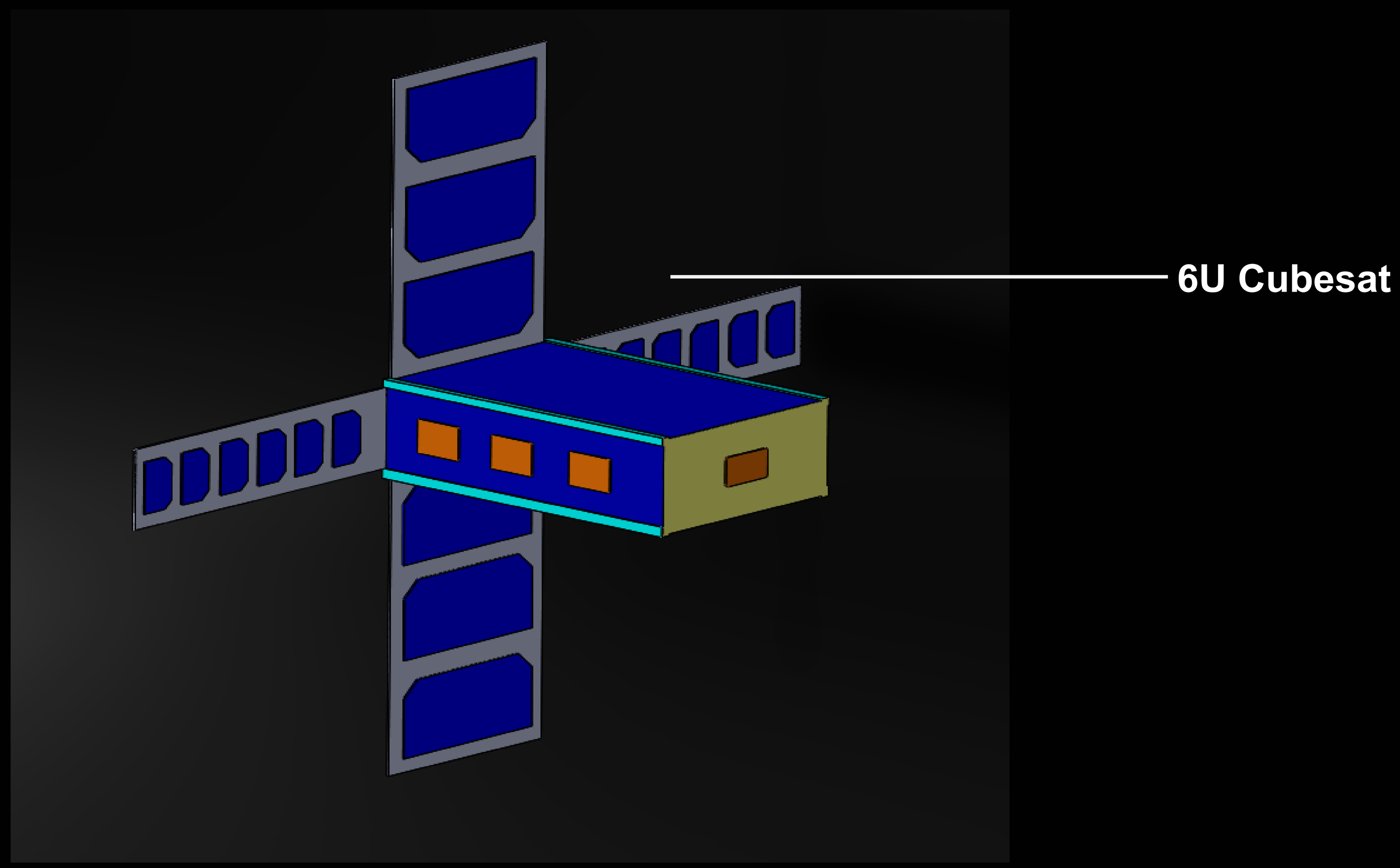
Figure 3: TITAN-1 Battery

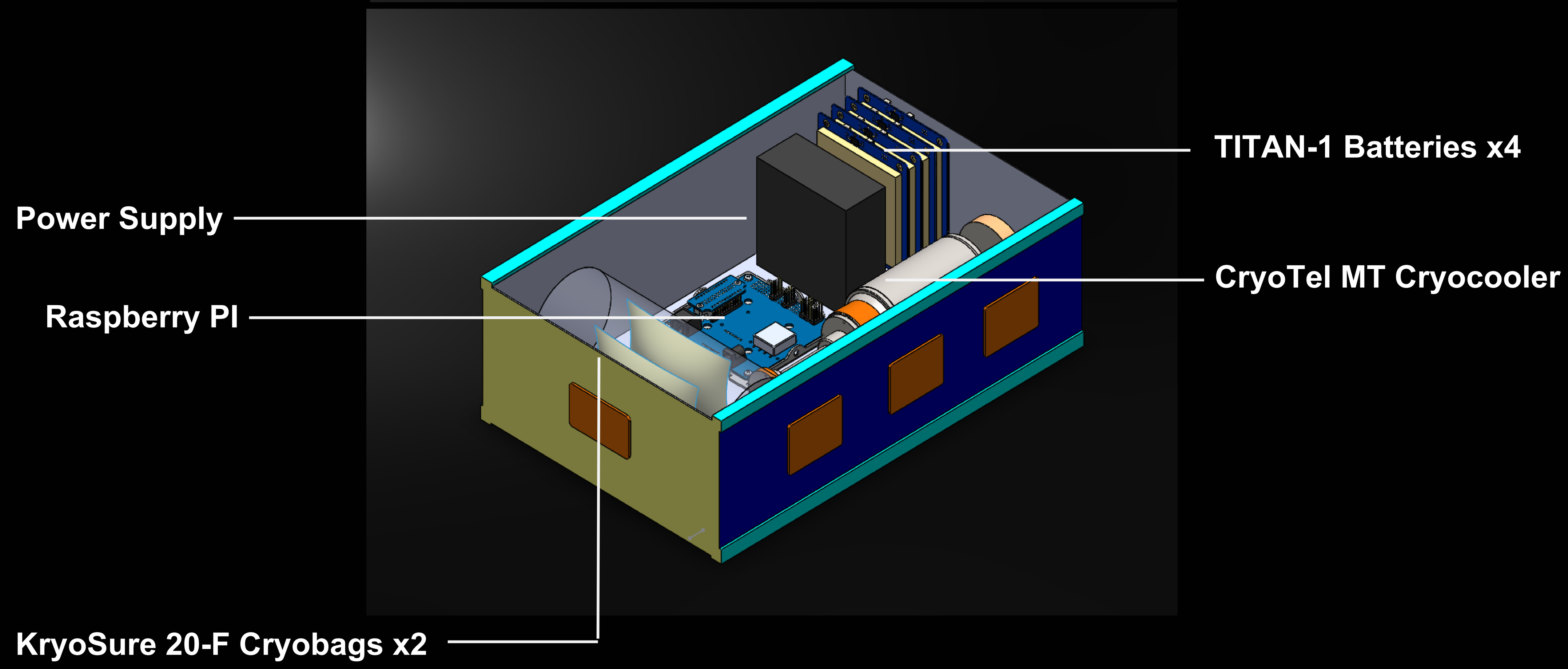
Figure 4: Lithium-Ion Battery

Justification

Lithium-Ion Batteries will be implemented for the primary mission as solar power is easily accessible and can be maximized based on location. This battery is long- lasting, practical, and faces a 1%-3% discharge rate per month. This mission requires a battery bank composed of 274,500 batteries. This is a determination with 12V batteries, but with greater financial resources, the amount of batteries can be significantly reduced. The secondary mission requires 24V of power and can be accomplished with 4 of the 7 batteries on the TITAN-1 battery with no recharge.

6U Interplanetary Cubesat for Testing





Concept of Operations

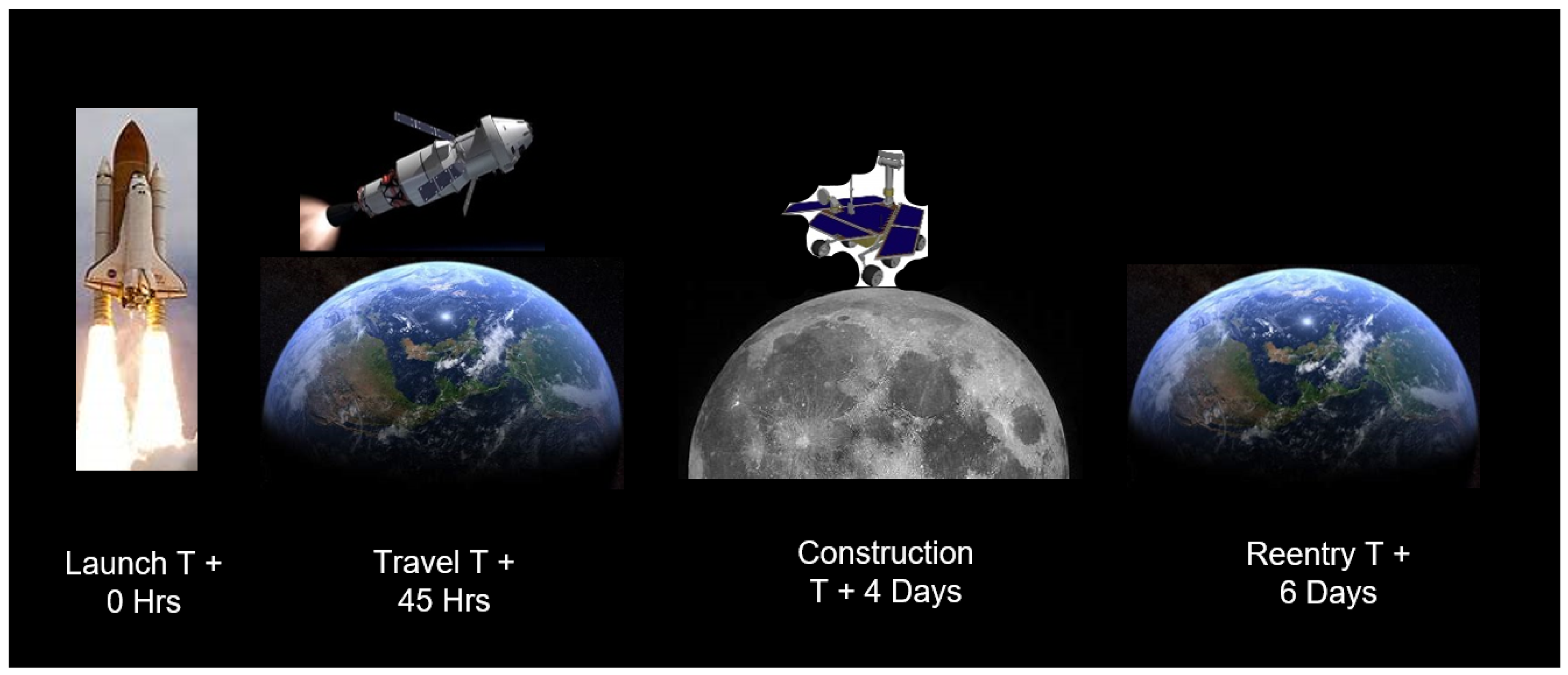


Figure 5: Primary Mission ConOps

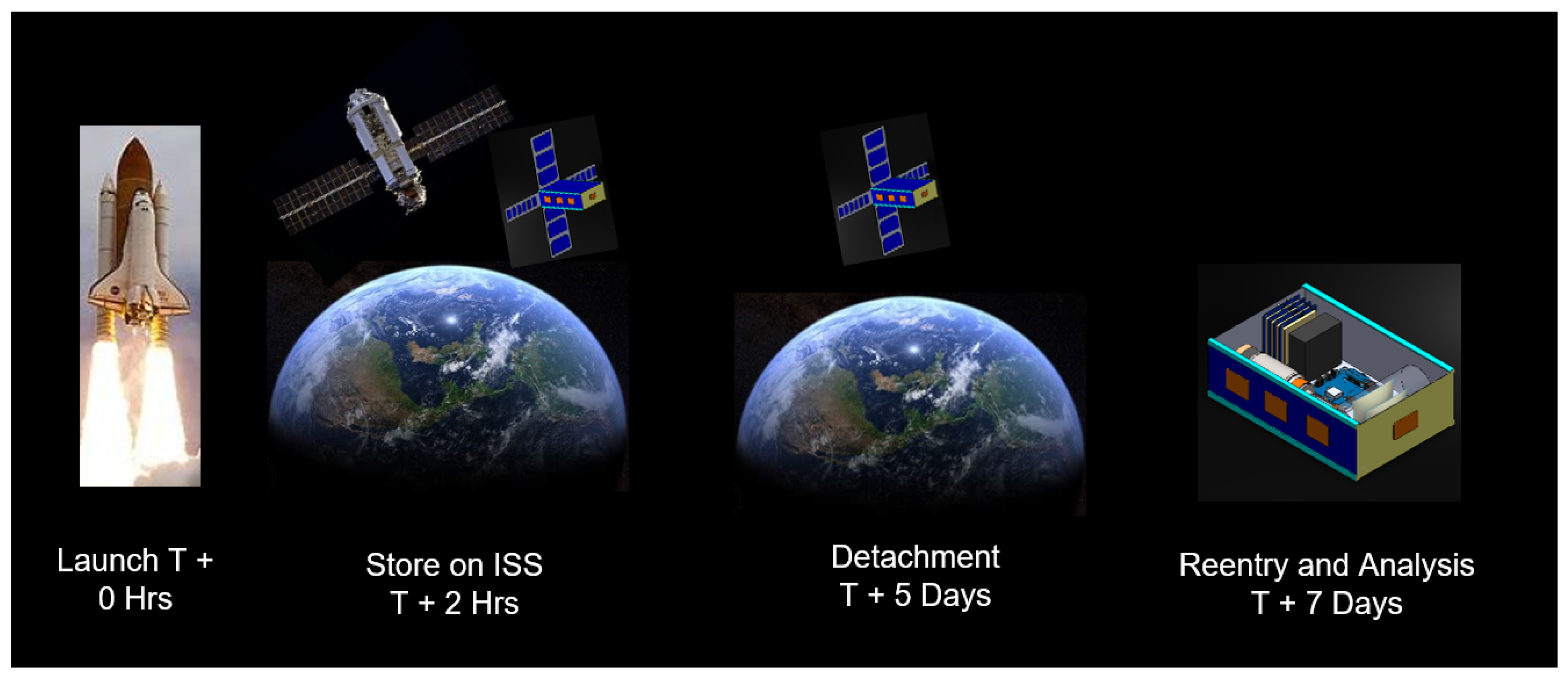


Figure 6: Secondary Mission ConOps

Specifications

Primary:

System: Lunar Ark Facility Power System
Mission Time: TBD
Instruments: Battery: 12V Lithium- Ion batteries, Solar panels: 0.1kW panels
Power: 5000J/s (module), 8564400kWh (total energy)

Secondary:

System: 6U Interplanetary Cubesat Power System
Mission Time: 7 days
Instruments: Battery: TITAN-1, 350 Whr, 50Whr/ battery module(x4), Cryocooler: CryTel MT 24V, 2.1kg(mass)
Power: 24 V(average), 29.6 V(peak)
Propulsion: Green Monopropellant, Aerojet GR-1

Current and Future Work

The research at this moment consists on creating a heat analysis on the batteries which are housed in a compartment on each module for the primary mission. The batteries in an enclosed area stacked on one another will create heat amongst each other which could short circuit batteries. This would ultimately lead to the damaging of other batters and ultimately the modules and Ark as a whole. A possible solution to this would be to utilize aerogel as an insulator to create a stable environment. Aerogel is a beneficial insulator due to its low- density structure and low thermal conductive nature. Aerogel is a difficult material to produce at it cannot be produced at a quick rate and the chemical structure is challenging to produce.

As time progresses with the design of the primary mission, it will be crucial to identify specific models of batteries and solar panels based on the finances available. In addition, simulations of battery charge and discharge under lunar lava tube conditions will mitigate challenges that could be experienced in space. Testing the effects of radiation projected from the lava tubes on to the power system equipment will determine how modifications can be made to prolong the life of the system. Ultimately the goal is to design a power system that will be fully functional for as long as possible with little to no human interaction.

Acknowledgement

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