28 - Habitat on Moon: Exodus

It has been over 50 years since man first set foot on the Moon and proved that mankind could extend its borders beyond Earth, and yet no permanent lunar outpost has been set yet. Like how the construction of larger ports allowed for the exploration of the New World in the Renaissance, human exploration of space requires infrastructure beyond that required for spaceships and launchers. As our only natural satellite, the Moon is the best choice for a permanent base, one that would be capable of refuelling interplanetary missions, providing plentiful resources for the needs of people on Earth, and giving opportunities for fundamental research.

Mission Objective

ESA set the goal to design the first crewed semi-permanent lunar outpost. The first challenge would be to design a mission resulting in a habitat capable of lasting 10 years, with four-person crews renewed on a yearly basis. Successful return of the first round of astronauts would prove long-term outposts far from Earth are possible and potentially profitable. The project encapsulates the mission as a whole, from the building of the habitat to its end-of-life, including the arrival and exit of the astronauts on SpaceXs new Starship rocket. The mission was named 'Exodus', meaning mass departure, due its potential to be the first step towards human migration outside of Earth.

System Design

The habitat should be light, sustainable, and offer the greatest possible protection against the hazards of the Moon environment. An inflatable, regolith-covered, multi-layer structure was chosen. The regolith is acquired in-situ, and is already stable when dealing with solar radiation, large temperature ranges, and meteoroid impacts. The nature of the inflatable structure and its layers allows for significant weight and storage volume savings, while still providing ample strength and resilience.

The habitat will be located near the Shackleton crater due to its near constant illumination and access to large amounts of water. The nearly vertical solar panels to capture the maximum amount of light to fuel the hybrid fuel-sell power system. The energy is then used to power the robots assembling the habitat in the assembly phase, and to power the habitat itself when it is crewed.

Avoiding harming the astronauts was the main consideration during the entirety of the design. This lead to designing the life support systems that will keep them alive, along with a safe house for use case of extreme events.

The robot-assembled structure will require two launches to be fully operable on the Moon. These will bring the structure itself, along with the robots to assemble it and the systems to make it thrive. Once its functioning is tested, the astronauts will arrive on the third and final launch. For the full 10 years, the cost was estimated to be $5B, or $500 per year of operation. Currently the team is validating and verifying the design, ensuring that it is feasible and not science-fiction. The team believes that the mission can be accomplished before 2030, and that its success would lead to a profitable and sustainable invigoration of space development and exploration. Ex Luna, Vita.