NUCLEAR POWER DEMONSTRATION IN A PERMANENTLY SHADOWED REGION OF THE MOON S. T. Goertzen[1], A. B. Conners[2], R. Gregg[3], A. Hugo[4], N. Webb[5] and H. Williams[6]

Introduction: The goal of this project is to develop a power demonstration system for use in a permanently shadowed region on the lunar surface. By using the current advancements in nuclear fission reactors along with the long history of nuclear power used by previous missions in space, this project will demonstrate power production for in situ resource utilization where sunlight is not readily available. Nuclear power offers the benefit of nearly constant power output and availability without needing a relay system from the edge of a crater like many other power systems rely on.

Technical Systems: Our preliminary design is made up of components currently being developed for use in space and features a scaled Kilopower nuclear fission reactor capable of producing electrical power and thermal energy. Another benefit of nuclear fission reactors is that as they are increase in power, their power to mass ratio increases making larger reactors more efficient. Launching within a single payload, the system will interface with a modified commercially available lunar lander. Working alongside the reactor is a thermal radiator system which will autonomously keep the internal temperatures within the operation range and transfer any excess heat either into an ice sublimation system or into the vacuum of space. A data and telemetry system will monitor all internal systems as well as any external instruments and transmit the data back to earth via a lunar satellite relay. In addition to the ability to power external instruments, there will be an external power adapter for rovers to recharge or for external systems to connect.

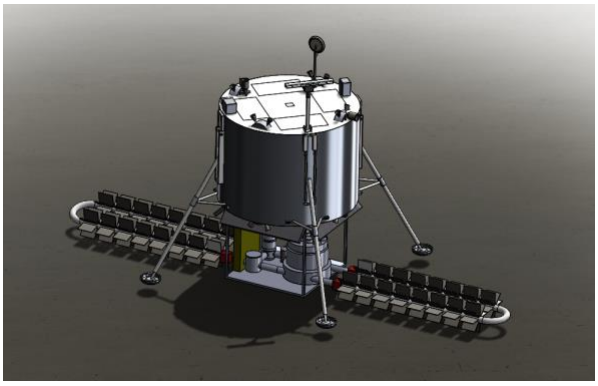

Figure 1: Preliminary Demonstration Design

Feasibility: Using a development cost and launch cost per kilogram model along with a maximum budget of 200 million US dollars, the overall mass limit is calculated to be 2300 kilograms excluding the mass of the commercial lander. By achieving this requirement, the project will be financially and physically feasible to achieve.

Potential Applications: This system enables greater production of water on the lunar surface by using the excess heat for ice sublimation while simultaneously providing electrical power and reducing the amount of wasted energy. Along with enabling resource extraction on the lunar surface, this also system enables potential applications all across the solar system by taking away the necessity of using the sun as an energy source. Since solar flux varies by one over the distance from the sun squared, the solar power generated decreases quickly one travels farther away from the sun. Even at only 1.5 astronomical units (roughly the distance from the sun to Mars), the solar flux has already decreased by more than 50 percent.

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