Solar Orbital Logistics Forecasting and Radiation Module (SOLFARM)

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ABSTRACT

SOLFARM is a Mission of Opportunity (MOO) to take advantage of the Gateway as an existing platform to study various aspects of space weather, as well as provide a platform for monitoring space debris via a unique vantage point from the Earth-Sun L4 point. The module will be a shared mission, with the first two phases of its Concept of Operations (ConOps) primarily focusing on a logistics mission to provide the Gateway with necessary supplies. In the second, third, and fourth phases, the module will monitor space weather and quantify the radiation environment at various points in space. In the fourth phase, the module will have a unique view that could prove beneficial for monitoring space debris. SOLFARM's ConOps will be as follows:

- Phase I: Launch and transit. This phase includes the launch and transit time in route to the Gateway, during which no SOLFARM-specific activities will take place so that power and communications capabilities can be directed towards rendezvous with the Gateway.
- Phase II: Docked with the Gateway. During the module's time with the Gateway, SOLFARM will begin its studies of space weather to compare the effects of the Earth and the effects of the Moon on space weather events.
- Phase III: Entering the disposal orbit. During this phase, the module will make the transfer from its near-rectilinear halo orbit around the Moon with the Gateway to its disposal orbit, which is a Lissajous orbit around the Earth-Sun L4 point.
- Phase IV: Monitoring space weather. With the module in its disposal orbit, the primary focus of SOLFARM will be detecting space weather events and relaying collected data to the ground station. SOLFARM will also use its vantage point and existing communications capabilities to monitor space debris.

SOLFARM will orbit in a Lissajous orbit about the Earth-Sun L4 point. This viewpoint is particularly advantageous for monitoring space weather, because it is far enough away from Earth that satellites in a variety of closer orbits can be viewed. As the Earth rotates and SOLFARM maintains its position, even satellites in geosynchronous orbit can be monitored. SOLFARM's remaining mass, power, and communications capabilities are sufficient to include equipment to image these satellites while still accomplishing its logistics mission and its space weather mission.

By incorporating a system to monitor space debris into an already-existing platform, the cost of the mission is greatly reduced. The only direct cost to monitoring space debris using SOLFARM is the cost of the equipment. The fuel cost for SOLFARM is calculated based on the maximum mass capability of the module, and because the equipment to monitor space debris is already constrained by that value, there is no added fuel cost. SOLFARM provides the platform to study space debris from a bird's eye view of the Earth, and as a MOO, takes advantage of a low-cost system to do so.