Lockheed Martin's Lunar Vertical Solar Array Technology (LVSAT)

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Introduction

Lockheed Martin has demonstrated a commitment to providing infrastructure services to the Lunar environment, which includes mobility, communication, and power. Lockheed Martin proposes the LVSAT power generation system utilizing heritage space hardware and qualifying it to lunar environments will support early lunar surface power generation and beyond.

Lunar Vertical Solar Array Technology

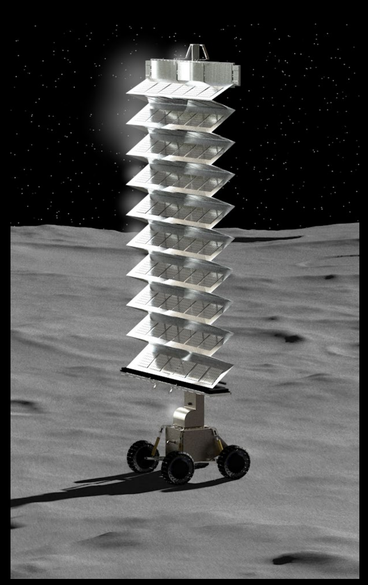
- Provides 10kW of mobile power, while being rugged enough to survive the harsh lunar environment for up to ten years.
  - Offers 120VDC/28VDC Bi-directional Power
- Transportable solar power generation by means of wheels, a mobility vehicle, and a z-fold flight-qualified array deployment and retraction mechanism.
  - Partnered with Goodyear, Apollo Lunar Roving Vehicle wheel heritage
- Leverages the heritage TRL-9 Multi-mission Modular Solar Array (MMSA) and flight proven power conditioning and mechanism hardware.
  - Patent for more information: US 20180309008
- Provides modular, flexible and reliable power solutions for early implementation in the south pole lunar architecture,
  - Scalable up to 5x the existing design implementation
- Configurable to fit on multiple CLPS landers either as a stand-alone unit or as a power-generating payload

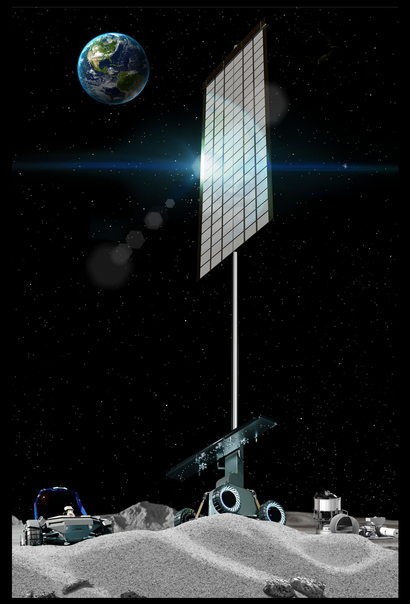
Lunar Development Design Challenges

- Lunar Architecture Compatibility – Interface Standardization
  - Need common dust-tolerant connector interface
  - Need common transportation interface
- Dust intrusion and mitigation
  - "Walking on wet talcum powder" – Buzz Aldrin
  - Lunar surface has unique properties from Earth and Mars such as electrostatic and abrasive regolith with no atmosphere for erosion or wind storms to help clean
  - No single simulant can cover all tests
  - 1/6 Earth gravity can lead to high ballistic curves and dust clinging to high surfaces

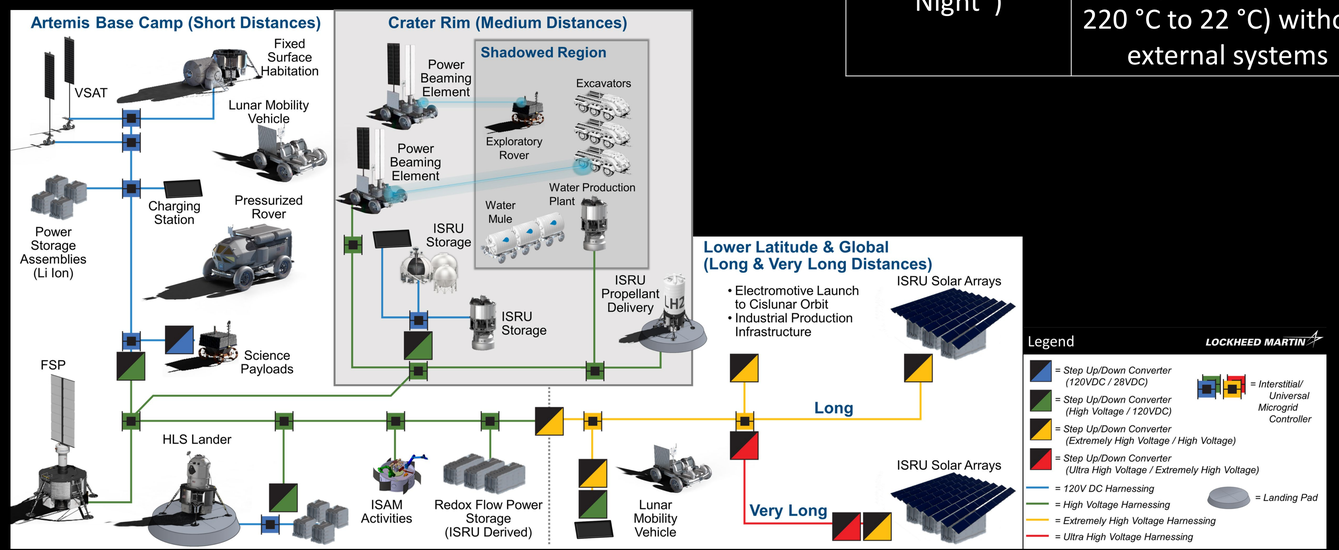
LVSAT Future

- Current NASA VSAT contract - TRL advancement ground demo - build begins Q3/Q4 2023, testing completes Q3 2024
- Power the moon! Lockheed Martin is anticipating flight readiness for manifest on the 2027 NASA STMD CLPS mission for a Lunar Surface Power Demonstration





Lockheed Martin's Lunar Surface Power Vision



Key Performance Parameter Highlights

Level 2 Objective	Threshold | Goal Value	Design Feature
Stable Vertical Deployment on Uneven Terrain	10° incline | 15° incline	Low CG and wide base footprint
Auto leveling	System will have auto-leveling capability to enable vertical deployment in rough and sloped terrain	Dual-axis inclinometers and mechanical actuators
Vertical Extension Mast	8m | 16m	MMSA lenticular mast has similar length flight heritage
Array Retract-ability	5x | 10x Retraction-Redeployments	Heritage Deployer motors can be reversed
Operational Life	5 years | 10 years	Multi-layer dust mitigation seals
Array Thermal Environment ("Survive the Night")	System must be capable of surviving and operating in lunar South Pole Region (temperatures from -220 °C to 22 °C) without external systems	• Battery sizing • Multi-Layer Insulation • Heaters • Passive thermal switches