



EXPLORE SCIENCE

CLPS Survive the Night: STN workshop and development approach

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Commercial Lunar Payload Services (CLPS)

- CLPS is an innovative, service-based, competitive acquisition approach that enables rapid, affordable, and frequent access to the Lunar surface via a growing market of American commercial providers
- The CLPS contract is an indefinite duration indefinite quantity (IDIQ) contract awarded to 14 domestic teams who are all eligible to bid for Task Orders
- Service task orders are firm fixed price (FFP) for the full scope of delivery: from payload hand-over to delivery (and often operation) on the lunar surface
 - All payload requirements must be captured in the originating Request for Task Plan (RFTP)
- NASA wants to be one of many customers for CLPS services
- CLPS deliveries are CLPS Provider missions (not NASA missions)
- CLPS systems/facilities are owned or contracted by the CLPS Provider (not NASA)
- CLPS launches are commercial launches provided via the CLSP provider (not LSP) and approved/licensed by the FAA and other agencies (not NASA)

ESSIO Approaches to achieving STN

- Facilitate environment for CLPS and technology communities to interact
- Plan timing of payload procurements and CLPS tasks to realistically “push” STN capability
- Direct investment into payload STN capability
- Inter-directorate, interagency clarification of commercial space use of nuclear materials



CLPS Survive the Night Workshop

Bringing together the communities of CLPS contactors, Lunar and Survive the Night technologists, and Lunar Exploration and Science stakeholders.

3-day event drawing 172 in-person and 384 virtual participants.



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CLPS STN Workshop



Stakeholders

CLPS Project Evolution and STN Goals
Science STN drivers and challenges
Future of STN enabled science
Lunar exploration EVA and mobility STN Needs
STMD STN Technology investments and vision for commercialization

CLPS Providers

Lightning Session and Panel
1-on-1 Networking

Technology Presentations

Nuclear power and thermal
Power storage and distribution
Thermal
Other

Resources / Information

GRC Mobility and COMPASS Labs
Dust mitigation info session
RPS program and launch approval overview
SBIR opportunities

Development and Advancement of Lunar Instrumentation (DALI) Program



Typical Solicitation Timeline:

- ROSES Solicitation Release – February
- Step 1 Proposals Submitted – April
- Step 2 Proposals Submitted – June
- Panel Reviews – October

Typical budget/award

~ \$1.0M/year

Maximum award duration

Up to four years

Solicitation Overview:

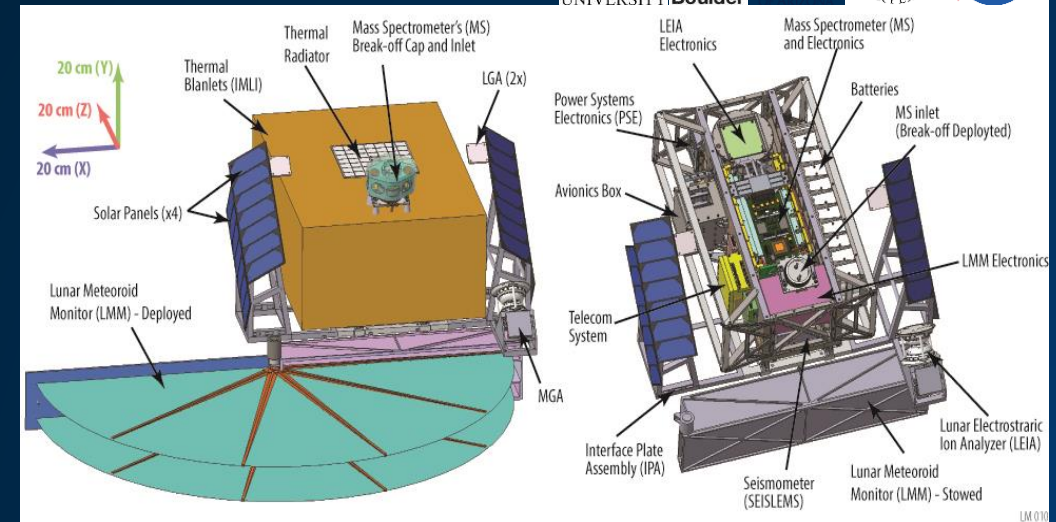
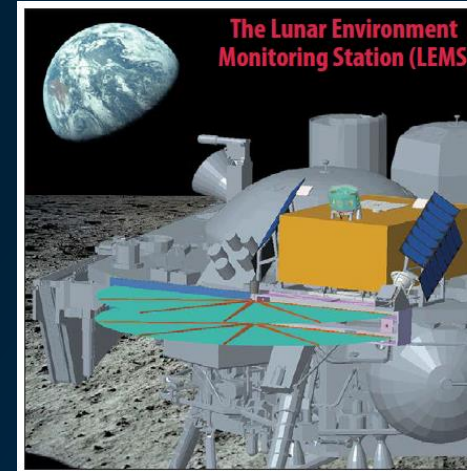
- DALI supports the development of **spacecraft-based instruments** for use on **future lunar missions** including commercial ventures (i.e. CLPS).
 - The DALI program goal is to develop lunar science instruments to the point where they may be **proposed to future flight opportunity announcements** (i.e. PRISM) without additional technology development.
 - DALI generally supports TRL maturation from **TRL 4 to TRL 6**.
- DALI seeks to mature lunar science instruments that **support NASA's broader lunar exploration goals**.
 - Goals applicable to human exploration, in situ resource utilization, and lunar science.
 - All instrument types, including rover-based and orbital, are considered with specific interest in small, stationary lander instruments.



Lunar Environment Monitoring Station (LEMS)



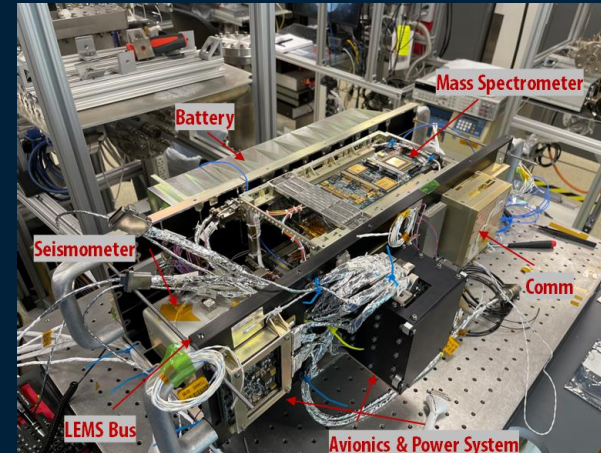
- Compact, autonomous, and self-sustaining instrument package enabling multi-year, in-situ, monitoring of the lunar geophysical environment.
- Self-powered, self-managed, and self-communicating flight system conducting science observations on the lunar surface both day and night.
- Suitable for CLPS or Artemis delivery
 - Stand-alone, all-in-one science package simplifies CLPS integration or minimizes Artemis crew deployment workload.
- Innovations include:
- New thermal/mechanical Leg mechanism
- Special conops that to manage hibernation and/awake times
- High efficiency MLI
- Repurposed high-performance thermal switch



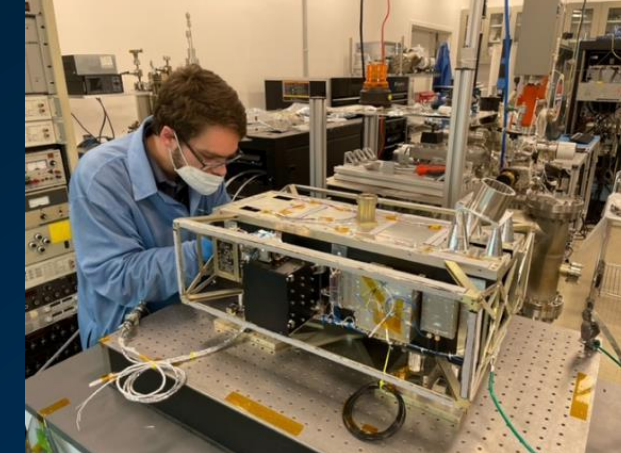
LEMS Technical Maturation



- Under a DALI development (2020-2022):
 - ✓ Optimized thermal design, fully passive, no RHUs reliance.
 - ✓ Electrical and mechanical flexibility to accommodate a variety of sensors and missions.
 - ✓ Fully-integrated Avionics systems that allows continuous and autonomous operations.
 - ✓ Self-reliant power architecture compatible with both day and night operations.
 - ✓ Integrated launch-lock mechanism compatible with GEVS-levels loading.
 - ✓ Built a prototype station and demonstrate compatibility with the flight and lunar environment.
 - ✓ Demonstrate day-of-life science operations in the relevant lunar environment.



LEMS ETU prior to closeout and installation of thermal IMLI and launch lock mechanism.



Finalized mechanical and electrical systems integration.



Preparation for Vibration Testing
02/28/2022



Preparation for Thermal-Vacuum Testing
03/08/2022

Lunar Experiment Survey System and Handling (LESSH) Placed

LESSH Placed common service module (CSM) that enabling rapid integration of modular lunar surface instruments for Artemis

LESSH Placed CSM provides core services for astronaut placed instrument

Provides power, data management, communications, thermal services and mechanical interface

Designed for multiple lunar day operations

Concept

Integrated thermal / mechanical chassis design

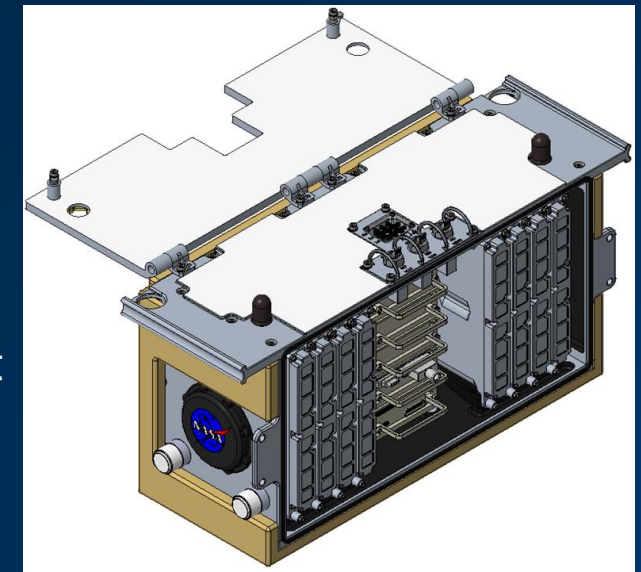
Leverage existing GSFC SpaceCube Mini avionics

Surface to surface communication to HLS

Established initial mechanical / electrical interfaces for instrument

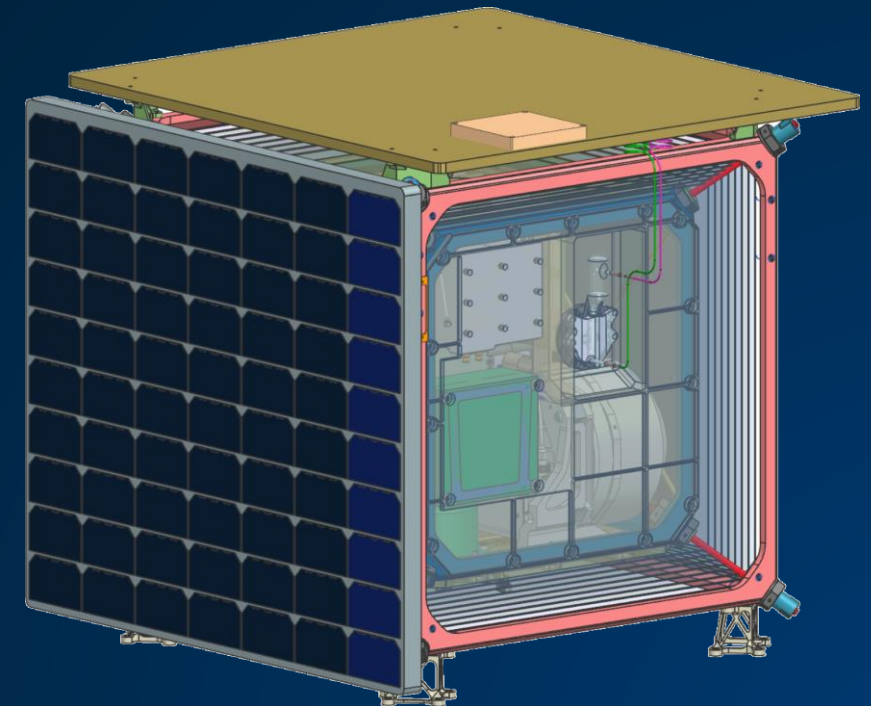
Power baseline uses xEMU Battery design, with options for enhanced power, wireless charging

Designed for astronaut handling and safety



Farside Seismic Suite (FSS)

- Conceptually: A cubesat on a lander
 - Independent power/comms
 - Must not only survive but also *collect data* during lunar night
- Flying heritage hardware
 - Flight spare InSight VBB
 - Flight-derived InSight SP
 - Flight spare MarCO avionics
- Includes novel thermal technology
 - Derived from STMD's PALETTE/ELSA technology investment
 - Reverse-operation thermal switch
 - "Spacerless" MLI
 - Vectron isolating suspension
- PRISM award slated for Lunar Delivery on CP-12 in early 2025



CLPS Evolution of NASA needs

- Progression of Government Requested Capabilities
 - Lunar Landing (1 Lunar Day, up to 14 Earth Days)
 - South Pole Landing
 - **Operate into Dusk (TO 19D)**
 - ~500 Kg Payload (VIPER; TO20A)
 - Sophisticated/complex payload complements (CP-11)
 - Far-side Landing / operations (data return; CP-12)
 - Mobility as a Service (Future TO CP-22)
 - Targeted Orbital Delivery (Future TO CS-3)
 - **Survive the Night (Future TO CP-32)**

PRISM 3 Solicitation Offers CLPS STN service

- **Threshold Services**
 - Operate the instrument suite for two lunar days, including survival through one lunar night
 - There will be no night operations supported in the threshold mission
 - Propose science objectives that can be accomplished within this threshold mission duration
- **Goal Services (not guaranteed)**
 - Operate through up to six lunar days, including survival through up to five lunar nights
 - Limited operation through a lunar night(s) possible
 - Payload suites must remain within night keep-alive power restrictions, including peak and sustained electric and thermal power draws
 - No data storage or communications services will be provided at night
 - Inclusive of any telemetry, data transfer, or commanding communication
 - Payloads must store any acquired data locally and wait for the lander to reawaken to transmit data

Inter-directorate, interagency coordination of space nuclear regulatory environment

Inter-directorate Coordination

- SMD/ESSIO/CLPS
- SMD/RPS Program
- ESDMD
- OSMA
- OIIR
- OGC

STMD-Led RFI

- Industry plans for space nuclear development
- Industry concerns and recommendations about commercial space nuclear regulatory environment

OSMA-Led Interagency Outreach

- Proactive working level coordination to clarify commercial space nuclear regulatory landscape.
- Government organizations including: NASA, DOE, NRC, DOT, FAA, FCC, EPA, DOD



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