NASA ISRU Status

Space Resources Roundtable 2026

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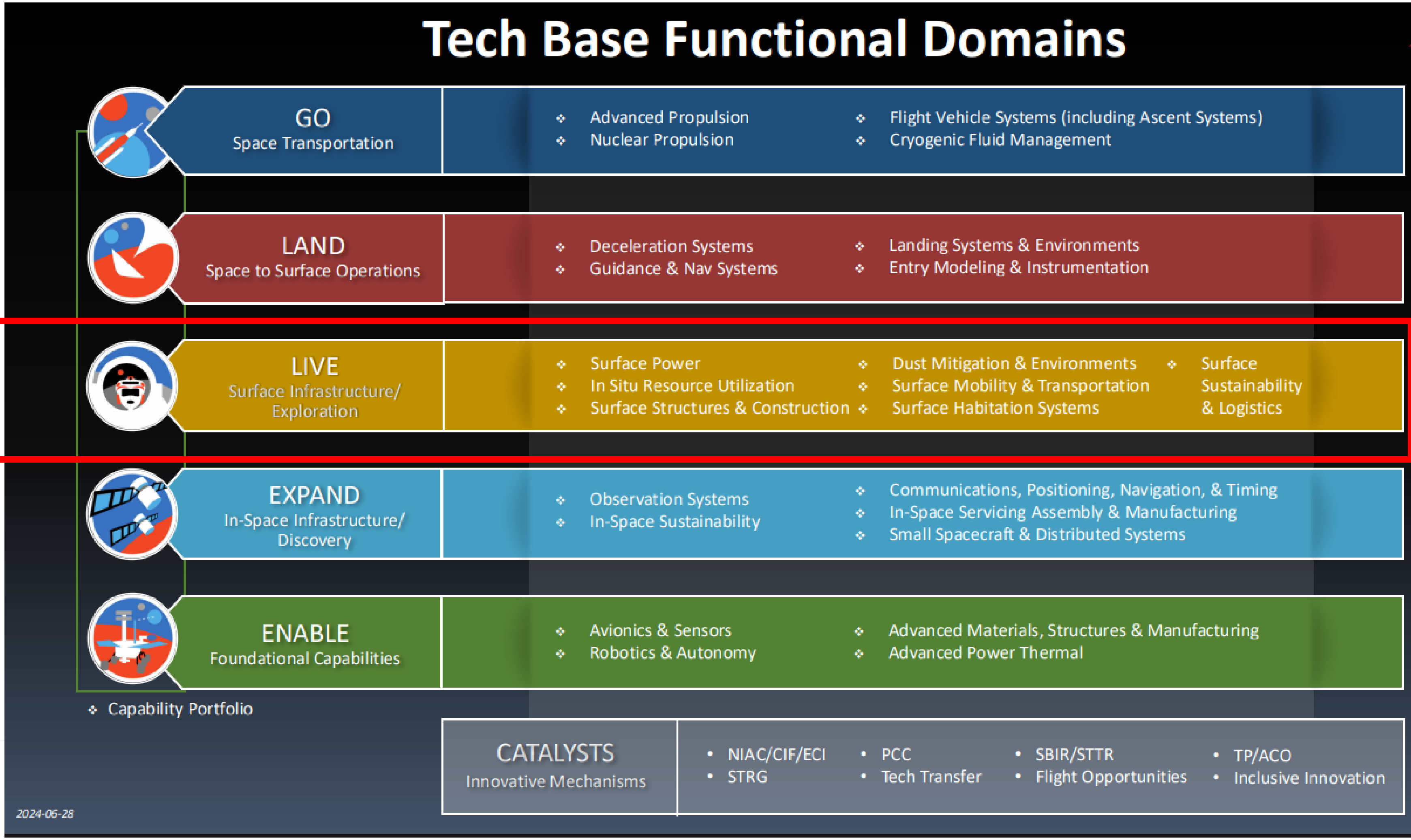
State of ISRU

- ISRU in NASA is “owned” by the Space Technology Mission Directorate (STMD)
  - Surface infrastructure has been tasked to STMD at NASA
- STMD is reorganizing and has seen significant shifts in leadership in the last 2 years.
- The priority of ISRU was diminished with the 2025 President Budget Request. This impacted the NASA ISRU program, with most projects ending in 2025.
  - We are formulating to reengage work
- The announcement of Moon Base signals a potential increase in ISRU priority, but what that means in terms of infusion and investment is still unclear.
  - How Moon Base impacts/interfaces with STMD investments and projects is still TBD
- ISRU technologies have been developed to mid and high TRL component and subsystems. Advancing ISRU to flight requires investments beyond low TRL pipelines that have traditionally fed it.

NASA STMD structure

- ISRU is in the STMD domain assigned to surface infrastructure.
  - The LIVE domain
- ISRU is a ‘capability’ within the STMD ‘domain’
- Also look for terminology like “Surface Sustainability and Logistics”



ISRU Traceability to NASA strategy

The items mapped primarily to ISRU are listed, other items can include ISRU use cases and needs (such as gaps for construction with locally produced feedstocks, CFM, propulsion, etc)

STMD 2026 Shortfalls	STMD 2024 Shortfalls (legacy)	STMD Technology Gaps*	NASA M2M objectives	ESDMD Technology Gaps (ADD App D)	ESDMD Use Case & Functions (ADD App B)	ESDMD Data Gaps (ADD App E + Moonbase)
5.1, 5.3, 5.4, 5.5, 5.6, 5.8 *Related (5.2, 5.7, 5.9, 5.10)*	1577, 1578, 1579, 1580, 1581, 1582, 1583, 1584, 1585, 581	See full list in link- ISRU Capability *These technology gaps are currently only tracked at the capability level	LI-7 MI-4 AS-3 *Related (Li-8, OP-22, TH-3, OP-3, LPS-3, TH-7, SE-3)*	601 603 604 606	UC-I-101L UC-I-202L UC-I-102L UC-I-203L UC-I-103L UC-I-204L UC-I-106L FN-I-201L FN-I-204L FN-I-202L FN-I-404L	DN-006L DN-007L DN-008L DN-010L DN-010L *Related (DN-001L thru DN005L, DN-009, DN-014L, DN-019L)*

ADD= Architecture Definition Document (Artemis)

NASA STMD Shortfall: Ranking

- Shortfalls are intended to identify work areas for STMD and their ranking feeds into prioritization and decision making within STMD.

- The latest Shortfalls were released for community input in January 2026 prior to the Ignition event.
  - Rankings results were released 5/20/26
  - Ranks are based on 454 responses external to NASA, and Mission directorate and NASA Center responses (at the need statement level)
  - There were 32 shortfalls with more detailed “Need statements” associated with each.

Rank out of 32	Shortfall #	Shortfall description
19	SF05	Produce propellant, consumables, and other usable materials from lunar resources to support human exploration and commercial activities.
28	SF10	Produce propellant, consumables, and other usable materials from Martian resources to support human exploration.

NASA STMD Shortfalls: Top 40 Need Statements FY26

- The top 40 need statements were identified as primary focus areas for mission directorate investments

- This top 40 list included considerations for:
  - NASA Ignition event announcements
  - Interest of other agency organizations
  - Preserving critical skills at NASA centers
  - Establishing and maintaining relevance with Industry and Academia

Need statement	Description
05.04	Produce oxygen from lunar regolith at a scale relevant for a demonstration mission. Reference ESDMD #0601 for specific details.
(Related) 05.02	Excavate and transport lunar regolith at a scale relevant for a demonstration mission. Reference ESDMD #0605 (excavation and transportation) for specific details.
(Related) 04.01	Perform site preparation and bulk regolith manipulation for infrastructure construction, including landing pads, berms, regolith overburden for radiation protection. Reference ESDMD #0605 (manipulation) for specific details.

Ignition event: Moon Base

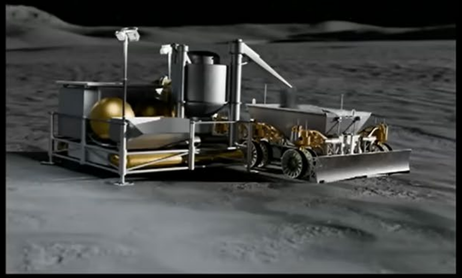
- ISRU targeted for phase 3 of Moon base
  - This is not dissimilar to last ADD where ISRU implementation was in the Sustained Lunar Exploration (SLE) phase
- Demonstration for ISRU technology and closure of knowledge gaps is mentioned in earlier phases of Moon Base
- Moon Base language mentions several target commodities

KEY MISSION

In-situ Resource Utilization

In-situ Resource Utilization (ISRU) technology and implementation

- Phase 1 & 2 experiment & demo
- Phase 3 continue demo and begin implementation
- Enabling use of lunar commodities could enable reductions in launch mass, cost, and risk to human exploration
  - Key commodities from regolith:
    - Oxygen, water, rare Earth elements, hydrogen
- Converting regolith into durable and sustainable materials with techniques such as
  - Corbelling, 3D printing, sintering



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Data Gap = (purple)
Tech Gap = (green)

TECHNOLOGY & KNOWLEDGE CHALLENGES

The capabilities below are essential for building and operating the Moon Base. NASA and its partners are working to fill the associated technology and data gaps, starting with initial missions in phase one.

Landing Safely and Accurately on the Lunar Surface

KNOWLEDGE CHALLENGE

Observe the lunar surface to identify surface blocks, such as rocks and craters; map surface topology; and characterize variance in gravitational fields to enable precise and safe landings.

Characterize and predict the properties of a plume-surface interaction (PSI) event, including ejecta trajectory, particle size distribution, and resulting surface site alterations to evaluate impact risk to mission and nearby assets.

DN-001 L | DN-014 L | DN-002 L | DN-017 L | DN-018 L

TECHNOLOGY CHALLENGE

Develop precision landing systems capable of taking highly accurate range and velocity measurements over low-visibility terrain, including in shadow and with induced PSI effects.

Develop hazard avoidance systems capable of real time identification of hazardous terrain to find safe touch down locations.

#1101

Associated Challenges

Securing Sites — Identifying, selecting, and landing at individual sites requires more data about the lunar surface, including regolith properties, high-resolution imagery, mapping, and resource locations.

DN-001 L | DN-002 L | DN-003 L | DN-004 L | DN-005 L | DN-006 L | DN-007 L | DN-008 L | DN-009 L | DN-010 L | DN-013 L | DN-014 L

Small Cargo Return — Returning cargo from the lunar surface (e.g., scientific samples) requires a detailed understanding of how launch from the surface affects lunar regolith and nearby assets.

DN-017 L | DN-018 L

Operating on the Lunar Surface for Long Durations

KNOWLEDGE CHALLENGE

Characterize the lunar surface environment to predict performance impacts and risks associated with long duration surface operations.

Investigate dust mechanics, regolith geotechnical properties, and radiation/charged particle fluctuations, seasonal patterns, and scattering.

DN-008 L | DN-009 L | DN-010 L | DN-011 L | DN-012 L | DN-013 L | DN-015 L | DN-016 L | DN-019 L

TECHNOLOGY CHALLENGE

Develop extreme temperature-tolerant mechanisms and electronics for operating through periods of lunar shadow without dedicated heating systems.

Develop mitigation systems and strategies to limit system degradation from lunar dust, which is extremely abrasive and electrostatic, meaning it will cling to and damage surface hardware.

Develop navigation and timing systems that account for the lunar surface electromagnetic radiation environment, which can impact their accuracy.

#0301 | #0804 | #0801 | #0101

Associated Challenges

Surface-to-Surface Comms — Deploy communications systems that can operate in the lunar geological, electromagnetic, and radio frequency environment.

#0103

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= Data Gap
= Tech Gap

TECHNOLOGY & KNOWLEDGE CHALLENGES

The capabilities below are essential for building and operating the Moon Base. NASA and its partners are working to fill the associated technology and data gaps, starting with initial missions in phase one.

Associated Challenges (Continued)

Manipulating Regolith — Manipulating lunar regolith at scale for excavation, compaction, and site preparation requires in-depth understanding of regolith properties and large-scale excavation and construction.

DN-008 L | DN-009 L | DN-010 L | DN-019 L | #0505 | #0605

Moving Logistics — Manipulating and transferring lunar surface logistics requires robotic systems for off-loading and manipulating payloads, as well as long-duration packaging systems for protecting cargo.

#0701 | #0806 | #1001

Solar Power — Deploying systems to generate, store, and distribute solar power requires precise knowledge of lighting conditions and array performance, as well as systems robust to the lunar environment.

DN-005 L | DN-019 L | #0504 | #0901 | #0903

Thermal Generators — Using radioisotope thermal generators (RTGs) to provide survive-the-night capabilities requires detailed knowledge of the lunar environmental and systems that can operate there.

DN-019 L | #0301 | #0901

Electrical Connections — Connecting systems and sharing power on the lunar surface requires dust-tolerant connections and the ability to deploy cables.

DN-008 L | DN-009 L | DN-019 L | #0903

Wireless Charging — Demonstrating wireless charging for rovers requires both detailed knowledge of the lunar environment and interoperable wireless power systems that work in that environment.

DN-009 L | #0903

Timing Systems — Timing systems must be capable of providing precise real-time synchronization between assets on the lunar surface with low latency and drift.

#0101

Pressurized Mating — Mating pressurized systems on the lunar surface requires dust-tolerant systems, which rely on detailed knowledge of lunar regolith and the surface environment.

DN-008 L | DN-009 L | DN-010 L | DN-019 L | #0807

Initial Habitation — Demonstrate deployment and operation of a small, pressurized, crew-rated surface module with a minimal environmental control and life support system and externally supplied power.

#0807 | #0903

ISRU Systems — Using local lunar resources to enable exploration requires both detailed knowledge of resource availability and systems to extract and process those resources.

DN-006 L | DN-007 L | #0601 | #0603 | #0604 | #0605

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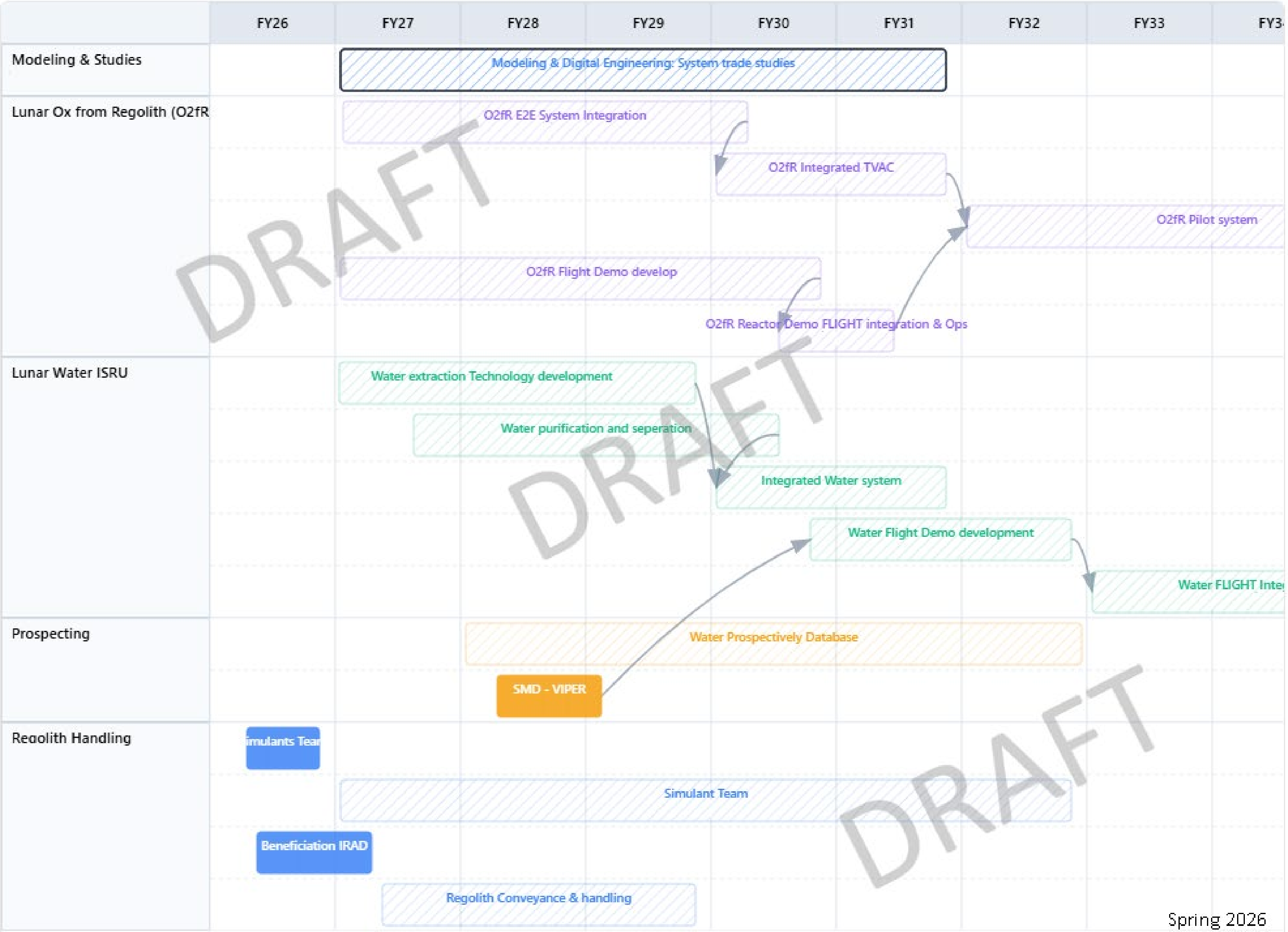
Proposed Lunar ISRU Roadmap

- **Proposed Roadmap**
- Timeline is notional
  - Moonbase plan impacts TBD
  - Mission directorate priority adjustments TBD (e.g. shortfall ranking impacts)
  - This draft was developed prior to Ignition
- Currently formulating investment strategies
  - Internal (NASA) work in formulation for some boxes
  - Exploring solicitation opportunities for broad ISRU roadmap support



Lunar Enabling Infrastructure Accelerator (LEIA) Broad Agency Announcement (BAA)

Synopsis Released: 5/20/26

Synopsis Feedback due: 6/3/26

NASA's STMD is responsible for accelerating the technological readiness of key systems and closing capability gaps critical to lunar surface and cislunar architecture. Paramount to this endeavor is a competitive and robust U.S. industrial base, which NASA relies upon as partners in the design, development, testing, and evaluation of innovative, industry-driven solutions to U.S. space priorities.

Through the Appendix that NASA GRC plans to solicit, STMD seeks proposals from U.S. institutions to mature and demonstrate capabilities in the areas of

- Vertical solar arrays,
- **In situ resource utilization (ISRU) oxygen production systems**
- Stirling radioisotope generators
- In-space manufacturing
- Advanced nanomaterials production

These targeted technology areas require further risk reduction and ground demonstrations to advance competing solutions to Technology Readiness Levels (TRL) 5-6. The efforts supported under this solicitation advance the technology objectives of NASA's Moon Base by demonstrating critical systems and accelerating the development of transformative capabilities essential to near-term mission success.

The anticipated release dates:
Draft BAA : June 2026.
Final BAA : August 2026
Offer date: September 2026.
----These dates are tentative----

Prospective offerors are encouraged to notify this office of their intent to submit an offer. All contractual and technical questions must be submitted electronically via email to Linda Nabors (linda.m.nabors@nasa.gov) & Ian Park (ian.park@nasa.gov) not later than June 3, 2026, at 5:00 PM EDT. Telephone questions will not be accepted

Summary

- From a NASA priority standpoint, shifting priorities and organizational structures, temporarily left ISRU in limbo. Recent developments are positive:
  - ISRU was indicated in the Ignition event as a Moon Base objective
  - Recent release of STMD shortfalls shows ISRU in the top 40 priority areas
  - Solicitation synopsis has been released for a BAA ISRU topic

- Opportunities for ISRU within Moon Base are TBD:
  - Results of RFI for CLPS-ready payloads to meet increased CLPS cadence objectives
  - ISRU moon base infusion listed as phase 3 objective, with technology development in earlier phases
  - Moon Base Users guide acknowledges ISRU gap closure as near-term objectives to meet phase 3 needs.

Conclusion – useful links

BAA Solicitation Synopsis

STMD Shortfall Prioritization

STMD funding opportunities

Moon Base

Simulant Database

backup

Example of STMD Shortfall w/ Need statements

Shortfall	Need Statements	
5.0 Produce propellant, consumables, and other usable materials from lunar resources to support human exploration and commercial activities.	5.01	Locate, characterize, and map the useful resources on the lunar surface.
	5.02	Excavate and transport lunar regolith at a scale relevant for a demonstration mission. Reference ESDMD #0605 (excavation and transportation) for specific details.
	5.03	Extract metal and manufacturing feedstock from lunar regolith at a scale relevant for a demonstration mission. Reference ESDMD #0604 for specific details.
	5.04	Produce oxygen from lunar regolith at a scale relevant for a demonstration mission. Reference ESDMD #0601 for specific details.
	5.05	Produce water from icy lunar regolith at a scale relevant for a demonstration mission. Reference ESDMD #0603 for specific details.
	5.06	Produce power components derived from in-situ resources.
	5.07	Excavate and transport lunar regolith at a scale relevant for sustained lunar exploration.
	5.08	Produce metals, oxygen, and water at a scale relevant for sustained lunar exploration.
	5.09	Manage, store, and distribute in-situ-produced materials and products at a scale relevant to sustained lunar exploration.
	5.10	Manage conversion, storage, and handling of oxygen into breathing air sufficient to support sustained lunar exploration mission needs.

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Example of ESDMD Use Case and Function

Function description	Function #	Use Case Description	Use Case #
Transport a moderate amount of cargo (1000s of kg) from Earth to south polar region sites on the lunar surface	FN-T-202 L	Deployment and operation of utilization payload(s) and/or equipment related to demonstration of oxygen recovery from lunar regolith	UC-I-102 L
Provide power for deployed surface utilization payloads(s) and/or equipment(context Initial Surface Habitation)	FN-P-401 L		
Enable crew lunar surface extravehicular activity in sunlit areas and non-PSRs(context xEVA System)	FN-M-101 L		
Unload a moderate amount of cargo (1000s of kg) on the lunar surface	FN-M-402 L		
Reposition a moderate amount of cargo (1000s of kg) on the lunar surface	FN-M-503 L		
Provide communications and data exchange between the lunar surface and Earth	FN-C-101 L		
Produce scalable quantities of oxygen from lunar regolith (demonstration)	FN-I-102 L		
Store oxygen on the lunar surface (demonstration)	FN-I-105 L		
Transport scalable quantities of oxygen produced to exploration elements (demonstration)	FN-I-107 L		
Collect regolith at sub-scale to support demonstration using scalable capability	FN-I-201 L		
Provide storage for collected regolith (demonstration)	FN-I-203 L		

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