

Results from the
The First Community Workshop on Capabilities for Human
Habitation and Operations in Cis-Lunar Space:
What's Necessary Now?

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Workshop Presentations and Materials Available at

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Workshop Premise

- **If we were to conduct a human spaceflight mission in the near term (within 10 years)...what are the possible missions that could be conducted and what capability development and demonstration activities are needed**

Key assumptions

- Constrained budget for the foreseeable future
- Significant pressure to carry out major in-space activities in the near-term

- **Workshop Goal:**

The goal of the September 21 – 23 Galveston workshop was for community representatives to critically assess the concepts, development plans, and investment strategies intended to enable a human-tended human habitation system in cis-lunar space by the early 2020s.



Workshop Structure and Process

- Two-day workshop with ~80 participants from NASA HQ, six NASA Centers and JPL, academia, other government agencies, and industry
 - Frank and open discussion among participants
 - General recognition that careful, unambiguous prioritization is necessary

- Breakout teams in three theme areas:
 - Cis-lunar operations and missions: robotics and EVA
 - Habitation concepts and architectures
 - Spacecraft systems and capabilities

- Civil servants met on a third day to produce actionable findings and deliberations for NASA Headquarters.

- Not included for consideration in this workshop: international partnerships, launch vehicles and space propulsion, major science or HSF goals beyond cis-lunar space



Workshop Findings: Broad Areas

- **We have most of the capabilities today to conduct human mission in cis-lunar space within about a decade**
 - Demonstration and development site for very-long-duration human voyages
 - On-orbit assembly/servicing/upgrade
 - Support for lunar exploration: staging and caching site, tele-robotics from orbit, etc.
 - Stepping stone or staging platform for future longer duration NEO or Mars missions

- **Capability development is needed only in a few areas beyond SOA**
 - ECLS reliability, maintainability and logistics support
 - Crew health, environmental monitoring and characterization
 - Communications (mainly DTN)
 - EVA
 - Human/robotic collaboration
 - Active thermal systems

- **Leveraging existing program capabilities and components significantly advances the opportunities to conduct cis-lunar missions (*14.7/10.2 psi architecture*)**
 - ISS, MPCV, ScaN, terrestrial prototypes and analogs



Workshop Summary Considerations

- Mission concepts presented were typically in the pre-Phase A state
- Additional engineering analysis is needed to validate mission and capabilities along with scientific value
- Near-term prototyping and demonstrations on ISS and elsewhere should be a high priority
 - high-fidelity analogs should also be pursued
- Next-generation EVA capability development should be a high priority
- Utilization of existing habitation environment vs. suit port capability development for near term missions should be assessed by senior management very soon



Workshop Summary Considerations (cont)

- ECLS demonstration and development activities should be assessed by senior management very soon.
- MPCV avionics should be assessed for cis-lunar missions.
- Understanding of solar particle events (SPEs) is sufficiently advanced for their risk to be reduced via engineering and operations solutions.
- The risks and mitigation strategies for galactic cosmic rays (GCRs) are far less well understood than for SPEs. At present, operational scenarios (e.g., limiting occupation to a very few months) appears to be the most expedient strategy.
- Improving human-robotic collaboration and advancing robotic modularity and capabilities for situational awareness should be a priority.