JSC Support of NASA’s Deep Space Gateway & Transport

Jose (Joe) Caram
DSG&T SE&I Lead, JSC
Using the International Space Station
Operating in the Lunar Vicinity (proving ground)

After 2030
Leaving the Earth-Moon System and Reaching Mars Orbit

Now
Using the International Space Station

2020s
Operating in the Lunar Vicinity (proving ground)

Phase 0
Continue research and testing on ISS to solve exploration challenges. Evaluate potential for lunar resources. Develop standards.

Phase 1

Phase 2
Complete Deep Space Transport and conduct yearlong Mars simulation mission.

Phases 3 and 4
Begin sustained crew expeditions to Martian system and surface of Mars.
# Phase 1 Plan
Establishing deep-space leadership and preparing for Deep Space Transport development

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<td><strong>2018 - 2025</strong></td>
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<tr>
<td>SLS Block 1</td>
<td>SLS Block 1B Cargo</td>
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<tr>
<td>Crew: 0</td>
<td>Crew: 4</td>
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<tr>
<td>CMP Capability: 8-9T</td>
<td>CMP Capability: 10mT</td>
<td>CMP Capability: 10mT</td>
<td>CMP Capability: 10mT</td>
<td>CPL Capability: 10mT</td>
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<tr>
<td>Distant Retrograde</td>
<td>Europa Clipper (subject to approval)</td>
<td>Multi-TLI Lunar Free Return</td>
<td>Near Rectilinear Halo Orbit (NRHO)</td>
<td>NRHO, w/ ability to translate to/from other cislunar orbits</td>
<td>NRHO, w/ ability to translate to/from other cislunar orbits</td>
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<tr>
<td>Orbit (DRO) 26-40 days</td>
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<td>8-21 days</td>
<td>16-26 days</td>
<td>26-42 days</td>
<td>26-42 days</td>
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<td>Gateway (blue)</td>
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<td>Configuration (Orion in grey)</td>
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Known Parameters:
- Gateway to architecture supports Phase 2 and beyond activities
- International and U.S. commercial development of elements and systems
- Gateway will translate uncrewed between cislunar orbits
- Ability to support science objectives in cislunar space

Open Opportunities:
- Order of logistics flights and logistics providers
- Use of logistics modules for available volume
- Ability to support lunar surface missions

These essential Gateway elements can support multiple U.S. and international partner objectives in Phase 1 and beyond.
Assumptions
  – Deep Space Gateway provides ability to support multiple NASA, U.S. commercial, and international partner objectives in Phase 1 and beyond
  – The Gateway is designed for deep space environments
    • Supports (with Orion docked) crew of 4 for a minimum of 30 days
    • Supports buildup of the Deep Space Transport

Emphasis on defining early Phase 1 elements
  – Gateway Power Propulsion Element
  – Gateway Habitat
  – Logistics Strategy

Future work to refine later elements; early feasibility trades complete
  – Airlock
  – Deep Space Transport
Deep Space Gateway (DSG) Concept

Deep Space Transport (DST) Concept

PHASE 2
(PLANNING REFERENCE) Phase 2 and Phase 3
Looking ahead to the shakedown cruise and the first crewed missions to Mars

<table>
<thead>
<tr>
<th>Transport Delivery</th>
<th>Transport Shakedown</th>
<th>Mars Transit</th>
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<tbody>
<tr>
<td><strong>EM-6</strong></td>
<td><strong>EM-7</strong></td>
<td><strong>EM-8</strong></td>
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<td>2027</td>
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<tr>
<td>SLS Block 1B Cargo P/L Capability: 41t TLI</td>
<td>SLS Block 1B Cargo P/L Capability: 41t TLI</td>
<td>SLS Block 2 Cargo P/L Capability: 45t TLI</td>
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<tr>
<td>Logistics</td>
<td>Logistics &amp; Refueling</td>
<td>Logistics</td>
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<td>DST checkout in NRHO 191-221 days</td>
<td>DSG: continued operations in cislunar space</td>
<td>DST: shakedown in cislunar space with return to DSG in NRHO 300-400 days</td>
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<td>Cislunar Support Flight</td>
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<td>Cislunar Support Flight</td>
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Reusable Deep Space Transport supports repeated crewed missions to the Mars vicinity

**Known Parameters:**
- DST launch on one SLS cargo flight
- DST shakedown cruise by 2029
- DST supported by a mix of logistics flights for both shakedown and transit
- Ability to support science objectives in cislunar space

**Open Opportunities:**
- Order of logistics flights and logistics providers
- Shakedown cruise vehicle configuration and destination/s
- Ability to support lunar surface missions
HABITATION CAPABILITY

Systems to enable the crews to live and work safely in deep space. Capabilities and systems for use in conjunction with Orion and SLS on exploration missions in cislunar space and beyond.
NextSTEP Habitation Overview - Commercial

**NextSTEP Phase 1: 2015-2016**

Cislunar habitation concepts that leverage commercialization plans for LEO

- Partners develop required deliverables, including concept descriptions with concept of operations, NextSTEP Phase 2 proposals, and statements of work.

**NextSTEP Phase 2: 2016-2018**

- Partners refine concepts and develop ground prototypes.
- NASA leads standards and common interfaces development.

**Initial discussions with international partners**

**Define reference habitat architecture in preparation for Phase 3.**

**Phase 3: 2018+**

- Partnership and Acquisition approach, leveraging domestic and international capabilities
- Development of deep space habitation capabilities
- Deliverables: flight unit(s)
JSC Roles

• ISS Program chairs IECST and ISCWG with responsibilities for defining IP approach for exploration
  - IP’s are proposing Hab concepts as well as other elements

• SE&I Lead for DSG

• Mars Study Capability Lead – Transport

• Integrated Ground Test Lead for NextStep BAA

• Other key areas supported by JSC:
  - Concept and Design Studies, Analysis and Product development
    - Requirements, ConOps, Standards, etc.
  - NextStep Hab BAA technical oversight
  - Mock up and Virtual Reality development