



# HEO NAC Subcommittee

## DSG&T Concept Update

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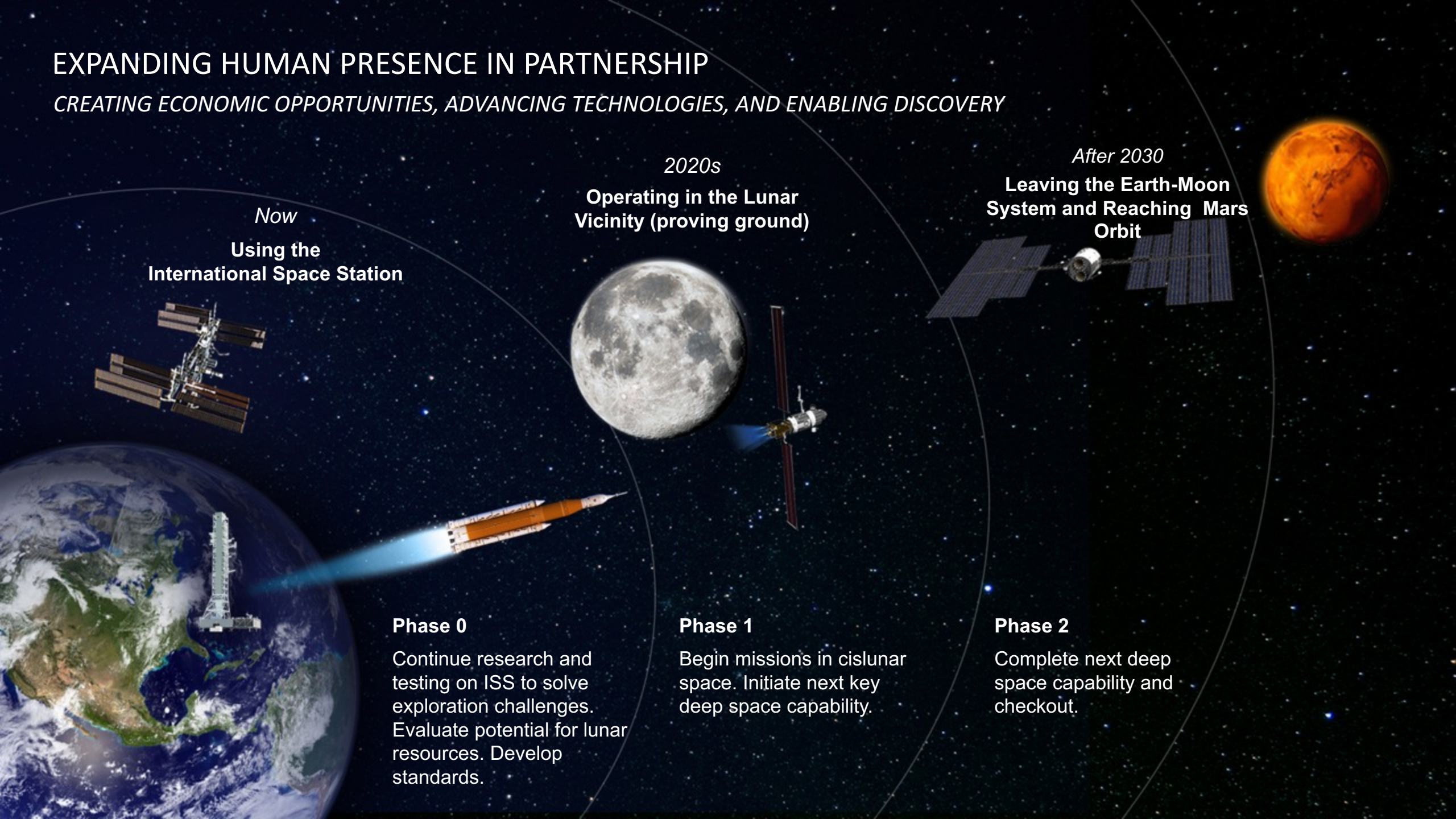
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# EXPANDING HUMAN PRESENCE IN PARTNERSHIP

*CREATING ECONOMIC OPPORTUNITIES, ADVANCING TECHNOLOGIES, AND ENABLING DISCOVERY*



# Understanding potential utilization options for cislunar space



## Cislunar Space Utilization

### Exploration Technology Validation

Utilization driven by technology development needs and roadmaps that feed forward

### Commercial Capabilities

Assessment of commercial utilization interests

### International Capabilities

International space agency utilization

### Science and Research

Scientific expertise to cislunar space requirements, capabilities, concept of operations, and utilization from the larger Agency, international and academic communities.

- **Represent the users or stakeholders in any concept development processes**
  - Objectives, concept of operations, trades
  - Potential uses of a deep space gateway to include commercial involvement and what tech needs to be developed (utilizing ISS and other platforms)
- **Develop a balance between resources, schedules, technology, objectives – achieving the capability and using the capability**
  - System must be developed
  - System must achieve HEOMD Exploration Objectives and extension toward next phases of exploration
  - System must provide stakeholder value after development
  - PM challenge: 'Needs of the now often outweigh the goals of the future'
- **Stakeholders a part of that balance**
- **Ensure long term sustainability of exploration systems**

### **Three near-term needs identified:**

1. Establish an Internal Team for trade analysis
  - Concept Integration & Strategic Analysis
  - Systems Engineering & Integration
  - Utilization
  - Elements (e.g., PPE)
2. Establish a way for the Team to make decisions on trade analyses
  - Overall Control Board – Working with ISS and ESD
  - Systems Engineering & Integration Control Board
  - Near-term focus on early concept definition and trades involving PPE
3. Begin documentation of concept options and plans
  - Objectives, requirements, and options for utilization (International and Domestic)
  - Interoperability and Design & Construction Standards with public review process
  - Draft of a Concept of Operations



## Key Analysis Tasks being conducted for Concept maturation

### Design Integration

- Phase 1 System Maturation & Definition (Reference, Baseline)
- Assessment of options
- Integrated Stack Analyses
- Detailed ConOps
- Mission Design Definition
- Design Description Documents
- Analysis Cycle/Review Cycle Product Dev
- Technology Integration

### Requirements Development

- Level 2 Technical Requirements Dev.
- IRDs/ICD's
- Functional Allocation Document
- Life cycle Phase Analysis –Technical
- Standards WG
- Interoperability Standards Dev & Standards IP coordination\*\*

### Cross-Program Integration

- CPIT
- Cross Program Systems and Mission Integration
- Integrated Hazards Development
- Integrated Product Development
- Cross program integrated analyses coordination

Specialty Engineering, System level SME's leveraged across



### **SE&I is conducting analysis for the overall systems engineering and integration of the concepts**

- Maintains and recommends updates to mission design concept(s) and draft concept of operations
- Maintains and performs detailed analysis of the technical reference of the concept maintaining cognizance of future potential trade space options
- Develops and maintains concept integrated functional and performance requirements and related verification plans at Level 2 and Level 3 Top level allocations.
- Responsible for all integrated technical data, analyses, and test plans of the concepts and related products.
- Leads/supports development of respective elements where they integrate with the ESD Enterprise
- Responsible for the maturation of Interoperability Standards and the identification and allocation of D&C, S&MA, and HTMA Standards

**Using the ESD/Cross-program Systems Integration (CSI) structure and governance to integrate across the ESD enterprise.**

**SE&I is comprised of key personnel and functions of the ISS Future Capabilities Team, the NextSTEP Habitation activity team, and ESD/CSI teams**



## International participation in Deep Space concept maturation activities

- **In an effort to maximize utilization of the ISS for exploration, NASA has led the ISS partner agencies (CSA, ESA, JAXA and Roscosmos) in the study and development of a potential concept for a deep space gateway in cislunar space.**
- **ISS partners also coordinating and contributing to draft interoperability standards in several critical areas**
  - International Avionics Data Interface Standard
  - International Communications System Standard
  - International Environmental Control Life Support Interoperability Standard
  - International Power System Standard
  - International Thermal System Interfaces Standard
  - International Rendezvous Standard
  - International External Robotic Interfaces Standard
- **The ISS Partners are continuing to discuss options for extending human presence into the solar system, noting that additional international, commercial and academic entities have significant capabilities to contribute to the larger effort.**



# Options to document beyond objectives

*For preliminary planning purposes*

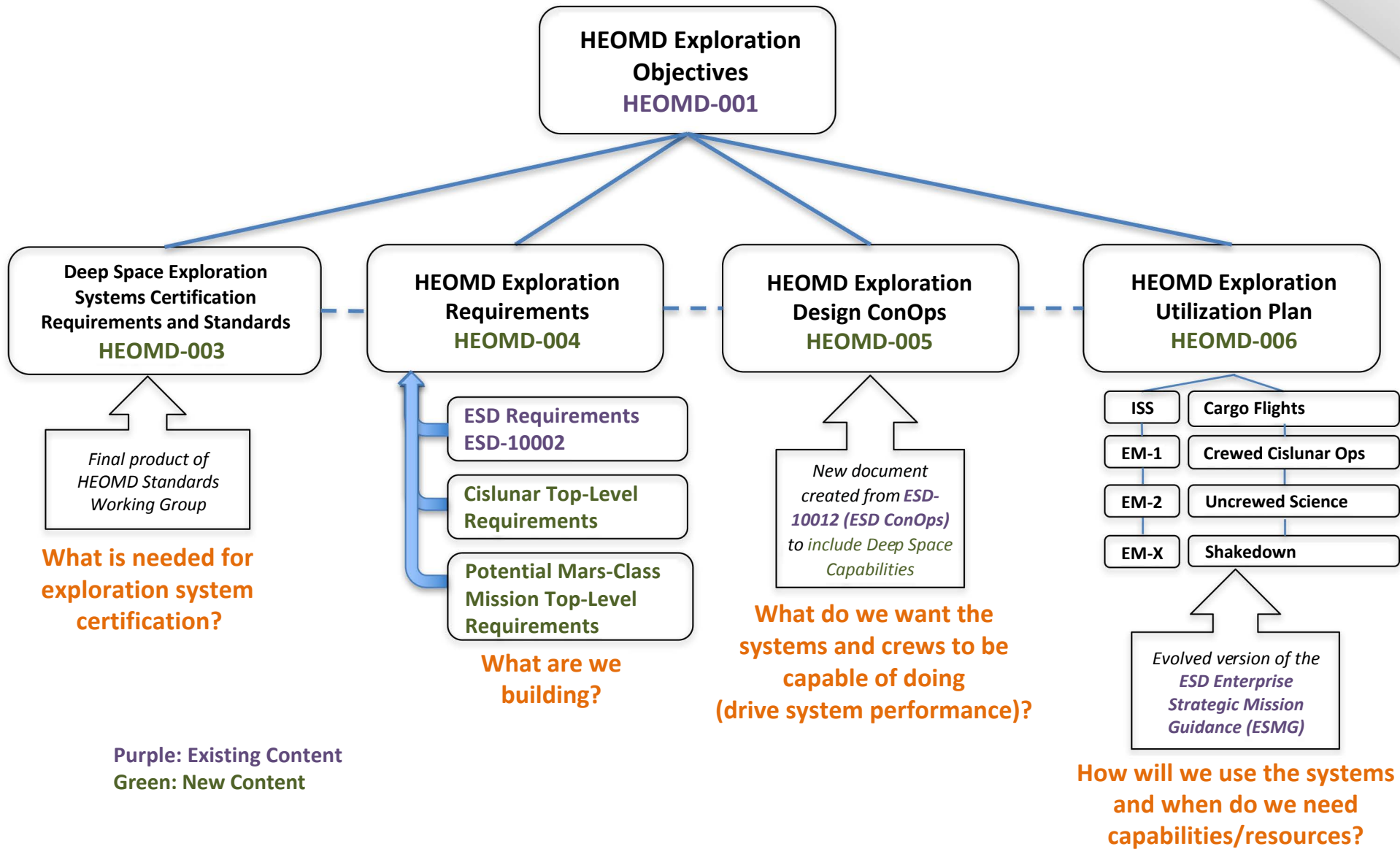




- **As integrated exploration planning and development progresses, need to scope what is documented and controlled at the HEOMD-level and within the exploration programs/activities**
  - Provides common planning objectives, integrated requirements, exploration ConOps and Phase 1 and 2 utilization plans
  - Builds on an integrated exploration strategy and fosters better internal and external communication with stakeholders
- **HEOMD has implemented configuration management processes at the Directorate level to manage and control documents that are applicable across programs**
- **To help understand how a potential deep space gateway (and other options) can support overall objectives, need to identify what documents flow from HEOMD docs and are required to begin integrated formulation and development work**
- **Where it makes sense, use existing ESD documentation as much as possible**
  - Amend existing ESD-level integrated products to include DSG&T applicability
  - If it doesn't make sense, then create a new integration level ESD companion document
  - If it doesn't make sense to document at the integration level, then it flows to the potential elements



HEOMD Configuration  
Management Process  
HEOMD-002





- **HEOMD-001 Human Exploration Objectives:**

- Translates and bridges the gap between NASA's human exploration strategy and discrete objectives for implementation
- Defines the scope of Phase 0 – 2 activity
- Focuses development activities (requirements, ConOps, etc.) on how to address Exploration Objectives
- Baselined Revision A on July 31:
  - Implementation Principles (IPs)
  - Removed ARM as Phase 1 Capstone
  - HEOMD-001, RevA Available Online: <https://www.nasa.gov/sites/default/files/atoms/files/heomd-001-heomd-exploration-objectives-revision-a-cr-08032017.pdf>

- **HEOMD-002 HEOMD Configuration Management Process:**

- Defines the methodology and process for implementing configuration management, within HEOMD, for a select number of integrated products controlled at the HEOMD level
- The HEOMD CMP establishes and maintains configuration change control of the HEOMD products/baseline
- Evaluating potential updates to address relationship to Program and Center CM processes





- Document provides set of HEOMD-level requirements necessary to certify integrated space systems for deep space missions
  - This will enable NASA, industry, and International Partners to contribute systems and elements for beyond LEO capabilities.
- Document includes
  - Tailoring of NPR 8705.2, Human-Rating Requirements for Space Systems
  - Applicable Engineering, Safety & Mission Assurance (S&MA), Health & Medical (H&M) standards/documents
  - Definition of Interoperability standards
  - Certification philosophy
- HEOMD expedited review of draft Interoperability Standards complete
  - Objective - Ensure prior to the first industry review of the draft documents with the NextSTEP Habitation companies that no significant disconnects exist with other ongoing efforts
- The NextSTEP Habitation contractors began their review of the draft standards and draft list of documents
  - Draft interoperability standards feedback is due December 1 followed by the draft standard/documents lists for Engineering, S&MA, and H&M early next year
  - Following the award of the NextSTEP PPE study contracts, those contractors will be provided the documents for review and comment.
  - Broader industry and international review of draft interoperability standards planned for next year – targeting Spring 2018



- **HEOMD-004 captures the Level 1 requirements for the ESD Programs (Orion, SLS, GSDO) and future deep space capabilities**
- **Provides descriptions for the currently defined Exploration Elements**
  - Orion Crew Vehicle
  - Space Launch System (SLS)
  - Ground Systems Development and Operations (GSDO)
- **Change authority for HEOMD-004 is the Associate Administrator for HEOMD (ESD 10002 had the same change authority)**
- **Requirements Allocation Matrix now includes DSG and DST, along with SLS, Orion, GSDO**
- **The intention is to not change the ESD Element requirements except**
  - When necessary to merge into the combined document
  - When a change is necessary to work with the new elements



- **Exploration Design ConOps define what we want the systems defined in HEOMD-004 to be capable of doing, focused on system performance**
  - It describes a bounding set of missions and functions of elements within those missions to provide scope for interpretation and implementation guidance of the controlled requirements.
  - Together the HEOMD Requirements Document and HEOMD ConOps provide the comprehensive information required for programs to identify system requirements, system interfaces, and perform systems analyses to derive integrated program requirements.
- **This is a new document based heavily on ESD 10012, ESD ConOps**
  - Supplemented with existing DRM content from previous habitation analysis
- **Content:**
  - Primary and support element summaries
  - Design Reference Missions
    - Phase 1, Phase 2, and Phase 3 bounding analytical cases
  - Operations and Interfaces including ground, crewed and uncrewed, on-orbit, re-entry, payload delivery and summary contingency operations



- **The Exploration Utilization Plan defines how and when we will use the systems and what capabilities and resources are provided to support utilization**
  - Resources and capabilities to support utilization will be identified
  - Phasing of resources and capabilities availability will be captured
  - Science, Human Research, Technology Demonstration, Education/outreach, and risk mitigation validation activities
- **Evolves existing plans for ISS exploration systems testing, exploration mission descriptions and bridges the gap between individual EMs to include**
  - ISS exploration systems testing
  - Cargo Flights
  - Crewed and uncrewed operations in cis-lunar space
  - Potential DST checkout, Shakedown operations
  - Additional analysis scenarios (i.e., lunar surface activity)
- **HEOMD Exploration Objectives Allocation Matrix to identify how and when EOs will be addressed**
  - Assigns Mission Objectives which will ultimately trace to Flight Test Objectives
- **Phase 1 plans are more defined whereas Phase 2 and beyond evolve**



