NASA Status

INTERNATIONAL MULTIDISCIPLINARY ARTIFICIAL GRAVITY (IMAG) PROJECT
Senior Management Steering Committee Meeting
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Contents

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  – Mars Planning
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NASA’s Exploration Roadmap

- Lunar Lander Development
- Ares V Development
- Earth Departure Stage Development
- Surface Systems Development
- Orion Production and Operations
- Orion Development
- Ares I Development
- Commercial Crew/Cargo for ISS
- Space Shuttle Ops
- Science Robotic Missions
- Lunar Robotic Missions
- Initial Orion Capability
- Lunar Outpost Buildup
- 7th Human Lunar Landing
- Early Design Activity
- Lunar Lander Development

Timeline:
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- 2018
- 2019
- 2020
- 2021
- 2022
- 2023
- 2024
- 2025
Components of Program Constellation

Earth Departure Stage

Heavy Lift Launch Vehicle

Crew Launch Vehicle

Orion - Crew Exploration Vehicle

Lunar Lander
Typical Lunar Reference Mission

Vehicles are not to scale.
The Moon – Reference Architecture

Objectives:
- Gaining significant experience in operating away from Earth’s environment
- Developing technologies needed for opening the space frontier
- Conduct fundamental science – Astronomy, physics, astrobiology, human research, historical geology, exobiology

Reference Mission Features:
- Polar Site
- Areas with greater than 80% sunlight and less extreme temps
- Incremental deployment of systems – one mission at a time
Mars – Reference Architecture

- TBD
- However, NASA will soon charter a team tasked with updated our human mission to Mars reference architecture including:
  - Long term goals and objectives for human exploration missions
  - Flight and surface systems for human missions and supporting infrastructure
  - An Operational Concept
  - Key trade studies for future analysis
  - Key challenges including risk and cost drivers
  - Development schedule options
- Initial results expected at the end of 2007
<table>
<thead>
<tr>
<th>Year</th>
<th>Scenario</th>
<th>Key Areas</th>
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<tbody>
<tr>
<td>2018</td>
<td>Lunar Sortie</td>
<td>• Medical support&lt;br&gt;• Specimen collection&lt;br&gt;• Minimal analytical capabilities&lt;br&gt;• Radiation protection and monitoring</td>
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<tr>
<td>2020</td>
<td>Lunar Outpost</td>
<td>• Medical support&lt;br&gt;• Diagnostics&lt;br&gt;• Expanded health care capabilities&lt;br&gt;• Exercise countermeasures&lt;br&gt;• Specimen collection&lt;br&gt;• Expanded life support systems&lt;br&gt;• Radiation protection and monitoring</td>
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<tr>
<td>2030-35</td>
<td>Mars</td>
<td>• Autonomous Medical operation&lt;br&gt;• Diagnostics&lt;br&gt;• Health care capabilities&lt;br&gt;• Life support systems&lt;br&gt;• Food production&lt;br&gt;• Bioregeneration&lt;br&gt;• Waste Management&lt;br&gt;• Specimen collection&lt;br&gt;• Exercise and pharmaceutical countermeasures&lt;br&gt;• Radiation protection, monitoring, and exposure countermeasures</td>
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The Human Research Program

• The role of Human Research Program is to:
  – Perform research necessary to understand and reduce spaceflight human health and performance risks in support of exploration
    • Very dependant on mission design and duration
  – Enable development of human spaceflight medical and human performance standards
    • Very dependant on agency level of human health risk tolerance
  – Develop and validate technologies that serve to reduce medical risks associated with human spaceflight
    • Always necessary to reduce mass, volume and increase robustness
Risk Management Process

Data Analysis → Evidence Base Analysis → Identify Human Health Risks (mission dependent) → Standards → Draft Prog Req → HRP Requirements → Products / Results
- Operations
- Development
- Research & Technology
- Countermeasures
- Knowledge

Risk Mitigation Analysis Tool
1) Status of standards
2) Mitigation requirements
3) Documentation of evidence
4) Specification of desired deliverable per mission

Compliance Assessment by Appropriate Board

End

Standard Req Met?

Yes

HMA/CHMO Appeal/Review Process

No

Identify, Analyze, Plan, Track, and Control

Feb 9, 2007
The Role of the Human Research Program

• HRP Program Elements:
  – ISS Medical Project
  – Space Radiation
  – Human Health Countermeasures
  – Exploration Medical Capability
  – Behavioral Health & Performance
  – Space Human Factors & Habitability
  – Program Science Management/National Space Biomedical Research Institute (NSBRI)

• HRP team members from JSC, ARC, GRC, KSC, and LaRC

• International partnerships are very important
  – ISLSWG, IMAG, Joint Working Group (Russia), others
Conclusion

• The global exploration architecture will continue to be defined based on established principles, including partnership and open architectures
• The exploration mission brings significant challenges to the human system
  – Partnerships such as IMAG are key to our success in developing risk mitigation strategies
• Resources available to human research are constrained
  – Money, crew time, upmass
• The Human Research Program, in consultation with partners, must continue to direct resources towards the highest priority research and technology development gaps
  – Leading to human heath and performance risk prevention and mitigation