NASA’s Exploration Plans and The Lunar Architecture

Dr. John Olson
Exploration Systems Mission Directorate
NASA Headquarters

February 25, 2009
Why Explore the Moon?

- **Human Civilization**
- **Exploration Preparation**
- **Economic Expansion**
- **Scientific Knowledge**
- **Global Partnerships**
- **Public Engagement**
<table>
<thead>
<tr>
<th><strong>Commercial Partnerships</strong></th>
<th><strong>International Partnerships</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Engaging US Chamber of Commerce and Industry for innovation, efficiency, and expansion</td>
<td>Establishing a global framework for coordination of lunar activities (e.g. global interface standards to enable exploration system interoperability</td>
</tr>
<tr>
<td>Cooperating with the private sector to promote expansion of economic activity on the moon</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Science</strong></th>
<th><strong>Inter-Agency Partnerships</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinating with science community to identify science objectives and scenarios</td>
<td>Coordinating activities with other U.S. government departments and agencies</td>
</tr>
<tr>
<td>Integrating science and exploration needs for lunar data</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Public Engagement</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigating opportunities for the public to access high bandwidth video broadcast of lunar exploration operations and highly interactive forms of participatory exploration</td>
</tr>
</tbody>
</table>
Global Exploration Strategy Development – Themes and Objectives

Architecture Assessment (LAT1) Dec 06 – Outpost first at one of the Poles, elements critical to US

Detailed Design Concepts (LAT2) Aug 07 – Operations concepts, technology needs, element requirements

Lunar Capabilities Concept Review June 08 – Refinement of concepts in support of the transportation system

Lunar surface concept additional analysis cycles

Lunar Surface Concept Review, June 2010

Lunar transportation and surface systems SRRs

Lunar surface system element SRRs
Constellation Program

LUNAR CAPABILITY

INITIAL CAPABILITY

Ares I

EVA

Orion

Mission Systems

Ground Systems

Composite Shroud
Altair Lander
Earth Departure Stage (EDS)
J-2X Engine
Interstage

Core Stage
(2 solid Rocket Boosters)

Ares V

ADDRESS AT LCCR

Ascent Module
Descent Module
Altair
Airlock
EVA
Constellation Program Fleet of Vehicles

- Ares V
  - Cargo Launch Vehicle

- Ares I
  - Crew Launch Vehicle

- Orion
  - Crew Exploration Vehicle

- Altair
  - Lunar Lander

- Earth Departure Stage
Lunar Architecture Framework — A Notional Point of Departure

- Human lunar missions will be used to build an outpost at a polar site
- The ability to fly human sorties and cargo missions with the human lander will be preserved
- Initial power architecture will be solar with the potential augmentation of nuclear power at a later time

- Robotic missions will be used to:
  - Characterize critical environmental parameters and lunar resources
  - Test technical capabilities as needed (Build-up approach)
- The ability to fly robotic missions from the outpost or from Earth will be a possible augmentation
Notional Elements of an Outpost

- Lander and Ascent vehicle
- Basic Hab
- Initial EVA System
- Carrier Mobility
- Solar Power
- Augmented Power System
- Logistics Module
- Site survey, resource mapping
- ISRU
- Communications
- Logistics carriers
- Regolith moving
- Habitation
- Physics lab
- Science Lab
- Mobility
- Regolith moving
- ISRU
Summary

- International, Commercial, Science, and Other Government Agency Partnerships are Vital to Exploration Success

- NASA is continuing to perform integrated architecture assessments that incorporate and influence element designs (e.g. Orion, Altair, Ares, Lunar Surface Systems) to meet strategic and policy objectives, as well as mission-level performance, cost and risk goals

- NASA continues to seek innovative concepts and designs from all sources to improve the evolving architecture