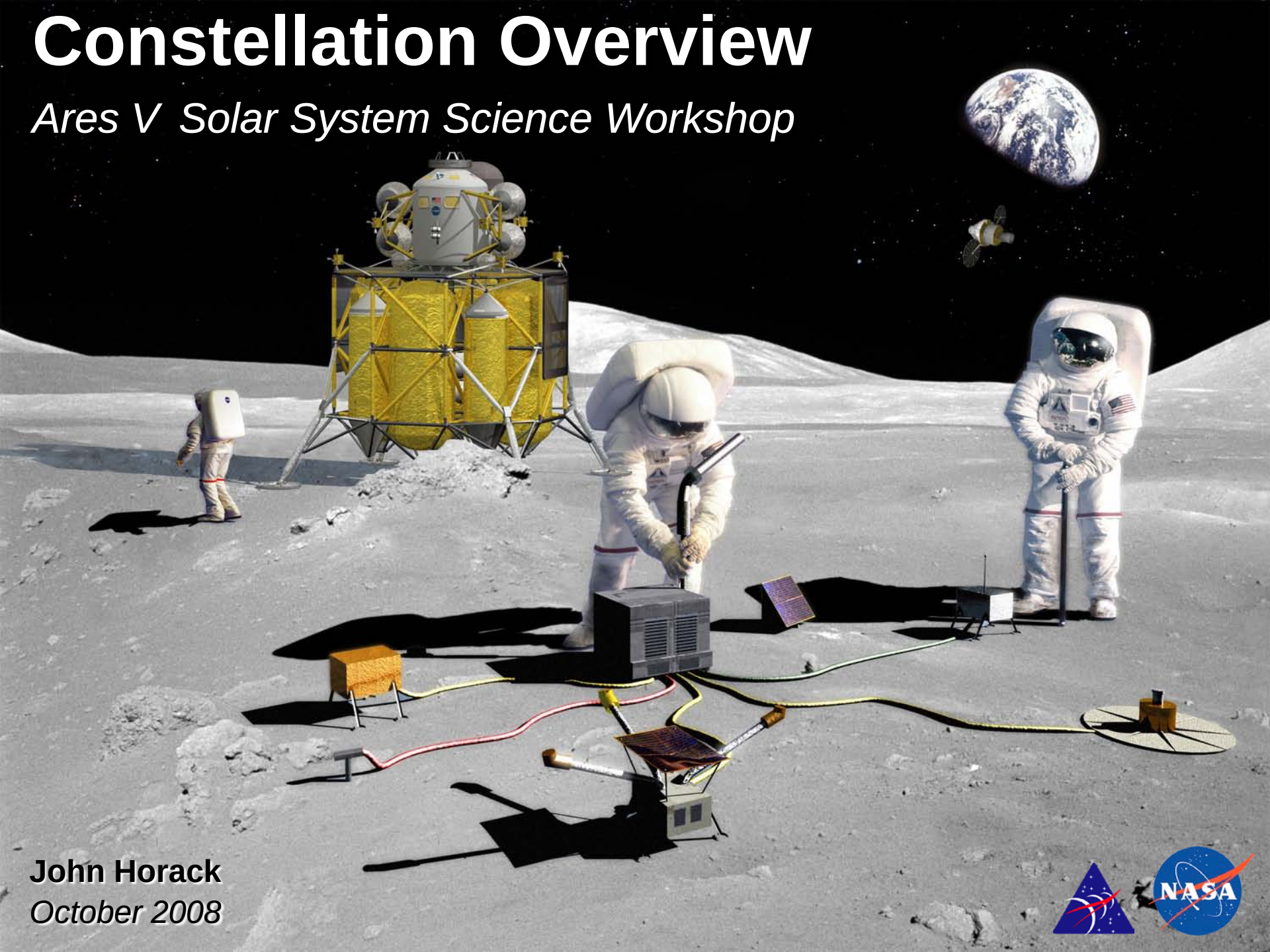
Constellation Overview

Ares V Solar System Science Workshop

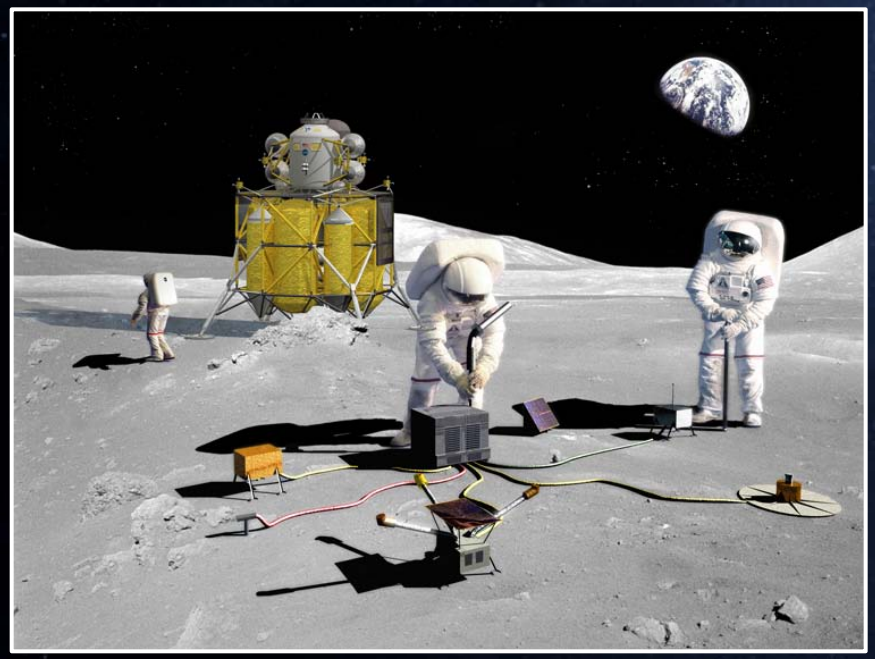


John Horack

October 2008

What is NASA's Mission?

- **Safely fly the Space Shuttle until 2010**
- **Complete the International Space Station (ISS)**
- **Develop a balanced program of science, exploration, and aeronautics**
- **Develop and fly the Orion Crew Exploration Vehicle (CEV)**
  - Designed for exploration but will initially service ISS
- **Land on the Moon no later than 2020**
- **Promote international and commercial participation in exploration**

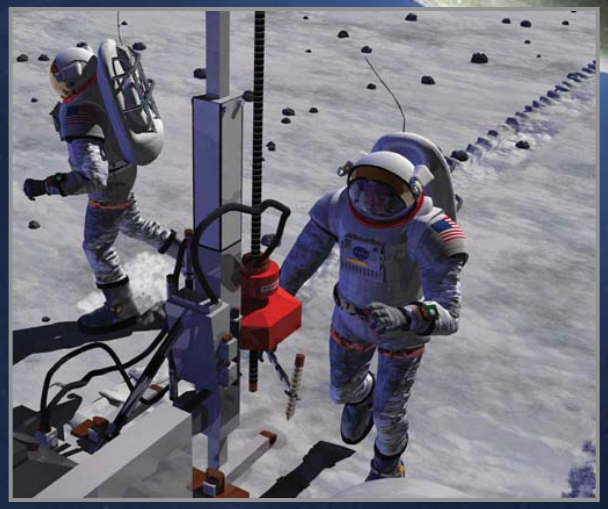


"The next steps in returning to the Moon and moving onward to Mars, the near-Earth asteroids, and beyond are crucial in deciding the course of future space exploration. We must understand that these steps are incremental, cumulative, and incredibly powerful in their ultimate effect."

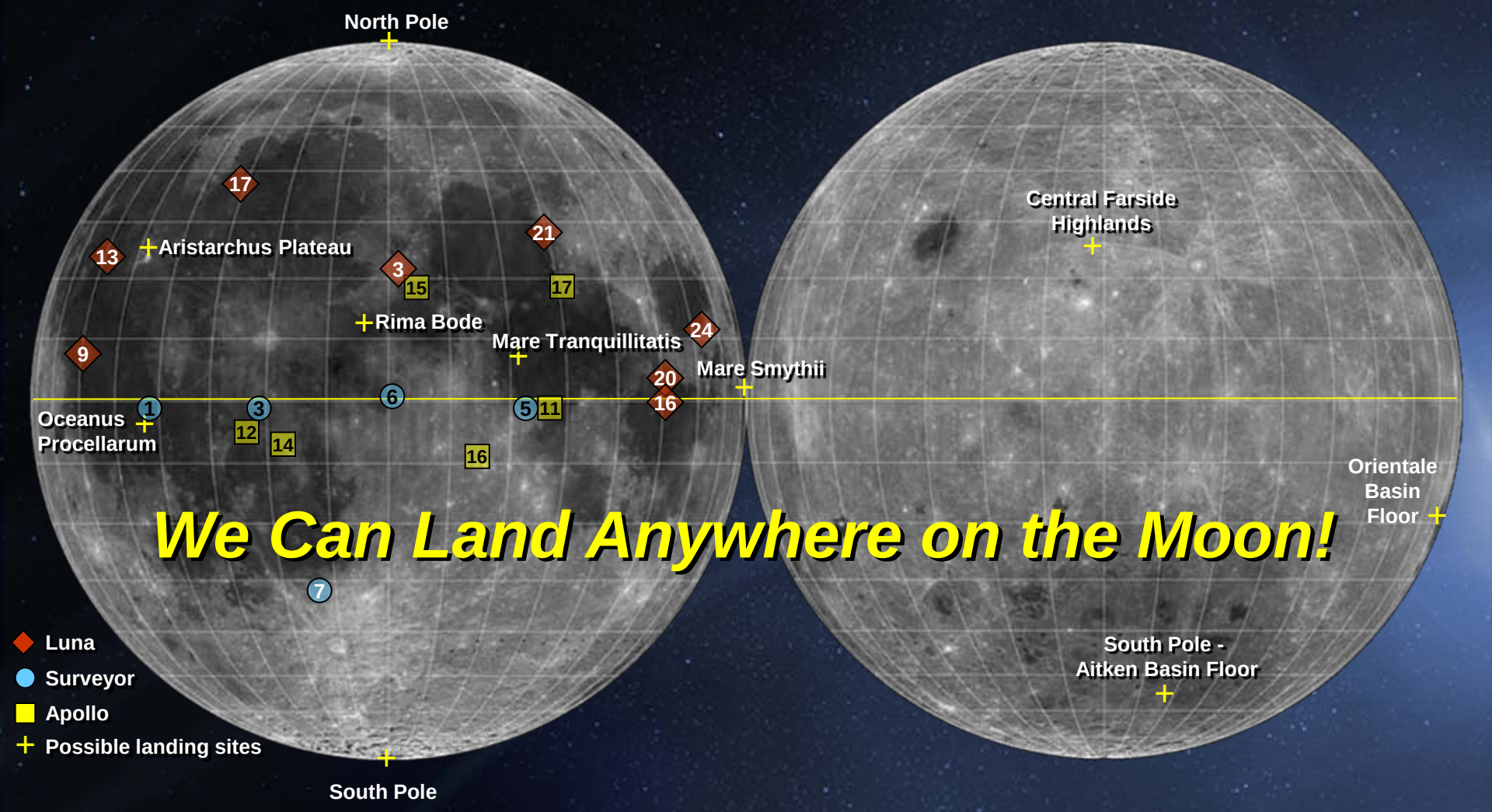
– NASA Administrator Michael Griffin
October 24, 2006

Why the Moon Next?

- It is close (3 days) and accessible – as near as Geosynchronous Earth Orbit (GEO)
- Alien yet familiar; Earth is visible to crew and TV audiences
- Moon can be reached with existing or derived launch systems
- Transport system to Moon can also access GEO, cis-Lunar, Earth-Sun Lagrangians, and some asteroids
- Retire risk to future planetary missions by re-acquiring experience and testing with lunar missions
- Development of lunar resources has potential to be a major advancement in space logistics capability
- Advance science, improve engineering state-of-the-art, inspire country



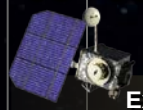
There Are Many Places To Explore



We Can Land Anywhere on the Moon!

NASA's Exploration Roadmap

05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25…

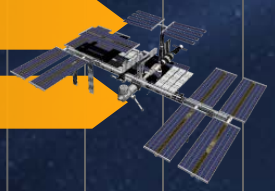


Exploration and Science Lunar Robotics Missions

Lunar Outpost Buildup

Research and Technology Development on ISS

Commercial Orbital Transportation Services for ISS



Space Shuttle Operations

SSP Transition

Ares I and Orion Development

Operations Capability Development
(EVA Systems, Ground Operations, Mission Operations)

Ares I-X
Test Flight
April 2009

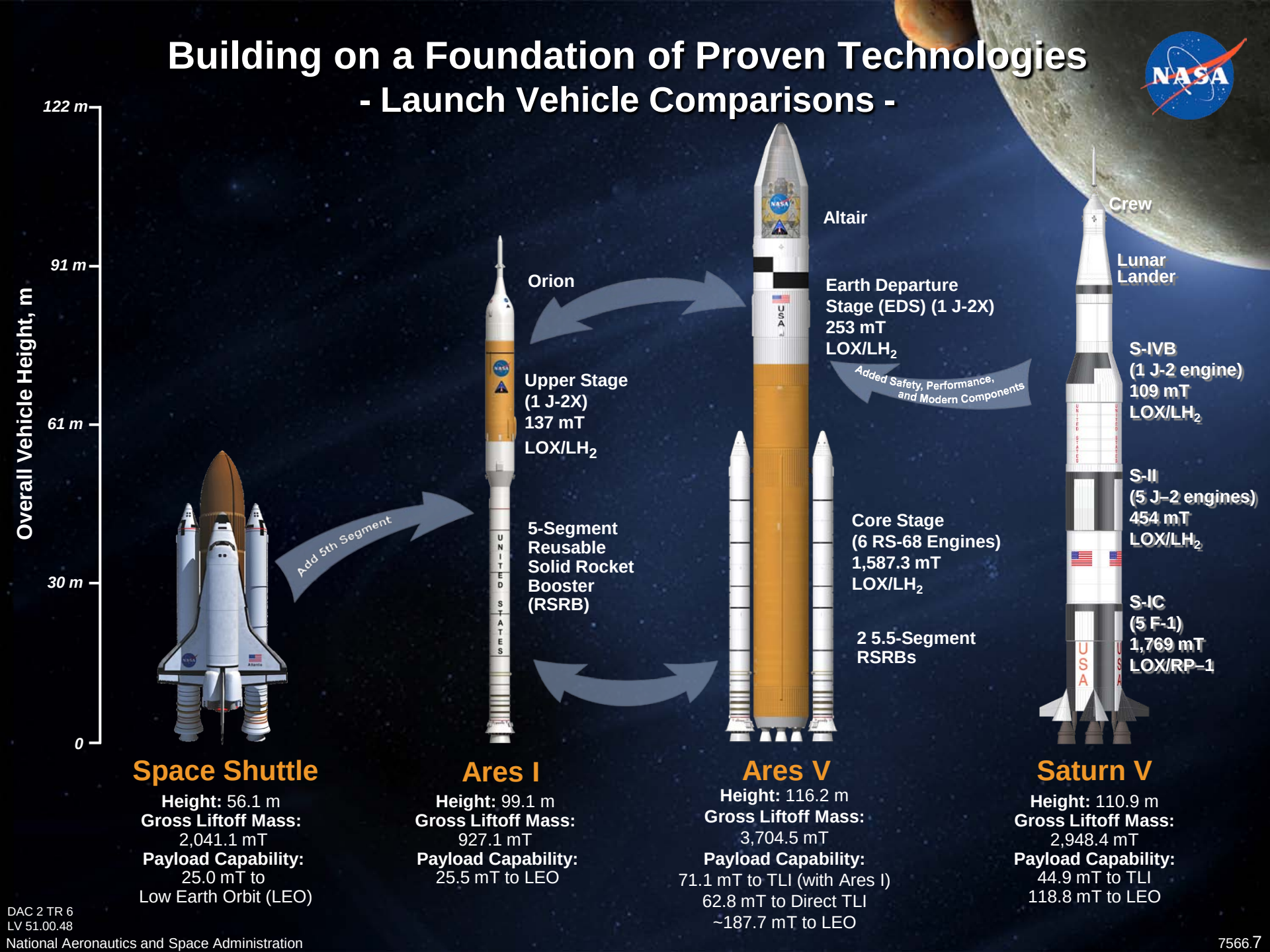
Orion and Ares I Production and Operation

Altair Development

Ares V & Earth Departure Stage

Surface Systems Development

Building on a Foundation of Proven Technologies
- Launch Vehicle Comparisons -



Space Shuttle
Height: 56.1 m
Gross Liftoff Mass:
2,041.1 mT
Payload Capability:
25.0 mT to
Low Earth Orbit (LEO)

Ares I
Height: 99.1 m
Gross Liftoff Mass:
927.1 mT
Payload Capability:
25.5 mT to LEO

Ares V
Height: 116.2 m
Gross Liftoff Mass:
3,704.5 mT
Payload Capability:
71.1 mT to TLI (with Ares I)
62.8 mT to Direct TLI
~187.7 mT to LEO

Saturn V
Height: 110.9 m
Gross Liftoff Mass:
2,948.4 mT
Payload Capability:
44.9 mT to TLI
118.8 mT to LEO

Ares Nationwide Team

ATK Launch Systems

Ames

Marshall

Glenn

Langley

Pratt & Whitney Rocketdyne

Johnson

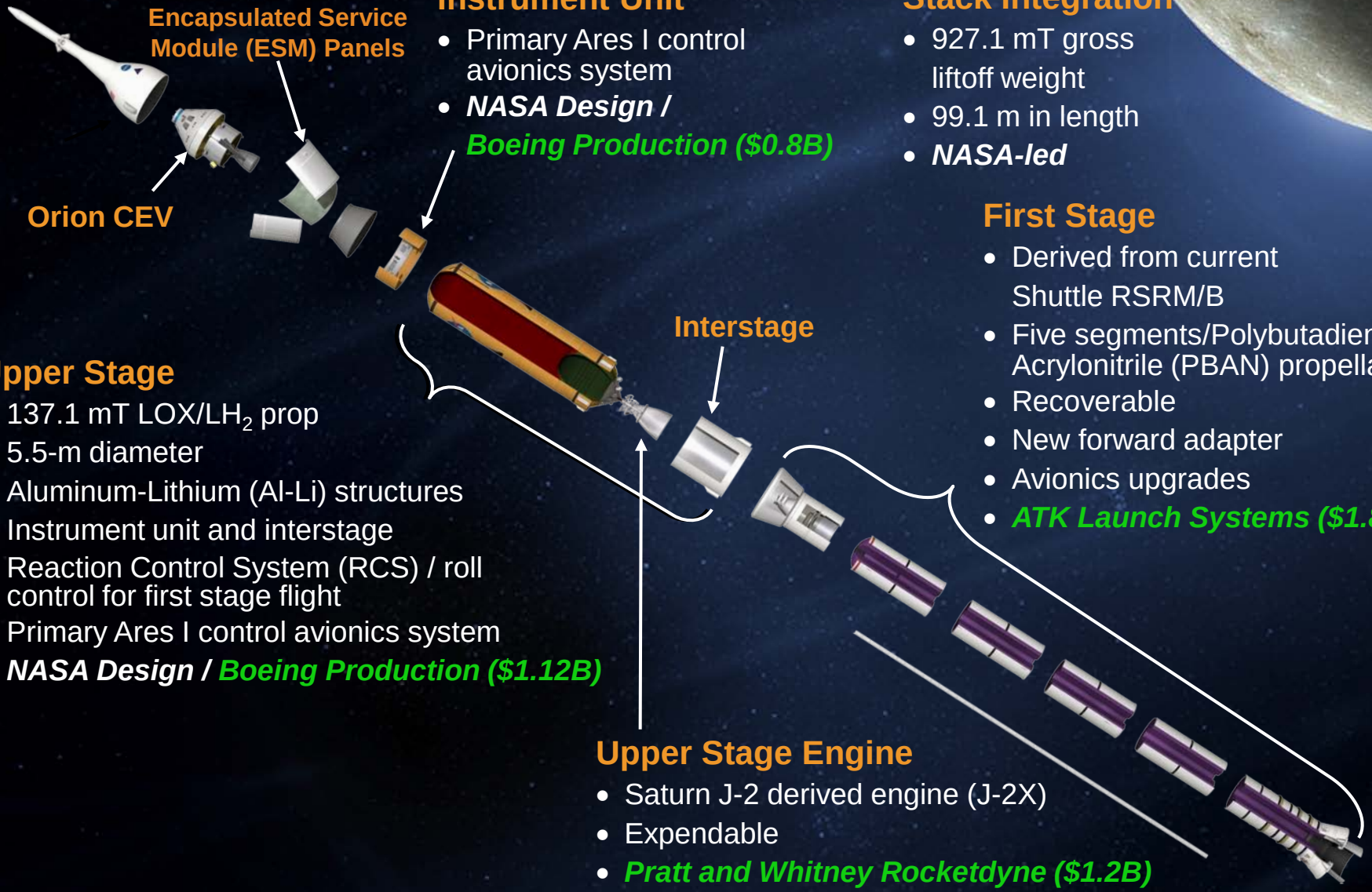
Boeing

Michoud Assembly Facility

Stennis

Kennedy

Ares I Elements



Instrument Unit

- Primary Ares I control avionics system
- ***NASA Design / Boeing Production ($0.8B)***

Stack Integration

- 927.1 mT gross liftoff weight
- 99.1 m in length
- ***NASA-led***

First Stage

- Derived from current Shuttle RSRM/B
- Five segments/Polybutadiene Acrylonitrile (PBAN) propellant
- Recoverable
- New forward adapter
- Avionics upgrades
- ***ATK Launch Systems ($1.8B)***

Upper Stage

- 137.1 mT LOX/LH_2 prop
- 5.5-m diameter
- Aluminum-Lithium (Al-Li) structures
- Instrument unit and interstage
- Reaction Control System (RCS) / roll control for first stage flight
- Primary Ares I control avionics system
- ***NASA Design / Boeing Production ($1.12B)***

Upper Stage Engine

- Saturn J-2 derived engine (J-2X)
- Expendable
- ***Pratt and Whitney Rocketdyne ($1.2B)***

Vehicle Integration Accomplishments

QuickTime™ and a
Sorenson Video 3 decompressor
are needed to see this picture.

Wind Tunnel Testing – Boeing, Langley Research Center (LaRC), VA;
Ames Research Center (ARC), CA

QuickTime™ and a
Sorenson Video 3 decompressor
are needed to see this picture.

3% First Stage Reentry Testing
Arnold Air Force Base, TN

QuickTime™ and a
Sorenson Video 3 decompressor
are needed to see this picture.

Ares I-X Rigid Buffet Model
LaRC, VA

QuickTime™ and a
Sorenson Video 3 decompressor
are needed to see this picture.

Ares I System Definition Review
Huntsville, AL

Ares I-X Test Flight

- **Demonstrate and collect key data to inform the Ares I design:**
  - Vehicle integration, assembly, and Kennedy Space Center launch operations
  - Staging/separation
  - Roll and overall vehicle control
  - Aerodynamics and vehicle loads
  - First stage entry dynamics for recovery

- **Performance Data:**

	Ares I-X	Ares I
First Stage Max. Thrust (vacuum):	14.1 MN	15.8 MN
Max. Speed:	Mach 4.7	Mach 5.75
Staging Altitude:	39,600 m	57,700 m
Liftoff Weight:	816 mT	927 mT
Length:	99.7 m	99.1 m
Max. Acceleration:	2.46 g	3.79 g

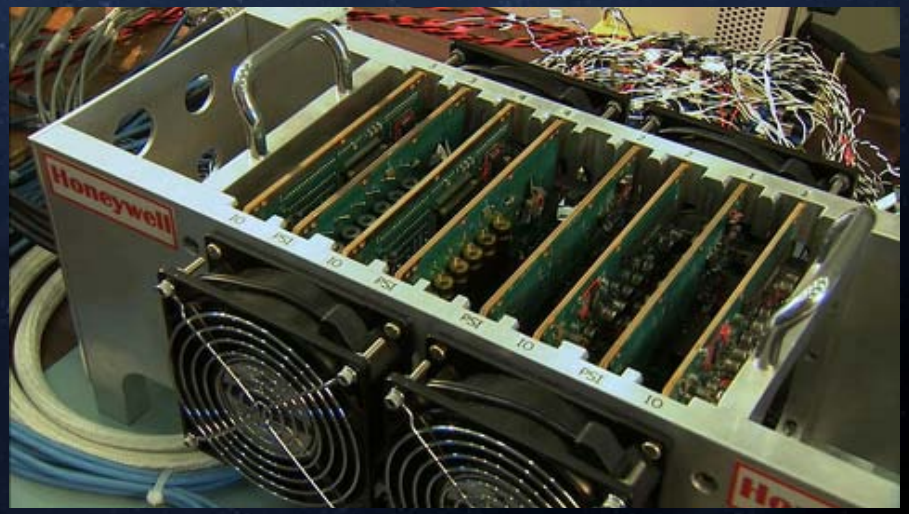
Ares I-X Accomplishments

QuickTime™ and a
Sorenson Video 3 decompressor
are needed to see this picture.

Roll Control System Test and Fabrication
Huntsville, AL and White Sands Test Facility (WSTF), NM

Upper Stage Simulator Assembly
Glenn Research Center (GRC), OH

Forward Frustum Fabrication
Indianapolis, IN



First Stage Actuator Systems Testing
Marshall Space Flight Center (MSFC), AL

Orion Crew Exploration Vehicle

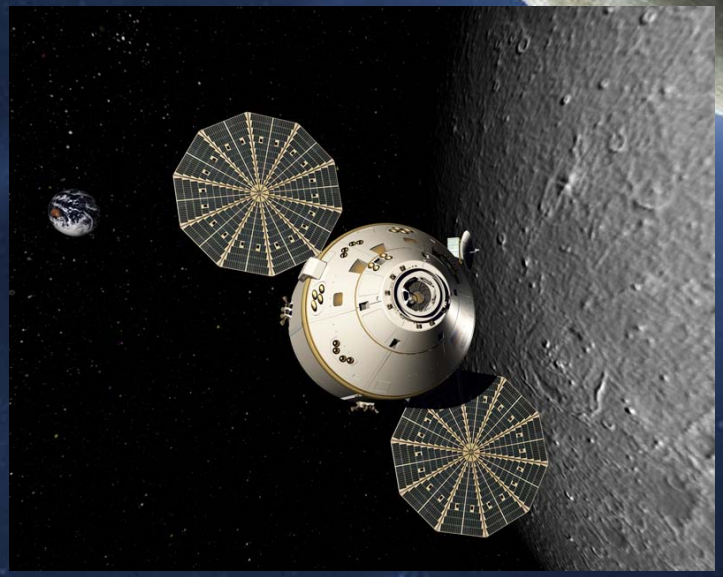
Launch Abort System

Attitude Control Motor
(Eight Nozzles)

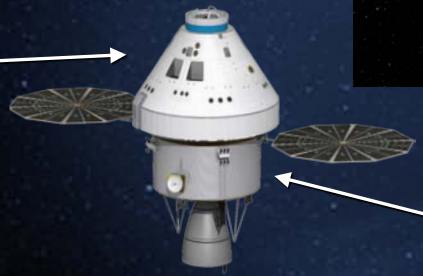
Canard Section
(Stowed Configuration)

Jettison Motor
(Four Aft, Scarfed Nozzles)

Abort Motor
(Four Exposed, Reverse Flow Nozzles)



Crew Module



Service Module

LOCKHEED MARTIN

ESM Panels

Spacecraft Adapter

Volume: 115.8 m^3
– 80% larger than Apollo
Diameter: 5.0 m

Altair Lunar Lander

- **Transport 4 crew-members to and from the surface**
  - Visits start with 7 days on surface
  - Length of stays increases step-by-step
  - Builds up to 6 month lunar outpost crew rotations
- **Global access capability**
- **Return to Earth anytime**
- **Deliver approximately 16 metric tons of dedicated cargo**
- **Provide airlock for surface activities**
- **Descent stage:**
  - LOX/LH_2
- **Ascent stage:**
  - Storable propellants

Ares V Elements

Stack Integration
- 3,704.5 mT gross liftoff mass
- 116.2 m in length

Solid Rocket Boosters
- Two recoverable 5.5-segment PBAN-fueled boosters (derived from current Ares I first stage)

Earth Departure Stage (EDS)
- One Saturn-derived J-2X LOX/LH_2 engine (expendable)
- 10-m diameter stage
- Aluminum-Lithium (Al-Li) tanks
- Composite structures, instrument unit and interstage
- Primary Ares V avionics system

Core Stage
- Six Delta IV-derived RS-68 LOX/LH_2 engines (expendable)
- 10-m diameter stage
- Composite structures
- Al-Li tanks

Summary

- Human beings will explore the Moon and beyond to encourage inspiration, innovation, and discovery.
- We must build beyond our current capability to ferry astronauts and cargo to low Earth orbit.
- We are starting to design and build new vehicles, using extensive lessons learned to minimize cost, technical, and schedule risks.
- Team is onboard and making good progress—the Ares IX test flight is on schedule for 2009.

Questions?

www.nasa.gov/ares