NASA Risk Management Conference

The New Role of MSFC in Exploration

David King

Director, MSFC

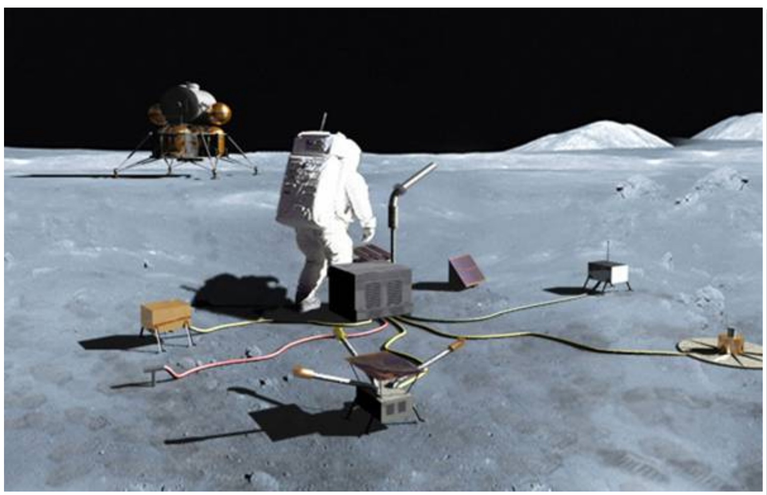
MSFC is Executing the Exploration Vision

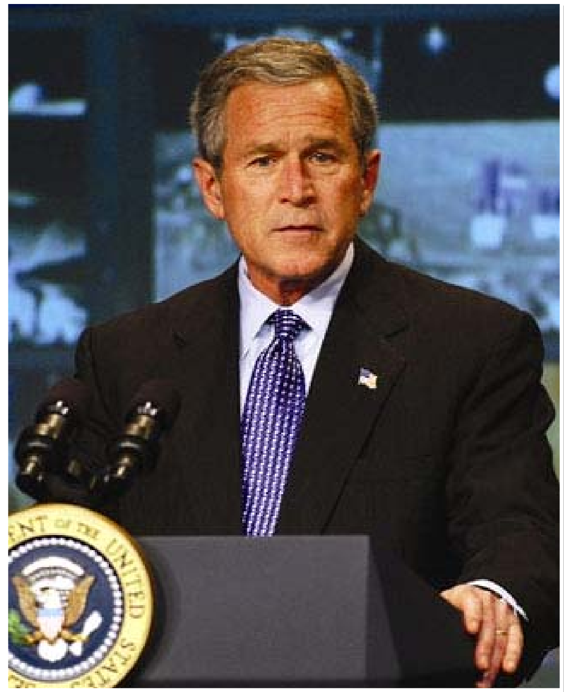
♦ Existing Responsibilities

- Shuttle
- ISS
- Developmental Research & Engineering

♦ New Roles

- Crewed Launch Vehicle
- Heavy Lift Launch Vehicle
- Robotic Lunar Exploration



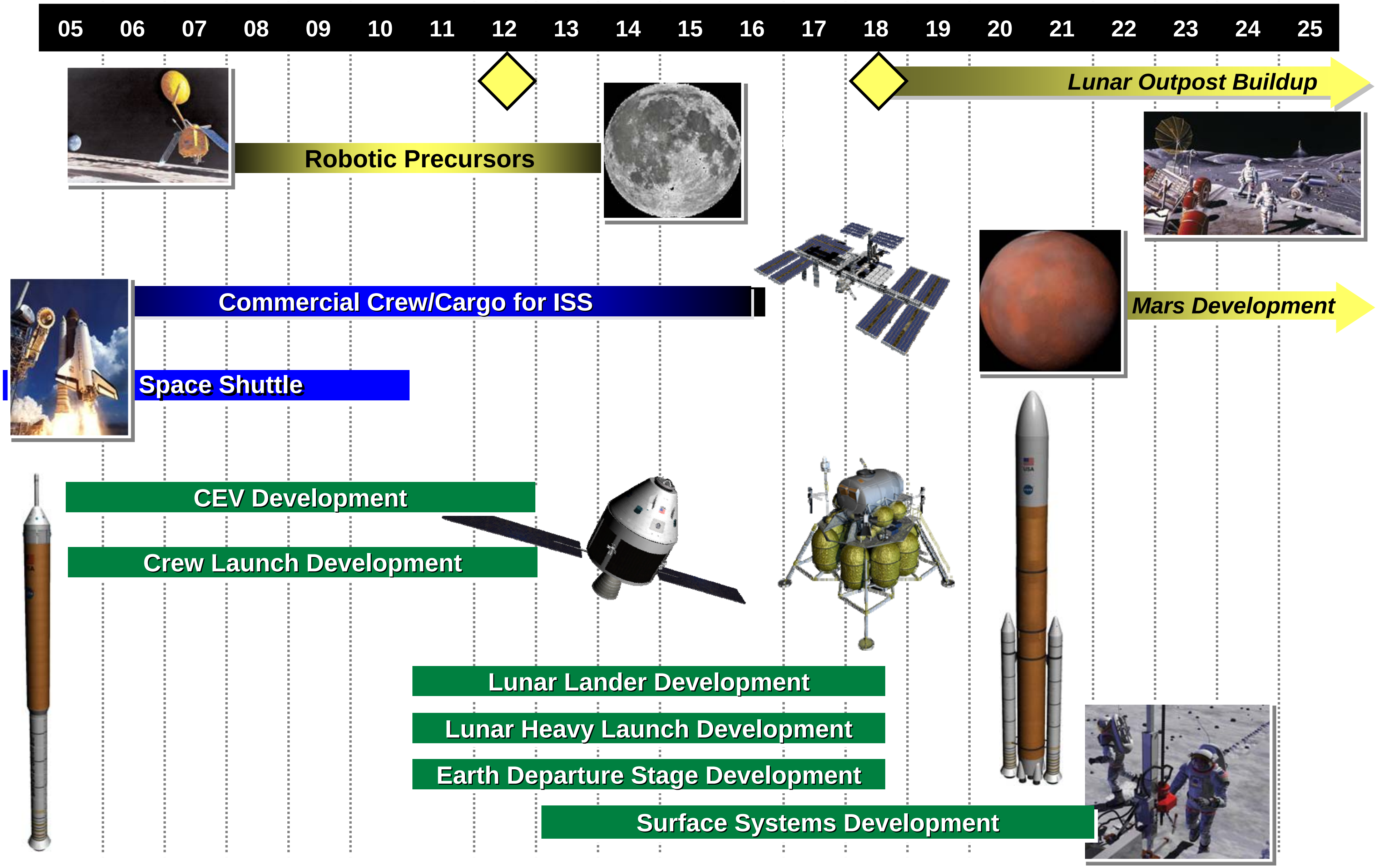


"It is time for America to take the next steps.

Today I announce a new plan to explore space and extend a human presence across our solar system. We will begin the effort quickly, using existing programs and personnel. We'll make steady progress – one mission, one voyage, one landing at a time"

President George W. Bush – January 14, 2004

NASA’s Exploration Roadmap



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The Moon - the 1st Step to Mars and Beyond …

- Gaining significant experience in operating away from Earth's environment
- Developing technologies needed for opening the space frontier
- Conduct fundamental science

Next Step in Fulfilling Our Destiny As Explorers

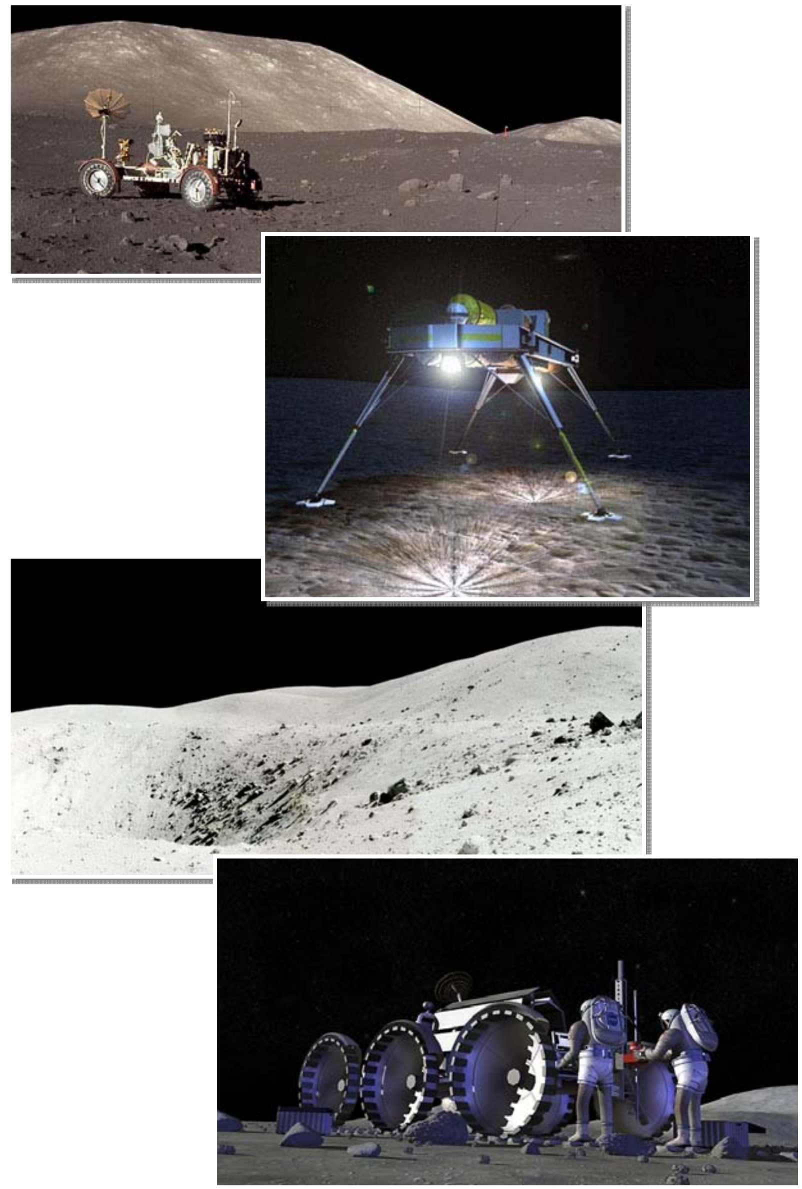
Going Back to the Moon Provides Unique Challenges Compared to Exploring Mars

- Moon has no atmosphere, making landing entirely propulsive

- Lunar polar environment different from Mars surface

- Exploration requirements different for two bodies

- Moon exploration architecture driven by need for sustained human presence

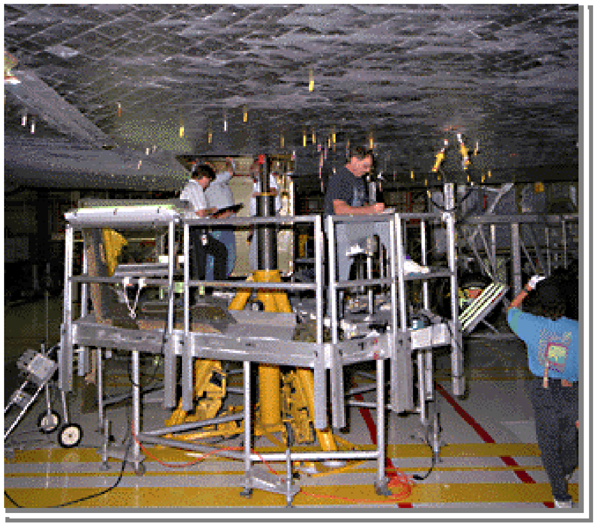


Existing Responsibilities

- Shuttle
- ISS
- Developmental Research & Engineering

Characterization of Shuttle Assets to Support the Exploration Vision

- Shuttle occupies 640 facilities
- Over 900,000 line items associated with equipment
- More than 2,000 FTE's Civil Service and more than 15,000 WYE's prime contractors
- Total equipment value is more than $12B
- Total facilities value is ~ $5.7 Billion

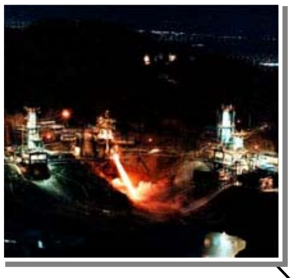


Near-Term Decisions have major impacts on the 'Transition' required to support the Exploration Vision

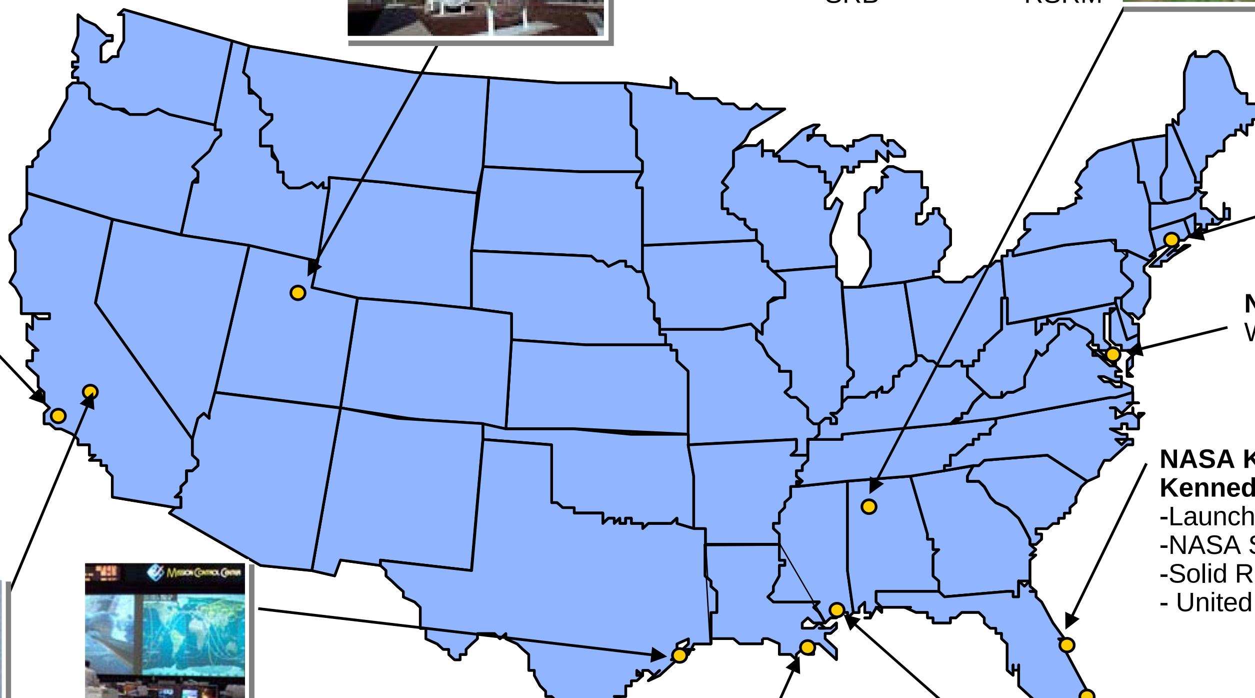
Key Shuttle Infrastructures

Reusable Solid Rocket Motor
ATK Thiokol Propulsion
Brigham City, Utah

NASA MSFC
Huntsville, AL
-Shuttle Projects Office
-SSME - ET
-SRB - RSRM



Space Shuttle
Main Engines
Boeing Rocketdyne
Canoga Park, CA



EVA Suits
Hamilton Sundstrand
Winsor Locks, CT

NASA Headquarters
Washington, D.C.

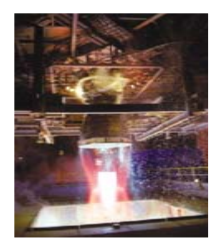
NASA KSC
Kennedy Space Center, FL
-Launch & Landing
-NASA Shuttle Log. Depot
-Solid Rocket Booster
- United Space Alliance (USA)

Alternate Landing Site
Edwards AFB, CA

NASA JSC
Houston, Texas
-Shuttle Program Office
-Program Integration
-Space Shuttle Veh. Eng. Office
(FSW, FCE, ORB, RMS)
-United Space Alliance - SFOC

External Tank
LMCO
Michoud Assembly Fac.
New Orleans, LA

NASA SSC
Bay St. Louis, MS
- SSME Test



Alternate Turbo Pumps
Pratt & Whitney
West Palm Beach, FL

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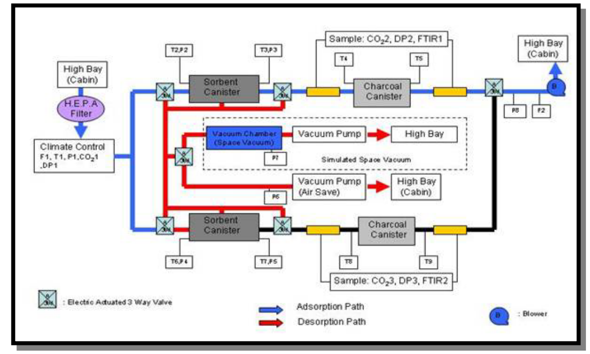
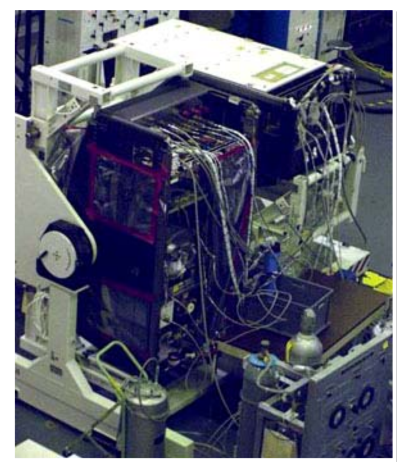
Exploration and ECLSS Development

- **Key Atmosphere Revitalization Objectives**
  - Lead development of regenerative combined Carbon Dioxide, Humidity, and Trace Contaminant Removal system for CEV
  - Develop atmosphere system loop closure technologies for Lunar Outpost applications and beyond



- **Key contributor to Exploration Life Support Water Reclamation**
  - Leverage extensive flight hardware development experience
  - Perform advanced water recovery system development and evaluation for Lunar Outpost applications

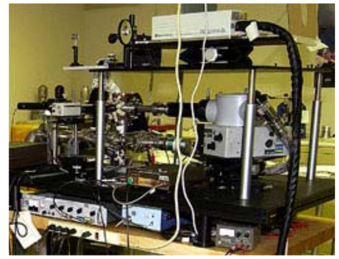
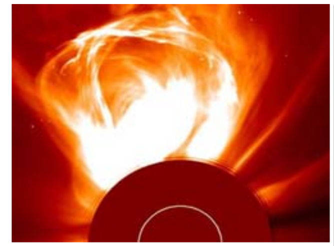


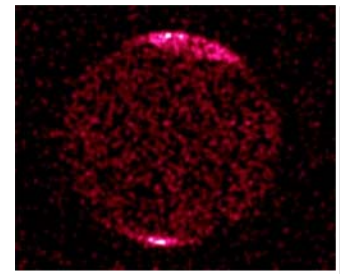
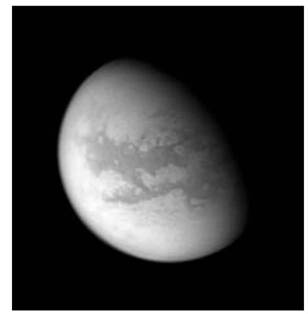
Application of ISS and SSP Experience … Benefits Exploration

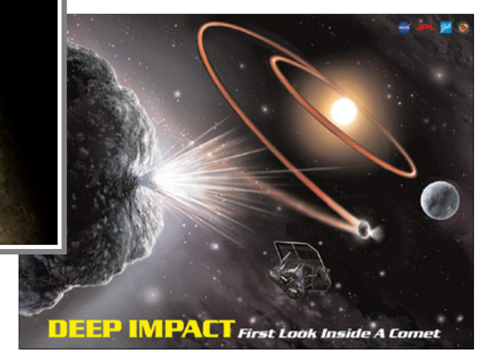
MSFC's Role in Developmental Research & Engineering supports the Exploration Vision

- **On-Going Research & Engineering Accomplishments**
  - Lunar Dust Experiments
  - Instrument Development for Lunar & Mars Exploration
  - Radiation Hazards within Spacecraft and Structures
  - Automated Rendezvous & Docking
  - Space Weather Forecasting
  - Analyzing the Atmospheres of Saturn's moon Titan

- **Exciting Discovery & New Frontiers Missions have led to Missions such as:**
  - Stardust
  - Messenger
  - Deep Impact

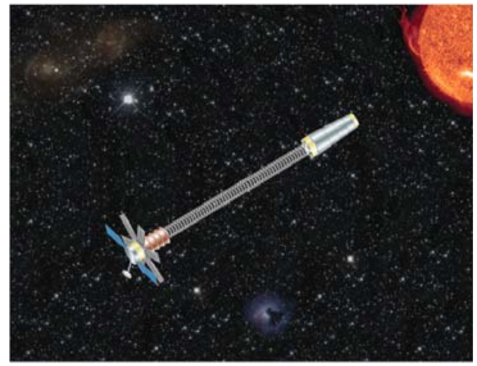



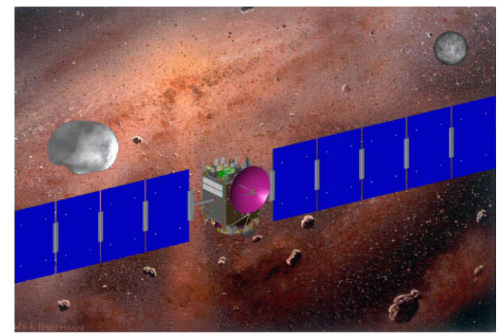



MSFC's Role in Developmental Research & Engineering supports the Exploration Vision

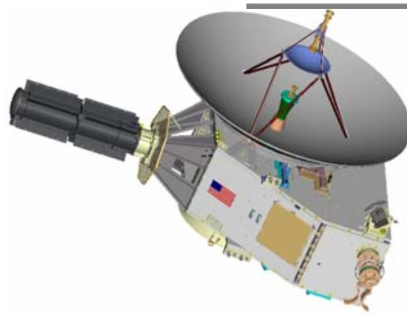
- **Future Research and Exciting new Missions**
  - Magnetic TRAnsition region Probe (MTRAP)



  - DAWN

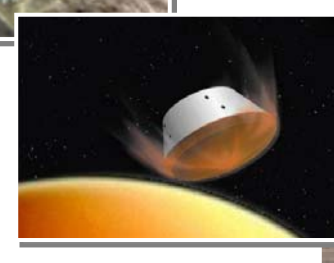


  - New Horizons



  - Moon Mineralogy Mapper (MMM)

  - Space Technologies -9 … potential to fly Aero capture or Solar Sail Validation flight

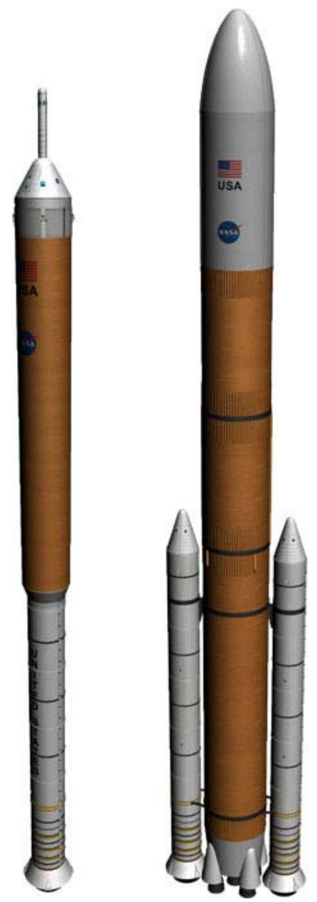


New Roles

- Crewed Launch Vehicle
- Heavy Lift Launch Vehicle
- Robotic Lunar Exploration

ESAS Launch System Selection Summary

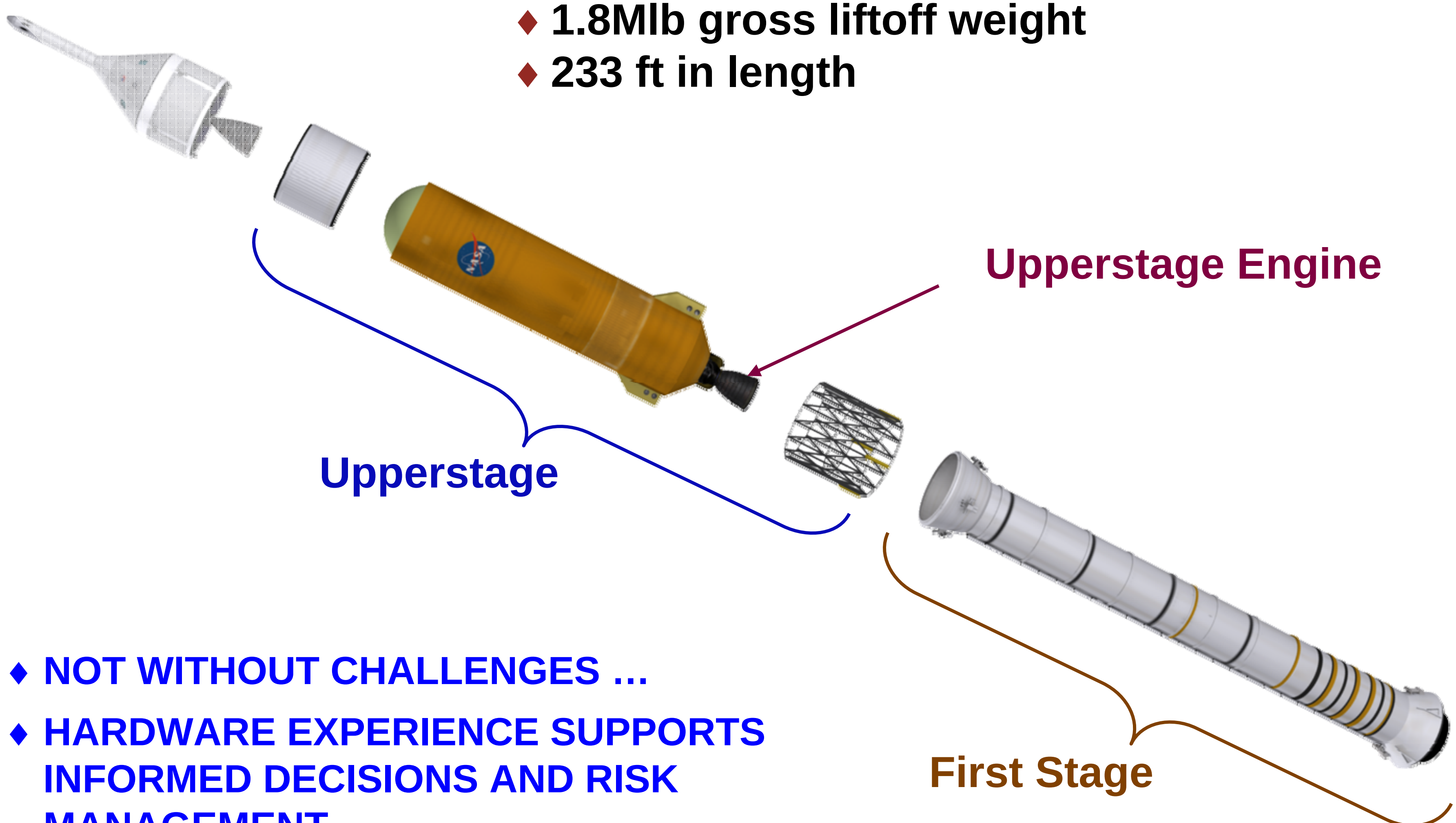
- Continue to rely on the EELV fleet for scientific and International Space Station cargo missions in the 5-20 metric ton range to the maximum extent possible.
- The safest, most reliable, and most affordable way to meet exploration launch requirements is a 25 metric ton system derived from the current Shuttle solid rocket booster and liquid propulsion system.
- 125 metric ton lift capacity required to minimize on-orbit assembly and complexity – increasing mission success



THE LAUNCH SYSTEM IS A KEY ENABLER TO THE VISION BUT WE MUST APPLY OUR HARD WON LESSONS LEARNED … RISK MANAGEMENT

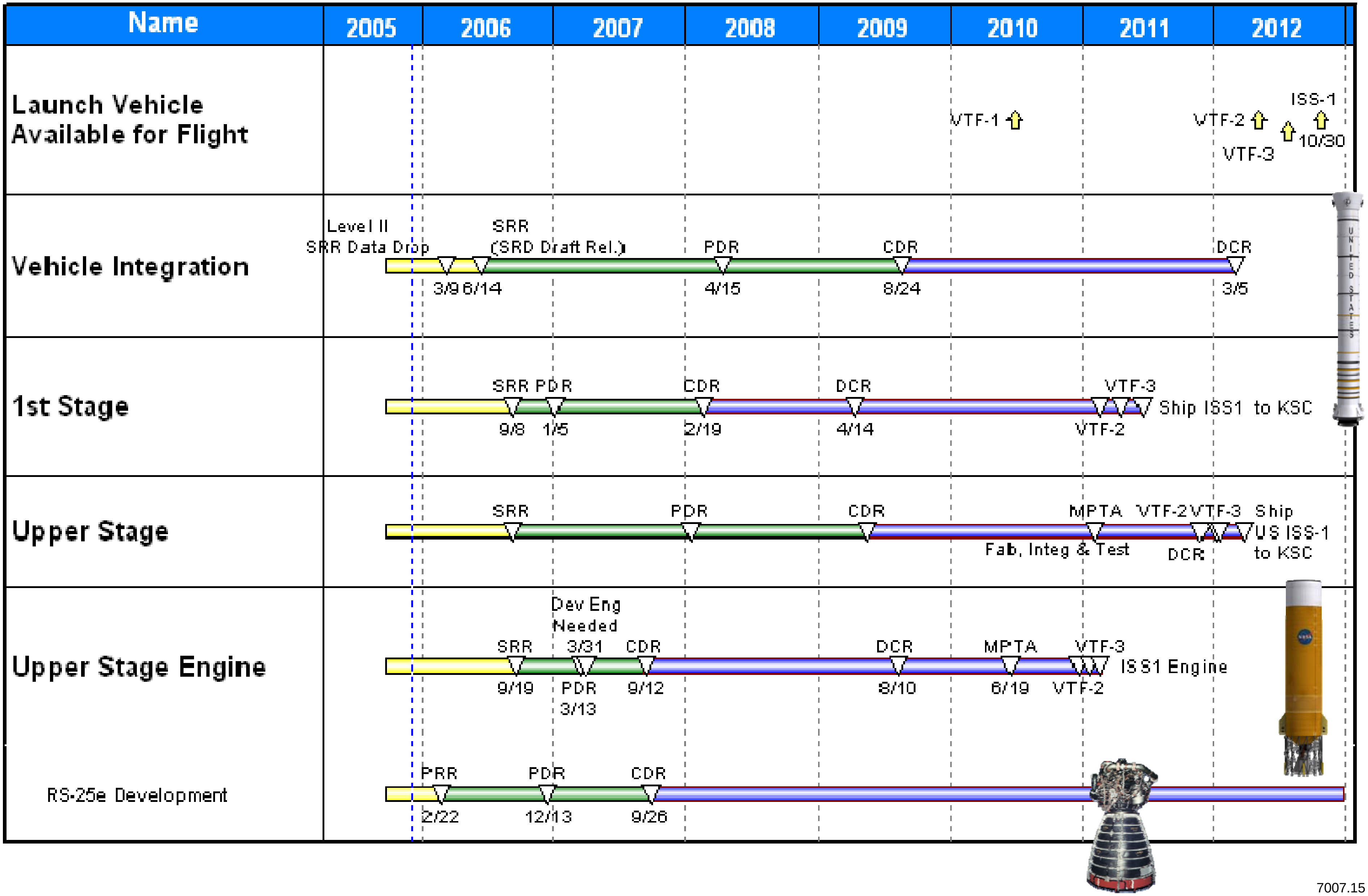
Crew Launch Vehicle Description

- ~25mT payload capacity
- 1.8Mlb gross liftoff weight
- 233 ft in length

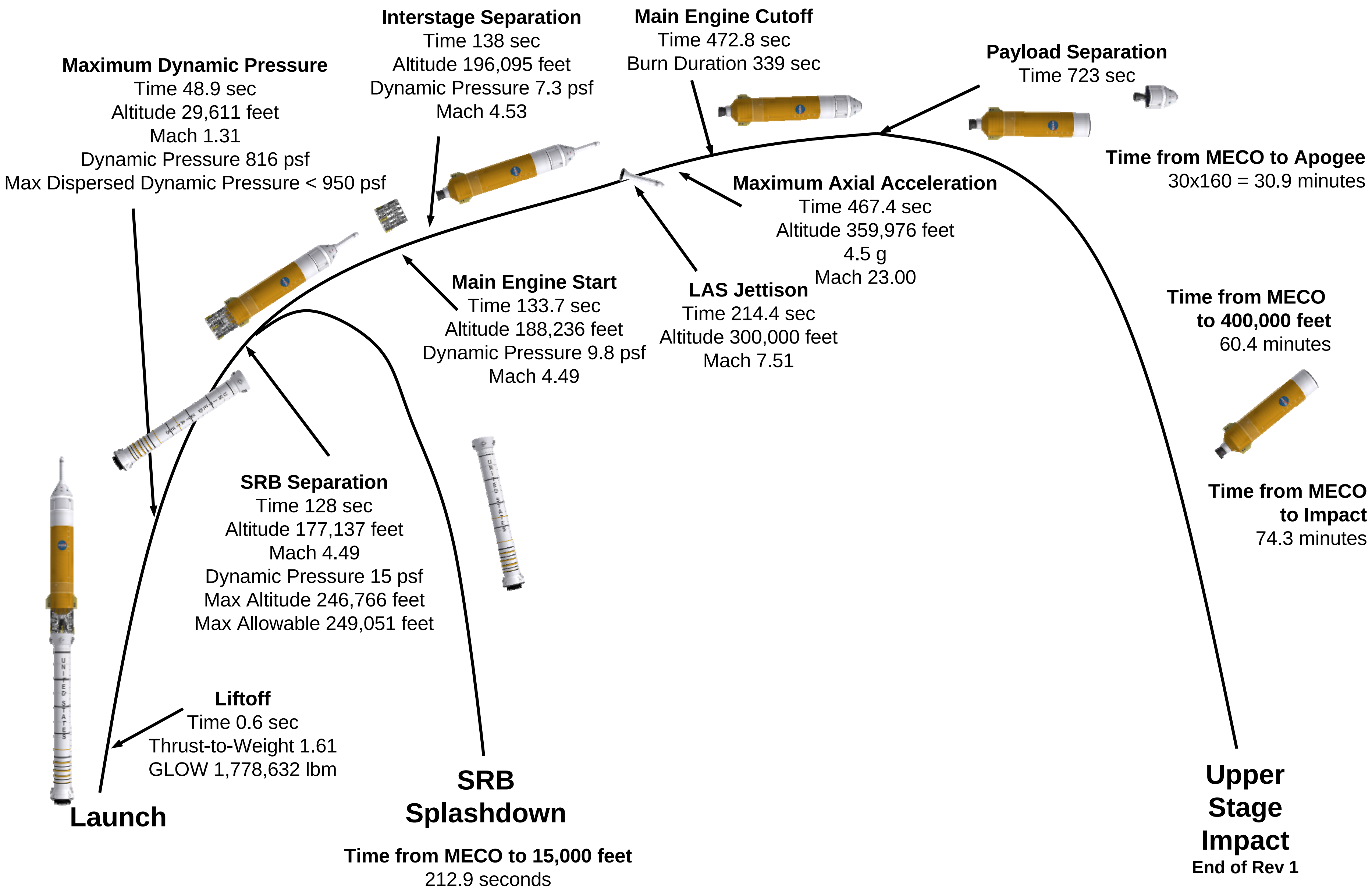


- **NOT WITHOUT CHALLENGES …**
- **HARDWARE EXPERIENCE SUPPORTS INFORMED DECISIONS AND RISK MANAGEMENT**

CLV Schedule (CY)



Typical CLV Mission (Lunar/28.5°)



CLV Implementation Tenets

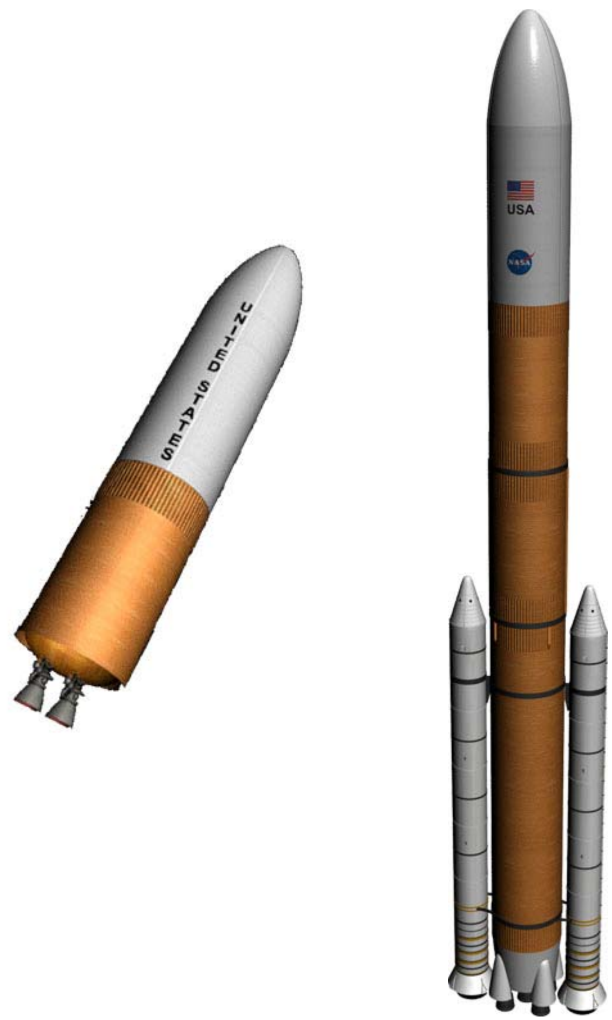
- Utilize current, proven technology
- Constantly look for ways to drive costs down and out … non-recurring and recurring

- “Zero Based” approach
- Performance based contracting

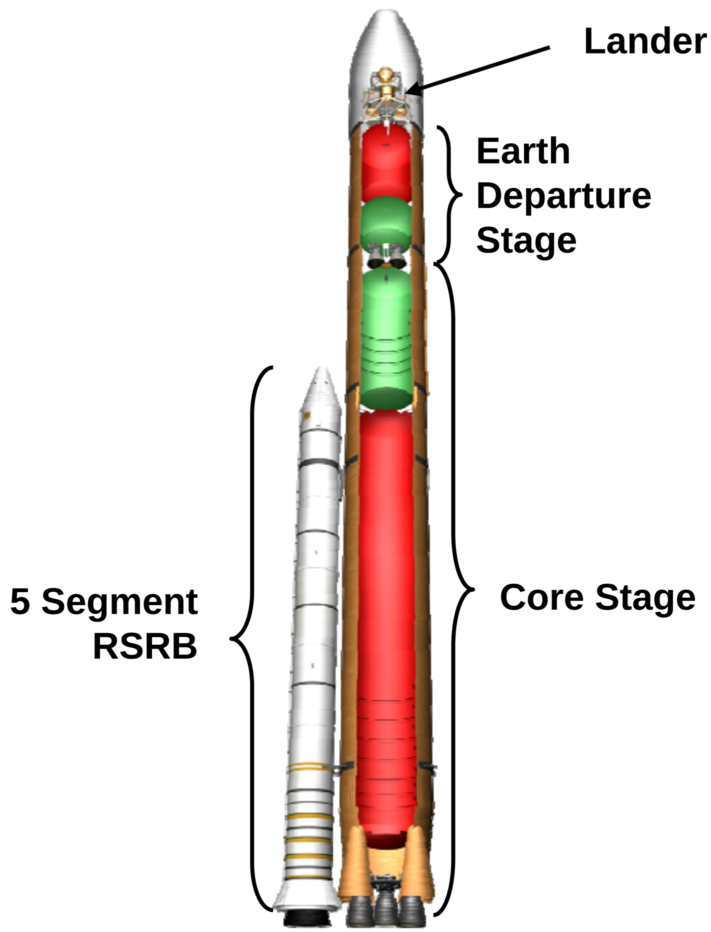
- Strategic application of Insight and Oversight to help manage risk

Lunar Heavy Cargo Launch Vehicle Summary

- 5 Segment Shuttle Solid Rocket Boosters
- Liquid Oxygen / liquid hydrogen core stage
- Payload Capability
- Can be certified for crew if needed



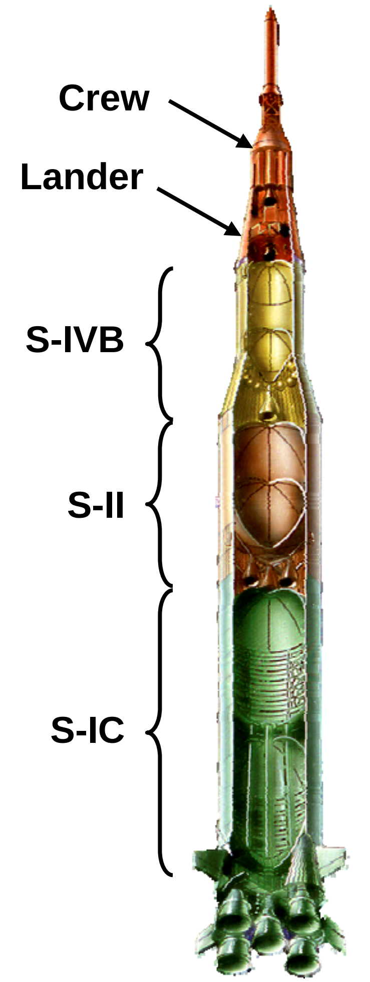
Comparison with Saturn V



5 Expendable SSMEs

55mT to Trans-Lunar Injection
67mT to TLI in Dual Launch Mode with CLV

Cargo Launch Vehicle



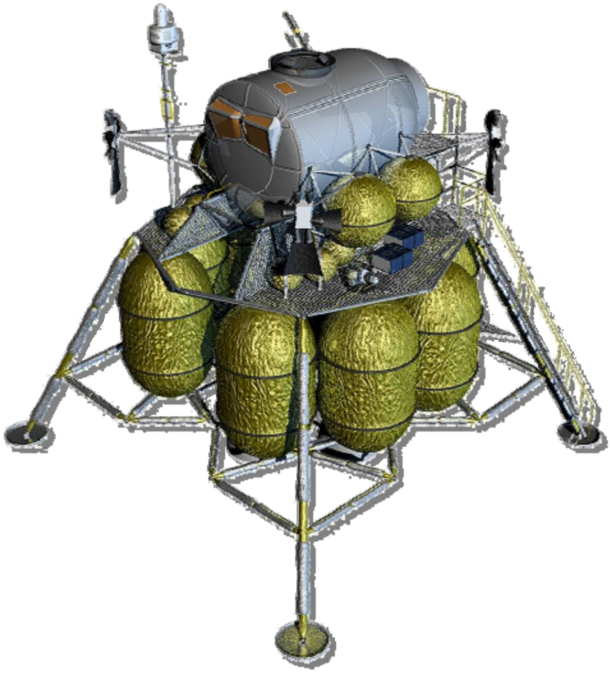
5 F-1 Engines

51mT to Trans-Lunar Injection

Saturn V

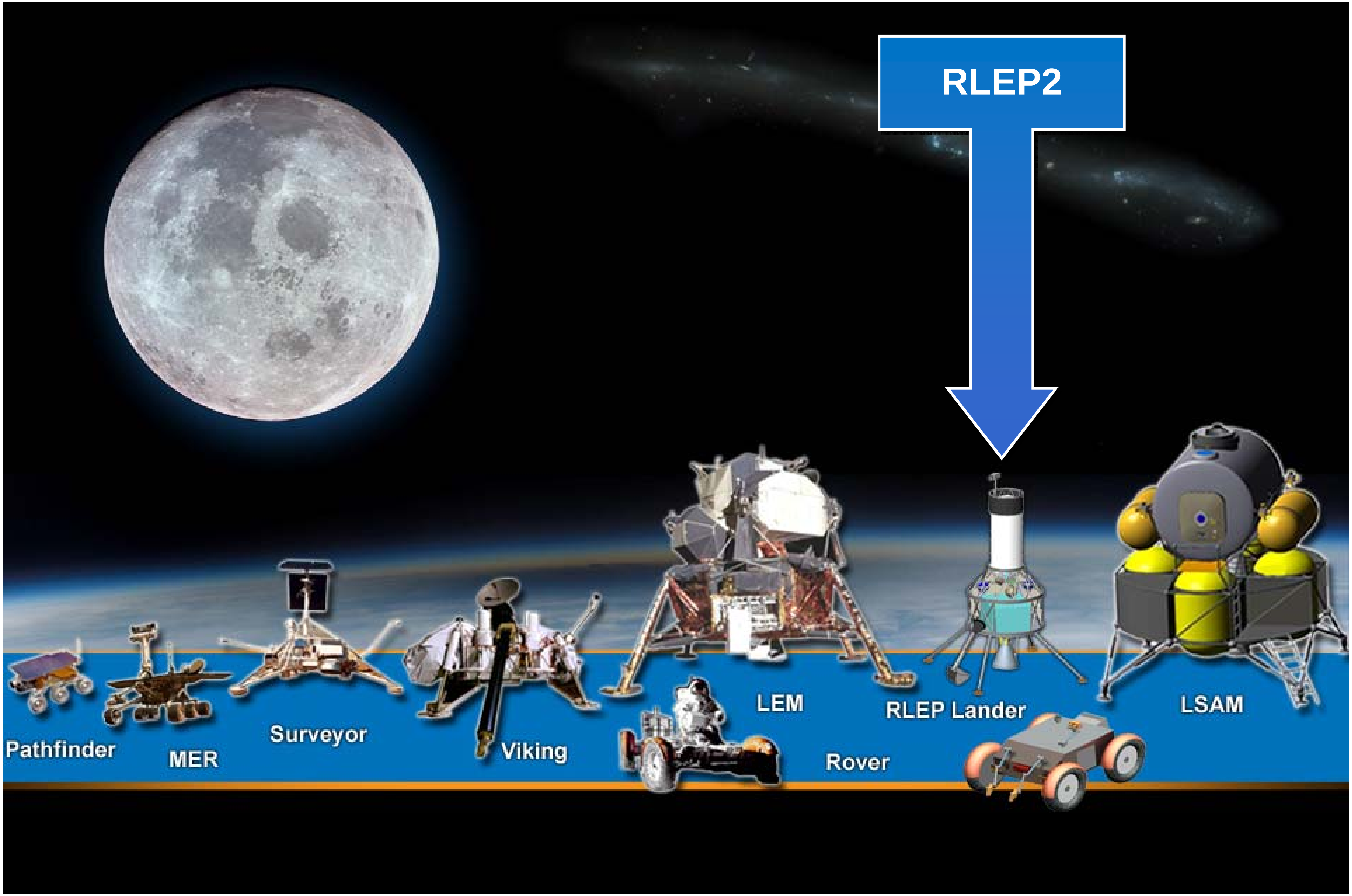
Earth Departure Stage and Lunar Lander and Ascent Stage

- **Earth Departure Stage**
  - Liquid oxygen / liquid hydrogen stage
  - Stage ignites suborbitally and delivers the lander to low-Earth orbit
  - The CEV later docks with this system and the Earth departure stage performs a trans-lunar injection burn
  - The Earth departure stage is then discarded

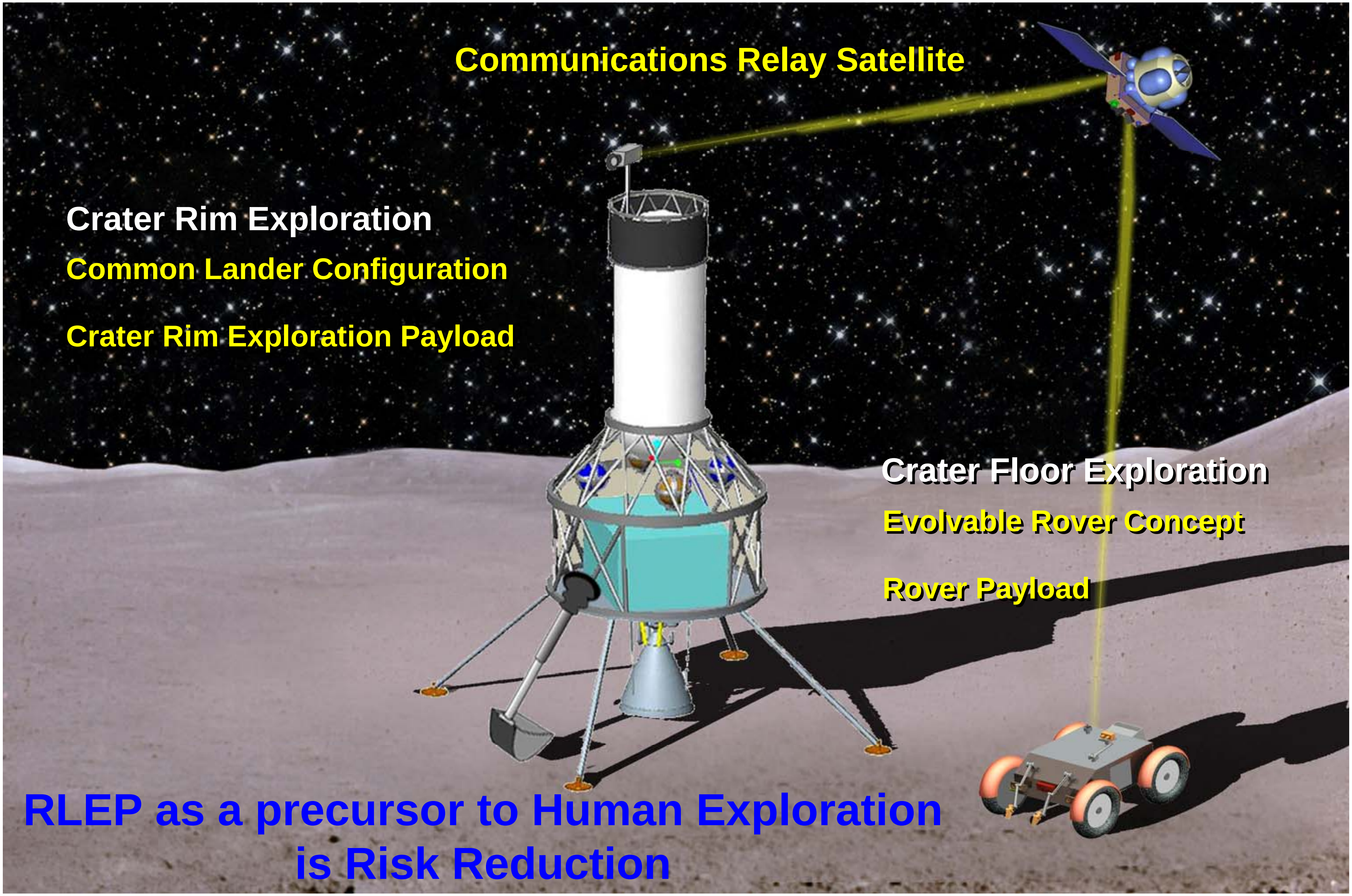


- **Lunar Lander & Ascent Stage**
  - 4 crew to and from the surface
  - Global access capability
  - Anytime return to Earth
  - Capability to land 21 metric tons of dedicated cargo
  - Airlock for surface activities
  - Descent stage
  - Ascent stage

NASA's Next Investment in Lunar Landers

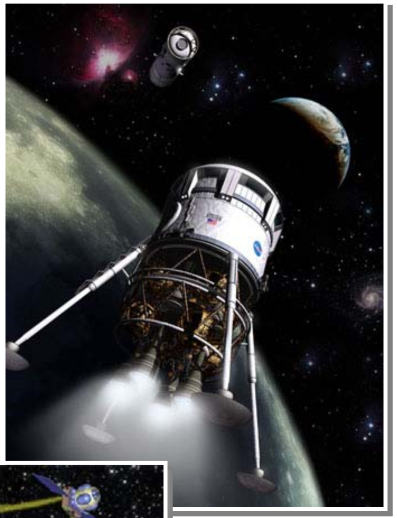


RLEP 2 Hardware Architecture



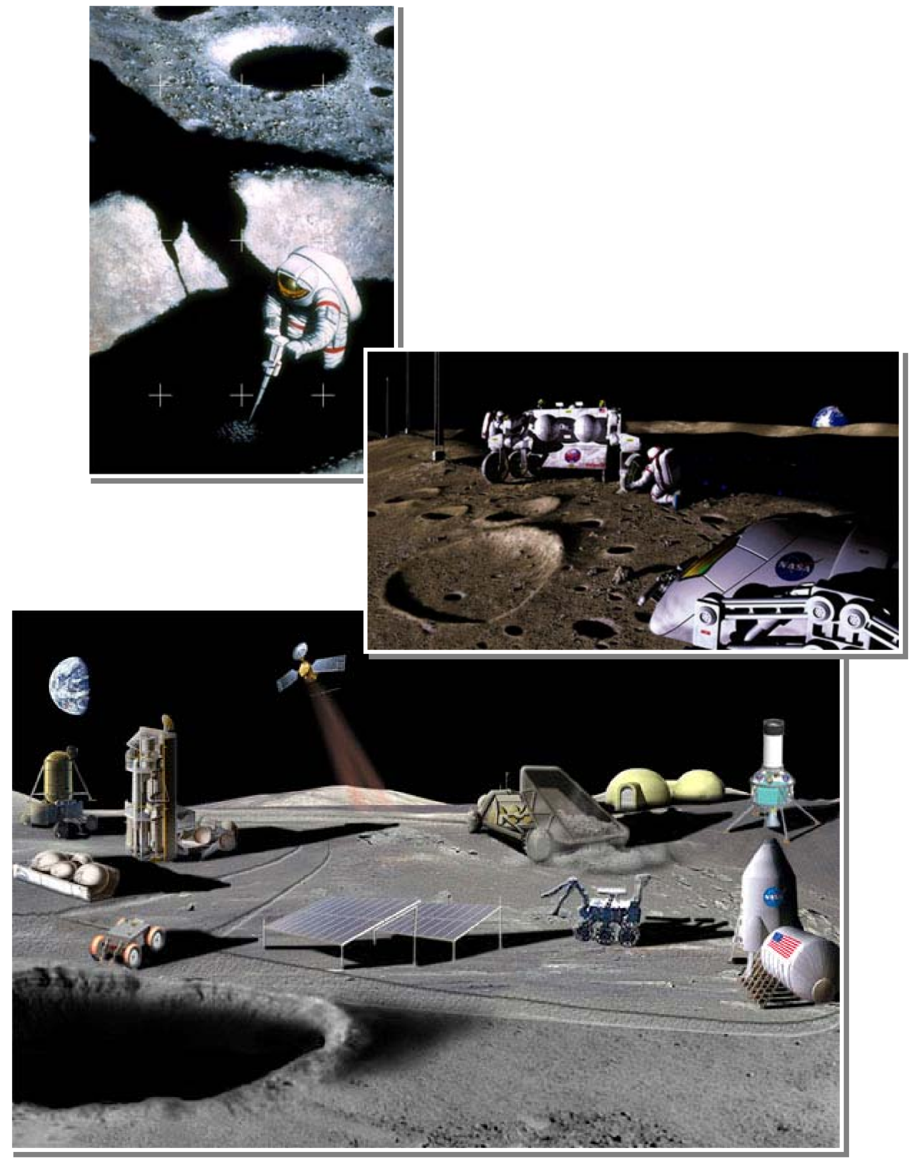
RLEP 2 Pre-Phase A Trade Studies & Assessments

- Determine Launch and Transit Approach
- Determine Lander Capability
- Determine Surface Mobility Solution
- Determine Navigation and Communication Approach
- Determine RLEP 2 Measurement Plan (Lander and Surface Mobility)
- Develop and evaluate life cycle cost, risk, and extensibility of the mission architecture
- Conduct technology assessment and identify funding offsets



RLEP 2 Pre-Phase A Deliverables

- ♦ **Mission Concept and Architecture Report**
- ♦ **Preliminary Programmatic and Technical Risk Assessment**
- ♦ **Technology Assessment Results**
- ♦ **CADRe Part A and Preliminary Part B**
- ♦ **Mission Life Cycle Cost and Funding Profile (Pre-Phase A fidelity)**
- ♦ **Integrated Master Schedule**
- ♦ **Detailed Phase A Plan**

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Create the Future