



Exploration Strategy Workshop

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A Bold Vision for Space Exploration



The Fundamental Goal of This Vision is to Advance U.S. Scientific, Security, and Economic Interest Through a Robust Space Exploration Program

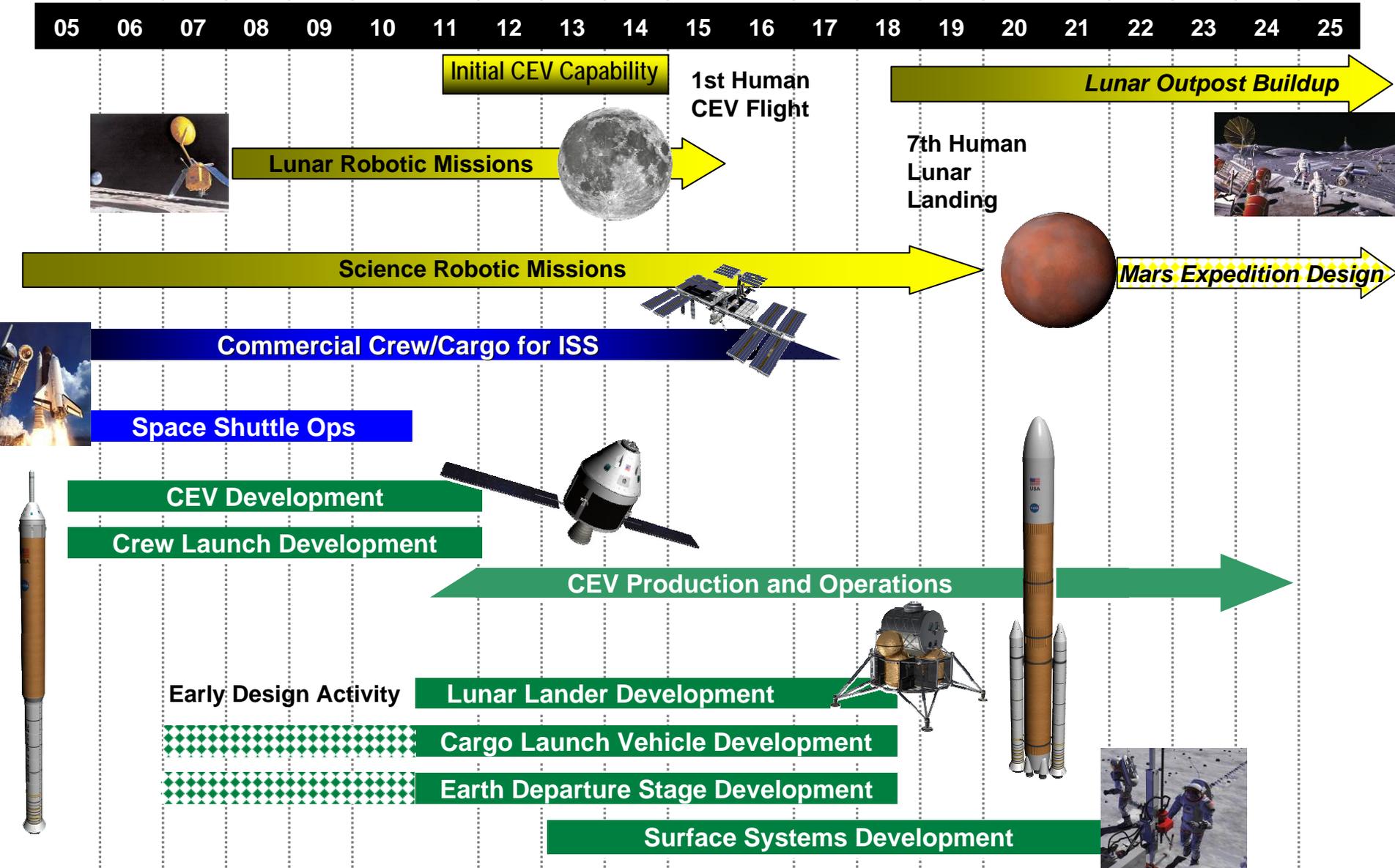
- Implement a sustained and affordable human and robotic program to explore the solar system and beyond
- Extend human presence across the solar system, starting with a human return to the Moon by the year 2020, in preparation for human exploration of Mars and other destinations;
- Develop the innovative technologies, knowledge, and infrastructures both to explore and to support decisions about the destinations for human exploration; and
- Promote international and commercial participation in exploration to further U.S. scientific, security, and economic interests.



NASA Authorization Act of 2005

The Administrator shall establish a program to develop a sustained human presence on the Moon, including a robust precursor program to promote exploration, science, commerce and U.S. preeminence in space, and as a stepping stone to future exploration of Mars and other destinations.

NASA's Exploration Roadmap



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



- **Extending operational experience in a hostile planetary environment**
- **Developing capabilities needed for opening the space frontier**
- **Preparing for human exploration of Mars**
- **Science operations and discovery**
- **Enabling national, commercial and scientific goals for the development and use of the moon**



Next Step in Fulfilling Our Destiny As Explorers

Components of NASA's Exploration Programs



- **Crew Exploration Vehicle (CEV)**
- **Crew Launch Vehicle/Heavy Lift Launch Vehicle (CLV/HLLV)**
- **Robotic Lunar Exploration Program (RLEP)**
- **RLEP Strategic Priorities**
- **Human Research & Technology Development**
- **Commercial**
- **Exploration Systems Mission Directorate Basic Tenets**

Crew Exploration Vehicle (CEV)



- **Command Module**

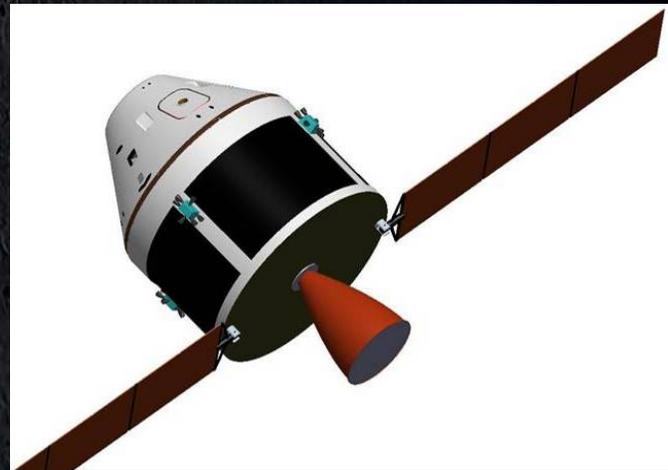
- Mold Line: Apollo-Derived Capsule
- Crew: 6 for ISS & Mars, 4 for Moon
- Size: 16.4 ft (5 Meter) Diameter
- Docking Mechanism: APAS or LIDS

- **Service Module**

- Propulsion: Industry Propose Best Solution
- Some Capability for Delivering Unpressurized Cargo

- **Ongoing Analysis**

- Impact of Reducing Volume
- Trading Functionality between Command and Service Module
- Eventual Migration to Non-Toxic Propellants



APAS – Androgynous Peripheral Attachment System

LIDS – Low Impact Docking System

Crew Launch Vehicle (CLV) *Cargo Launch Vehicle (CaLV)*



- **Crew Launch Vehicle**

- Single 5 segment RSRB/M 1st stage
- Upper stage powered by a single engine derived from the Saturn J-2

- **Cargo Launch Vehicle**

- Twin 5 segment RSRB/M 1st stage (from CLV)
- Core stage derived from the External Tank
- Powered by 5 RS-68 Engines
- CLV-derived avionics

- **Earth Departure Stage**

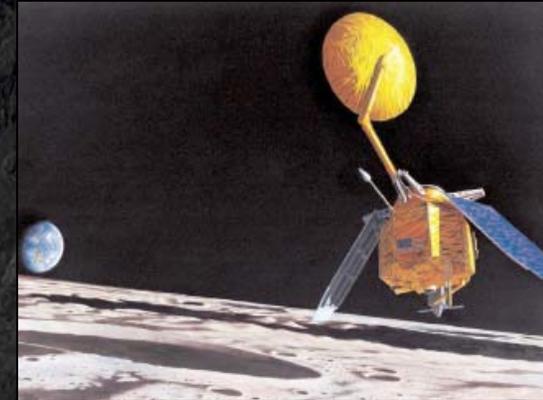
- Upper stage derived from the External Tank
- Powered by a single J-2 derived engine - 2 burn capability
- CLV-derived main propulsion systems and avionics



Robotic Lunar Exploration Program (RLEP)



- Provide early information for human missions to the Moon
- Evolvable to later human systems
- Most unknowns are associated with the North and South Poles – a likely destination for a lunar outpost
- Make exploration more capable and sustainable
- Key requirements involve establishment of
 - Terrain and surface properties
 - Knowledge of polar regions
 - Support infrastructure
- Lunar Reconnaissance Orbiter (LRO)
- Provides major scientific and exploration benefit by 2009
- Selected instruments complement other foreign efforts
- LRO launch planned for October 2008; one-year mission
- RLEP 2



RLEP Strategic Priorities



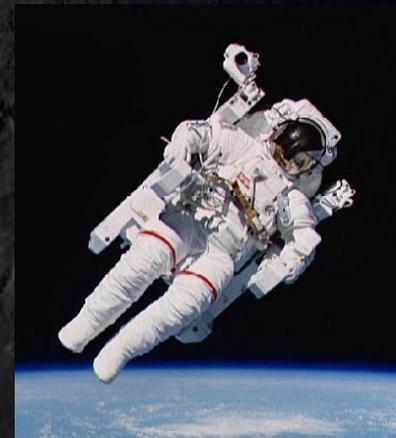
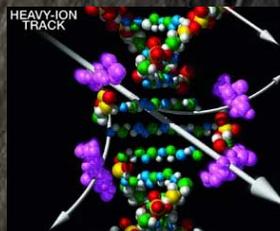
- **Good quality global map**
- **Altimetry for map overlay**
- **Resource distribution to overlay map**
 - Emphasis on identifying location / nature of excess hydrogen
- **Communication / navigation structure**
 - Early priority
 - Ensures future missions don't have to bring their own
- **Radiation environment**
- **Surface priority -- demonstrate prototypical ISRU**
 - Handling and loading regolith
 - Heating regolith
 - Driving oxygen out of regolith
 - Condensing regolith for storage

Human Research & Technology Development



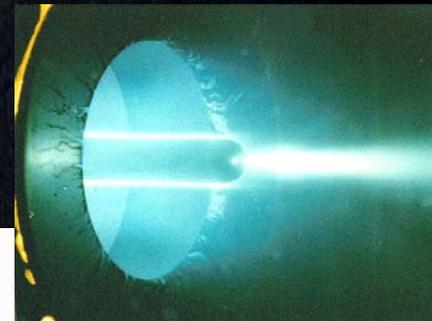
Human Research Major Areas of Investment

- Space Radiation Research
- Exploration Medical Capability
- ISS Research Capability
- Physiological Countermeasures
- Behavioral Health
- Human Factors and Environmental Standards



Technology Development

- Mature key technologies to support CEV, CLV, RLEP, and lunar sortie missions
 - Structures
 - Protection
 - Propulsion
 - Power
 - Thermal Control
 - Avionics & Software
 - Environmental Control & Life Support
 - Crew Support & Accommodations
 - Mechanisms
 - In-Situ Resource Utilization
 - Analysis & Integration
 - Operations





Centennial Challenges

- **Program of contests with cash purses to stimulate innovation and competition in technical areas of interest to space exploration and ongoing NASA priorities**
- **Four Categories of Challenges / Purses**
 - Flagship / Tens of Millions
 - Keystone / \$.5 - 1 Million
 - Alliance / up to \$250,000
 - Quest / Promote science, technology, engineering, and math (all ages)

Commercial Crew/Cargo Project

- **Challenge to U.S. industry to establish capabilities and services to open new space markets**
- **May eventually support the transportation needs of the ISS**
- **Phase 1 draft announcement released December 5, 2005**
- **Proposals due March 3, 2006**
- **Agreements expected to be awarded this summer**

ESMD Basic Tenets



- **Exploration beyond Low Earth Orbit -- Moon, Mars, & Beyond**
 - Not Mars Only --- Not Moon Only ---
 - Gain confidence through demonstrable progress
 - Moon, done well, will cement credibility & pave the way to Mars & beyond
- **Systems-level thinking & Integration are critical**
- **Embrace Change -- How we meet challenges will determine our future**
 - Must work as a team -- Engage the broader community
 - Change is hard -- accept that and move forward
 - Constructive dialogue is essential