Program Overview

March 2 - 3, 2004
Associate Administrator,
Office of Exploration Systems
Rear Admiral Craig E. Steidle (Ret.)

This Vision encompasses a broad range of human and robotic missions, including the Moon, Mars and destinations beyond

It establishes clear goals and objectives, but sets equally clear budgetary ‘boundaries’ by stating firm priorities and tough choices

It also establishes as policy the goals of pursuing commercial and international collaboration in realizing the new vision

Advances in Human and Robotic Technology will play a key role as enabler and major benefit of the new Vision...
The Vision for Space Exploration - National Benefits

Key Role of Innovation and Technology…

• Background
  – “…U.S. achievements in space…have led to the development of technologies that have widespread applications to address problems on Earth…”
  – “In preparation for future human exploration, we must advance our ability to live and work safely in space and, at the same time develop the technologies to extend humanity’s reach to the Moon, Mars and beyond. The new technologies required for further space exploration also will improve the Nation’s other space activities and may provide applications that could be used to address problems on Earth.

• Policy Objective (Technology)
  – “Develop the innovative technologies, knowledge, and infrastructures both to explore and to support decisions about the destinations for human exploration…

• National Benefits (Technology)
  – “Preparing for exploration and research accelerates the development of technologies that are important to the economy and national security. The space missions in this plan require advanced systems and capabilities that will accelerate the development of many critical technologies, including power, computing, nanotechnology, biotechnology, communications, networking, robotics, and materials.
  – “These technologies underpin and advance the U.S. economy and help ensure national security. NASA plans to work with other government agencies and the private sector to develop space systems that can address national and commercial needs.”
The Nation’s Vision

1. Return the Shuttle to safe flight as soon as practical, based on CAIB recommendations
2. Use Shuttle to complete ISS assembly
3. Retire the Shuttle after assembly complete (2010 target)
4. **Focus ISS research to support exploration goals; understanding space environment and countermeasures**
5. Meet foreign commitments
6. **Undertake lunar exploration to support sustained human and robotic exploration of Mars and beyond**
7. **Series of robotic missions to Moon by 2008 to prepare for human exploration**
8. **Expedition to lunar surface as early as 2015 but no later than 2020**
9. **Use lunar activities to further science, and test approaches (including lunar resources) for exploration to Mars & beyond**
10. **Conduct robotic exploration of Mars to prepare for future expedition**
11. **Conduct robotic exploration across solar system to search for life, understand history of universe, search for resources**
12. **Conduct advanced telescope searches for habitable environments around other stars**
13. **Demonstrate power, propulsion, life support capabilities for long duration, more distant human and robotic missions**
14. **Conduct human expeditions to Mars after acquiring adequate knowledge and capability demonstrations**
15. **Develop a new Crew Exploration Vehicle; flight test before end of decade; human exploration capability by 2014**
16. **Separate cargo from crew as soon as practical to support ISS; acquire crew transport to ISS after Shuttle retirement**
17. Pursue international participation
18. Pursue commercial opportunity for transportation and other services
Key Elements of the Nation’s Vision

• Objectives
  – Implement a sustained and affordable human and robotic program
  – Extend human presence across the solar system and beyond
  – Develop supporting innovative technologies, knowledge, and infrastructures
  – Promote international and commercial participation in exploration

• Major Milestones
  – 2008: Initial flight test of CEV
  – 2008: Launch first lunar robotic orbiter
  – 2011 First Unmanned CEV flight
  – 2014: First crewed CEV flight
  – 2015: Jupiter Icy Moon Orbiter (JIMO)/Prometheus
  – 2015-2020: First human mission to the Moon
Craig Steidle Background

- 1993 Secretary of Defense “Bottom-Up” Review
- Shut-down Navy Advanced Fighter (AF/X) program
- Shut-down Air Force Multi-Role Fighter (MRF) program
- Established Joint Advanced Strike Technology Office
- Established Advanced Short Take Off/ Vertical Landing program
Exploration Systems: Building on Past Findings and Lessons Learned

• Packard Commission Findings
  – Get operators and technologists together to enable the leveraging of cost-performance trades
  – Apply technology to lower cost of system, not just to increase its performance
  – Mature technology prior to entering engineering and systems development
  – Partnerships with Industry to identify innovative solutions

• Report of the DSB/AFSAB (Young Report)
  – Requirements definition and control are dominant drivers of cost, schedule, and risk in space systems development programs
Strategy-to-Task-to-Technology Process

Operational Environments
Available Technologies

Program
Mission
Engineering

Modeling/Simulation
Deficiencies
Required Features & Characteristics
Trade Studies

Nation’s Vision
NSPD
Science Objectives & Concepts of Operations
Mission Concepts & Requirements
Tasks & Technology Roadmaps

Affordable System Design & Development

Modeling & Simulation
Investment Plan

System Requirement Documents
History of Exploration Architecture Studies

- 1988 Case Studies
- 1989 Case Studies
- NASA 90-Day Study – 1989
- First Lunar Outpost – 1993
- Early Lunar Resource Utilization – 1993
- Human Lunar Return – 1996
- Mars Exploration Missions
- Mars Combo Lander-1999
- Dual Landers- 1999
- Decadel Planning Team/NEXT- 2000-2002
- Exploration Study 1 – 2002-2003
- Special Studies 2003
Requirements Division Organization

- **Requirements Division**
  - Provide overall direction and guidance to requirements capture process

- **Advisory Group**
  - Performs independent reviews of products

- **Systems Integration**
  - Defines component, system, architecture and logistics options and interfaces

- **Requirements Formulation**
  - Operators play key role in development of requirements
  - Space Logistician
  - Safety & Mission Assurance
  - ISS Crew
  - Flown Astronaut

- **Exploration Analyses**
  - Performs exploration mission/systems analyses
Requirements Capture Process

1. President’s Vision
2. Derived Requirements
3. System Options and Trade Studies
4. System Evaluation
5. Requirements Documents
6. Acquisition Plan

Cost, Perf, Risk, FOM

Refinement
Requirements and Technology Investment Flow

Requirements

OSS

OES

OBPR

Prometheus

Constellation

Spiral Development:

Boilerplate

Block I

Block II

Technology Investment Plan
Requirement Division FY04 Products

- Crew Exploration Vehicle (CEV) Level 1 requirements with supporting documentation (concept of operations, QFD analyses, technology assumptions, etc.)
- Lunar orbiter mission Level 1 requirements with supporting documentation
  - Technology guidelines, initial concepts, and use of existing hardware
- Lunar lander mission Level 1 requirements with supporting documentation
  - Technology guidelines, initial concepts, and use of existing hardware
- Prometheus Level 1 capability development requirements
- Integrated Agency capability and technology traceability assessment showing linkages from development activities to Space Architect’s space strategy
- Summary Report with supporting documentation
# CEV Requirements Development

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### Space Architect

- **Draft Level 0 Reqts**
- **JSAC Approved Level 0 Reqts**
- **JSAC Approved CEV 2008 Level 1 Reqts**

### Exploration Analyses

- **Architecture Definition**
- **BAA Awards**
- **BAA Responses**

### Exploration Systems Requirements

- **Implementation Plan Approved**
- **NGLT/OSP Transition**
- **Core Team Established**
- **CEV/Lunar Precursors/Prometheus Requirements Definition**
- **Demo Level 1 SRR**
- **Demo Level 2SRR**
- **Phase A CEV Concept Development RFP**
- **Phase A CEV Concept Development Awards**
Level 0/1 requirements are formulated within the requirements division with the help of an embryonic project team.

Project teams are transitioned and discipline engineers added to carry projects through remaining development cycle.

Coordination responsibility with other Enterprises
Development Programs Division

Strategic Analysis

Human & Robotic Technology
- Advanced Space Technology (TRL 2-5)
- Technology Maturation (TRL 3-6)
- SBIR

“Project Constellation” Exploration Transportation Systems
- Robotic Lunar Orbiters/Landers
- Crew Exploration Vehicle
- Launch Vehicle(s)
- Space Transportation Systems
- Supporting In-Space Systems
- Supporting Surface Systems

“Project Prometheus” Nuclear Systems Technology & Demo(s)
- Power Systems
- Propulsion Systems
- Jupiter Icy Moons Orbiter (JIMO)
- Mission Studies & Engineering Analysis

Coordination Responsibility with other Enterprises

Advanced. Development, Demonstration & Studies

TRL 2-6

TRL > 6

TRL 3-6
Development Division FY 04 Products

- Create Work Breakdown Structure (WBS) based on requirements for Exploration Systems
- WBS populated by re-aligned Advanced Space Technology, Technology Maturation, and NGLT demonstration technology projects plus OSP lessons-learned
- Investment Plan based on WBS gap analysis
- Single Acquisition Management Plan Framework to include:
  - Key Performance Parameters (KPPs), and Operational Thresholds and Objectives
  - Spiral Development Objectives and Milestones
  - Acquisition Strategy/Acquisition Program Baseline (APB)
  - Performance-Based measures for cost, schedule & performance
    - Integrated Baseline Reviews, EVMS tracking, Risk Analysis and Mitigation, Entrance/Exit Criteria…
Current Development Programs Status

- Vision, mission and goals formulated
  - Consistent with National vision
- FY04 objectives in review
  - Organizational structure being finalized
  - Staffing underway
- Program-level Work Breakdown Structure in development
  - Participation by all Code T divisions
- Advanced Space Technology, Technology Maturation and NGLT projects being re-aligned
  - Focused on Transportation System elements
- Program management processes, tools and metrics being evaluated for ensuring on-cost, on-schedule & on-performance
  - Integrated Baseline Reviews, EVMS Tracking, Technical Performance Measurement, Critical Path Method, etc.
- Major events for Spiral 1 being determined
  - Milestones A and B
  - SRR / SFR / PDR / CDR
Business Operations Division

- Institutionalize disciplined and repeatable business planning and management framework
  - Complements Requirements Division and Development Programs Division activities
  - Provides resources, business acumen, tools, and communication networks to execute exploration systems mission

- Hybrid staff/line unit continuously engaged and equally accountable for mission success
Business Operations Division Competency Areas

- **ACQUISITION STRATEGY**
  - Formulation, Review & Approval Process
  - Best Practices and Lessons Learned
  - Tools and Training

- **PROGRAM AND BUSINESS AUTHORIZATIONS**
  - Acquisition Plans, D&Fs, Solicitation Content Keyed to Developmental Spirals, Incentivization Construct, Business Clearance

- **BUDGET ANALYSIS AND ALLOCATION**
  - Enterprise Budget Formulation and Substantiation
  - Execution Planning and Performance to Goal Measurement

- **ENTERPRISE WORK FORCE UTILIZATION**
  - Efficient and Cost Effective Application of Human Capital

- **INTEGRATED PROGRAM ASSESSMENT MEASUREMENT**
  - Disciplined and Accurate Performance, Cost, Affordability and Schedule Indicators
  - Baselining and Uniform Reporting to Facilitate Trade-off Decisions

- **INFORMATION MANAGEMENT AND DISSEMINATION**
  - Electronic, Written and Face-to-Face Communication with all Stakeholders

**THRUST: SEAMLESS & RESPONSIVE BUSINESS PROCESSES**
**THAT BROKER REQUIREMENTS INTO PROGRAM EXECUTION**

24
Business Operations Division FY04 Products

- **Acquisition strategy & business formulation**
  - Enterprise system single acquisition and management plan (SAMP)
  - Conduct Industry and stakeholder roundtables
  - Head of Contracting Activity (HCA) delegations of authority to AA

- **Resource management**
  - Disciplined funds obligation & cost execution
  - Enterprise workforce business case assessment

- **Program assessment**
  - Integrated program & financial management module (EVMS)

- **Information management & dissemination**
  - Automated presentation archive & retrieval system, education plan, web site...
Overview and Goals for Centennial Challenges

• **What Is Centennial Challenges?**
  – Program of contests in which NASA will establish prize purses to stimulate innovation and competition in technical areas of interest to space exploration and ongoing NASA priorities.

• **Program Goals for Centennial Challenges**
  – Stimulate innovation in ways that standard federal procurements cannot
  – Enrich NASA research by reaching new communities
  – Help address technology pitfalls
  – Achieve returns that outweigh program investment
  – Educate, inspire and motivate the public
“Prehistory” of Centennial Challenges

• Long History of Prizes for Technological Innovation
  – 18th Century: British Longitude Prize
  – 20th Century: Aviation prizes including Orteig Prize (Lindberg)
  – Ongoing: X-Prize and DARPA Grand Challenge

• 1999 National Academy of Engineering Workshop
  – “Concerning Federally Sponsored Inducement Prizes in Engineering and Science,” 1999
  – Blue ribbon committee recommended that “Congress encourage federal agencies to experiment more extensively with inducement prize contests in science and technology”

• 2003 NASA Space Architect Study
  – X-Prize Foundation assisted
  – Interviews at field centers and headquarters generated list of 129 candidate challenges
  – Winnowed to 15 candidate challenges based on enterprise interests and other considerations
  – Estimated purse sizes and expected time to completion
  – Formed basis for Centennial Challenges program formulation
Program Assumptions for Centennial Challenges

• Challenges Will Address NASA Vision With Emphasis on Exploration
  – To Improve Life Here
  – To Extend Life to There
  – To Find Life Beyond
  – Lean program with low overhead to preserve funding for challenges

• Program Plan and Individual Challenges To Be Finalized After External Inputs
  – Spring workshop to solicit external challenge ideas and refine best candidates
  – Website, including listserv and form for submitting challenge ideas
  – Press announcement on workshop and website expected shortly

• Challenges Will Be Initiated on Annual Cycles
  – FY 2004 cycle limited to existing authority ($250K or less purses)
  – FY 2005 and later cycles to include larger purses (2005 NASA authorization bill)
  – Repeat workshops annually and solicit external ideas
Centennial Challenges Frequently Asked Questions

• What Kinds of Challenges?
  – Revolutionary advances in fundamental technologies
  – Breakthrough robotic capabilities
  – Very low cost space missions
  – Final challenges subject to external inputs and internal review and decisions

• Who Can Participate?
  – U.S. citizens who are not federal employees (including FFRDCs) unless otherwise specified in challenge rules
  – Industry, academia, non-profits, students, individuals
  – Contestants will be required to register

• How Can I Help?
  – Word of Mouth: Challenges improve with number and quality of contestants
  – Expertise: Help with rules formulation and judging
Exploration Systems 2004 Objectives

- Obtain OSP/NGLT Government/Industry lesson’s learned
- Bring Level 1 Constellation (CEV) and Prometheus requirements to SRR maturity
- Complete 1st round of Industry Concept Studies
- Complete preliminary requirements analysis
- Perform detailed technology assessments and baseline reviews
- ID high payoff areas for TM investment
- Competitively award follow-on Project Prometheus JIMO contract
- Hold several Industry Days
- Complete charter and 1st draft of exploration systems master plan
- Initiate risk mitigation plans
- Formulate acquisition strategy and initial acquisition plan
- Formulate demonstration plan
We’re not where we want to be,  
We’re not where we’re going to be,  
**BUT** we’re certainly not where we were yesterday.

*M.L. King, Jan ‘68*