AIAA Commercial Space Group

Meeting #7
AIAA Space 2009

Mike Beavin

Augustine Commission Members

Chairman

- **Norman R. Augustine**
  Retired Chairman and CEO, Lockheed Martin Corp.

Members

- **Dr. Wanda M. Austin**
  President and CEO of The Aerospace Corp.
- **Bohdan Bejmuk**
  Chair of Constellation program Standing Review Board
- **Dr. Leroy Chiao**
  Former Astronaut
- **Dr. Christopher Chyba**
  Professor of Astrophysical Sciences and International Affairs, Princeton University
- **Dr. Edward F. Crawley**
  Ford Professor of Engineering at MIT
- **Jeff Greason**
  Co-founder and CEO of XCOR Aerospace
- **Dr. Charles F. Kennel**
  Chair of National Academies Space Studies Board
- **General (ret.) Lester L. Lyles**
  Chair of National Academies Committee on the Rationale and Goals of the U.S. Civil Space Program
- **Dr. Sally Ride**
  Former Astronaut
- **Phil McAlister:** Executive Director

Review of U.S. Human Space Flight Plans Committee

- The U.S. human spaceflight program appears to be on an unsustainable trajectory.
- Whatever space program is ultimately selected, it must be matched with the resources needed for its execution.
- There are more options available today:
  - First, space exploration has become a global enterprise.
  - Second, there is now a burgeoning commercial space industry.

Key Questions

The Committee identified the following questions that, if answered, would form the basis of a plan for U.S. human spaceflight:

1. What should be the future of the Space Shuttle?
2. What should be the future of the International Space Station (ISS)?
3. On what should the next heavy-lift launch vehicle be based?
4. How should crews be carried to low-Earth orbit?
5. What is the most practicable strategy for exploration *beyond low-Earth* orbit?

Future Destinations

- **Mars First:** with a Mars landing, perhaps after a brief test of equipment and procedures on the Moon.
- **Moon First:** with lunar surface exploration focused on developing the capability to explore Mars.
- **Flexible Path:** to inner solar system locations, such as lunar orbit, Lagrange points, near-Earth objects and the moons of Mars, followed by exploration of the lunar surface and/or Martian surface.
- The Committee finds that both Moon First and Flexible Path are viable exploration strategies. It also finds that they are not necessarily mutually exclusive.

Options for the Human Spaceflight Program:

- The Committee developed five alternatives for the Human Spaceflight Program.
- Human exploration beyond low-Earth orbit is not viable under the FY 2010 budget guideline.
- Meaningful human exploration is possible under a less constrained budget, ramping to approximately $3 billion per year above the FY 2010 guidance in total resources.
- Funding at the increased level would allow either an exploration program to explore Moon First or one that follows a Flexible Path of exploration. Either could produce results in a reasonable timeframe.

The Committee believes an exploration program that will be a source of pride for the nation requires resources at such a level.

Integrated Program Options

- The committee was asked to provide two options that fit within the FY 2010 budget profile.
  - Option 1. Program of Record as assessed by the Committee, constrained to the FY 2010 budget.
  - Option 2. ISS and Lunar Exploration, constrained to FY 2010 budget.
- The remaining three alternatives are fit to a different budget increased to $3 billion by FY 2014, then growing at 2.4 percent per year.
  - Option 3. Baseline Case —Implementable Program of Record
  - Option 4. Moon First with variants A & B
  - Option 5. Flexible Path with variants A, B & C

Committee finds that no plan compatible with the FY 2010 budget profile permits human exploration to continue.

Integrated Program Options - Table

	Budget	Shuttle Life	ISS Life	Heavy Launch	Crew to LEO
Constrained Options					
Option 1: Program of Record (constained)	FY10 Budget	2011	2015	Ares V	Ares I + Orion
Option 2: ISS + Lunar (constrained)	FY10 Budget	2011	2020	Ares V Lite	Commercial
Moon First Options					
Option 3: Baseline - Program of Record	Less constrained	2011	2015	Ares V	Ares I + Orion
Option 4A: Moon First - Ares Lite	Less constrained	2011	2020	Ares V Lite	Commercial
Option 4B: Moon First - Extend Shuttle	Less constrained	2015	2020	Directly Shuttle Derived + refueling	Commercial
Flexible Path Options					
Option 5A: Flexible Path - Ares Lite	Less constrained	2011	2020	Ares V Lite	Commercial
Option 5B:Flexible Path - EELV Heritage	Less constrained	2011	2020	75mt EELV + refueling	Commercial
Option 5C: Flexible Path - Shuttle Derived	Less constrained	2011	2020	Directly Shuttle Derived + refueling	Commercial

Note: Program-of-Record-derived options (Options 1 and 3) do not contain a technology program; all others do.

Backup Slides

Current Programs

- **Space Shuttle**
  - Most options presented retire the Shuttle after a prudent flyout of the current manifest. However, one option does provide for an extension of Shuttle at a minimum safe flight rate.
- **International Space Station**
  - The strong and tested working relationship among international partners is perhaps the most important outcome of the ISS program.
- **Constellation Program**
  - Ares I launch vehicle
  - Ares V heavy-lift launch vehicle
  - Orion capsule
  - Altair lunar lander and lunar surface systems

Capability For Launch

- **Heavy-Lift Launch to Low-Earth Orbit and Beyond:**
  - Potential approaches to developing heavy-lift vehicles are based on NASA heritage (Shuttle and Apollo) and EELV (evolved expendable launch vehicle) heritage.
- **Crew Access to Low-Earth Orbit**
  - Two basic approaches: a government-operated system and a commercial crew-delivery service.
- **Lowering the cost of space exploration**
  - The Committee concluded that an architecture for exploration employing a policy of guaranteed contracts has the potential to stimulate a vigorous and competitive commercial space industry.

Organizational Issues

- The NASA Administrator needs to be given the authority to manage NASA's resources, including its workforce and facilities.
- NASA should be given the maximum flexibility possible under the law to establish and manage its systems.
- Significant space achievements require continuity of support over many years.
- NASA and its human spaceflight program are in need of stability in both resources and direction.

Key Findings - continued

- **The right mission and the right size:** NASA's budget should match its mission and goals.
- **International partnerships:** The U.S. can lead a bold new international effort in the human exploration of space.
- **Short-term Space Shuttle planning:** The current manifest will likely extend to the second quarter of FY 2011.
- **The human-spaceflight gap:** Under current conditions, the gap will stretch to at least seven years. The Committee did not identify any credible approach employing new capabilities that could shorten the gap to less than six years. The only way to significantly close the gap is to extend the life of the Shuttle Program.
- **Extending the International Space Station:** The return on investment to both the United States and our international partners would be significantly enhanced by an extension of ISS life.

Key Findings - continued

- **Heavy-lift:** A heavy-lift launch capability to low-Earth orbit is beneficial to exploration, and it also will be useful to the national security space and scientific communities.
- **Commercial crew launch to low-Earth orbit:** Commercial services to deliver crew to low-Earth orbit are within reach.
- **Technology development for exploration and commercial space:** Investment in a well-designed and adequately funded space technology program is critical to enable progress in exploration.
- **Pathways to Mars:** Mars is the ultimate destination for human exploration; but it is not the best first destination. Both visiting the Moon First and following the Flexible Path are viable exploration strategies.