

**Augustine Committee on the Future of Human Space Flight**  
**Public Meeting**  
**August 5, 2009**

The fifth public meeting of the Augustine committee deliberating options for the future of the human space flight program was held on August 5, 2009 in Washington, D.C. It was a half-day meeting. The committee heard presentations from the following :

- Jack Marburger, former science adviser to President George W. Bush and a key participant in developing the Vision for Space Exploration;
- Bob Zubrin, a champion of sending humans to Mars immediately, with no stops on the Moon or elsewhere in between;
- representatives of four National Research Council “decadal surveys” in different space science disciplines (biological and physical sciences in space, earth science and applications from space, astronomy and astrophysics, and planetary exploration);
- Jean-Yves Le Gall, President of Europe’s launch services company Arianespace; and
- Mark Kinnersley, Director of Business Development, EADS ASTRIUM (a European aerospace company)

Those presentations were followed by committee member Ed Crawley’s explanation of the progress made in beginning to narrow the options that the committee will present to the White House and NASA. All of the presentations are available on the committee’s website: <http://hsf.nasa.gov>.

**Dr. Marburger and the Vision for Space Exploration**

The day started with a somewhat surprising presentation by Dr. Marburger, who offered his version of the origin of President Bush’s Vision for Space Exploration. This glimpse into the past revealed significant differences between his views as the President’s science adviser versus those of Sean O’Keefe’s NASA. In fact, the two appear to be almost polar opposites. Dr. Marburger advocates humans in space only for those activities that cannot be accomplished robotically, a far cry from the “boots on the Moon by 2020” imperative of the policy President Bush ultimately announced.

He contrasted the “NASA view” and the “White House view” (apparently meaning that of his Office of Science and Technology Policy, which is part of the Executive Office of the President), and sounded somewhat bitter when stating “It would be a mistake to assume that the actual development path for space exploration since 2004 has accurately reflected the overall concept of the Vision.”

Dr. Marburger used his visit with the Augustine committee as an opportunity to share publicly the responses he made in September 2003 to questions posed by then-White House Chief of Staff Andrew Card about the future of human space flight in the wake of the space shuttle *Columbia* tragedy. Reading from that text (now available on the Augustine committee’s website), he began by asserting his own vision for future space exploration: “Our vision is to understand, as far as humanly possible, the universe beyond Earth’s immediate vicinity, and to use that knowledge to improve the quality of life, in every aspect, of all people.” He then delineated the value of space technology for national security, economic gain, and science, and

the ultimate need for “large structures beyond Earth’s orbit” to enhance the use of space for those purposes. He said that “imaginative schemes” proposed to build such structures are “impractical today” and laying the groundwork to realize those schemes “is the task of our generation.”

He believes that human space flight’s only tangible contribution is understanding the effects of weightlessness on humans because astronauts might be needed to assemble and service such “remote facilities.”

*Future desirable large scale operations in space, such as resource exploitation, climate control, and solar energy schemes, will probably exceed the capacity of robotic systems for independent operations. Under these circumstances, human participation can be justified and will probably be required. Until the costs and risks of human participation are better understood and controlled, however, the establishment of goals for such large scale operations is a futile exercise. The necessary human-oriented studies, which involve placing humans in a weightless environment, can be carried out simultaneously with continued robotic operations throughout the Solar System.*

He acknowledged intangible contributions to society from human space flight, but overall he advocated a step-by-step approach introducing “human capabilities only as appropriate, keeping in mind that the ultimate goal is to permit humans to operate routinely on missions **where they are needed.**” (emphasis added)

Dr. Marburger concluded the recap of his September 2003 responses by saying that his view of the future was compatible with a reduction in the human space flight program and “extensive robotic exploration of the Moon, potentially followed by the construction of a permanent lunar base whose objective is resource exploitation possibly for economic gain and to use the material to facilitate further expansion of human exploration deep into the solar system.” He stressed that he did not advocate setting specific dates.

*The pace of advance will be dictated by the level of resources devoted, but a range of budgets permits continued progress.... **No date should be established for humans to return to the Moon or Mars. The rate of advance away from the Earth should be dominated by budget and technical progress—and by no calendar but the winding of the planets along their eternal paths.***  
(emphasis added)

After reading the September 2003 statement, Dr. Marburger added that the only thing he would change today would be adding more about the importance of commercial space enterprises, and of the need for a sustained effort. He added: “That deficiency was remedied in the final version of the policy, but has been neglected in execution.”

In conclusion, he told that committee that –

*“In my opinion the all-encompassing scope of the vision we advanced was diminished in the final policy by specific mention of Mars as a target, and the immediate path forward was burdened by deadlines and difficult budget issues. Our view was pragmatic and conservative with respect to human operations, but vast beyond any scenario since von Braun’s in its view of a future in which the entire solar system is opened to the service of humanity.”*

## Science Briefings

Scientists representing four of the five NRC space science decadal surveys summarized the status of their studies and, where appropriate, their conclusions. Three decadal surveys are currently underway: biological and physical sciences in space, astronomy and astrophysics, and planetary exploration. The fourth that was discussed, earth science and applications from space, was published in 2007. The fifth is on solar and space physics, and was not on the agenda.

Betsy Cantwell, co-chair of the ongoing decadal on biological and physical sciences in space, stressed that the International Space Station (ISS) holds significant promise as a research laboratory now that it is capable of sustaining a 6-person crew. She explained that it is the only research facility that can make low gravity available on a continuous basis. That is critical to research necessary to safely send humans on long duration missions beyond low Earth orbit.

Tony Janetos, who briefed the committee about the earth sciences decadal, was the only one of the four who concluded that human space flight had very little relevance to his discipline.

Marcia Rieke briefed the committee on the ongoing astronomy and astrophysics decadal survey, commenting that the community is “grateful” for the role astronauts played in servicing the Hubble Space Telescope. She also cited the retroreflectors emplaced by the Apollo astronauts on the Moon as another example of where the astronomy community has benefitted from human exploration. She cautioned that the astronomy community is not demanding humans in space, however, it would likely take advantage of any opportunities that developed, perhaps in servicing future telescopes at the L2 Lagrange point (where the James Webb Space Telescope will be positioned).

Steve Squyres brought the committee up to date on the planetary sciences decadal, which is just beginning. Dr. Squyres is the “father” of the two robotic rovers, Spirit and Opportunity, that have been exploring Mars for more than four years. He commented that while most planetary exploration missions would not benefit from human presence, one subset would – “missions to the surfaces of solid bodies whose surface conditions are not too hostile to humans.” He listed those as the Moon, Mars and some asteroids. He argued that robots and humans each have advantages and disadvantages and they should be used together in the most effective manner. “Humans have extraordinary ability to function in complex environments, to improvise, and to respond quickly to new discoveries. Robots, in contrast, do best when the environment is simple and well understood, and the scientific tasks are well defined in advance.” The tasks accomplished by Spirit and Opportunity in a day, for example, could be completed by a human in less than a minute, he said.

### Zubrin, Le Gall, and Kinnersley

Mr. Zubrin’s presentation is well known within the human space flight community. He is an ardent advocate of a focused program to send humans to Mars in 10 years. He provided his own technical evaluation of what is needed to accomplish such a mission in such a relatively short period of time.

Mr. Le Gall expressed the interest of his company to participate in future exploration missions, reminding the committee that Ariane V was originally designed to be human-rated. That part of Europe’s program (the Hermes spaceplane) was cancelled, however, and Ariane V would have to be recertified for human space flight if desired.

Mr. Kinnersley discussed Europe's Automated Transfer Vehicle (ATV) and its role in providing logistics for the ISS. It currently can take cargo to the ISS, but not return anything to Earth, although there are discussions about building a version that could provide such a "down mass" capability. He stressed that it takes three years to build an ATV, so if the United States wants Europe to provide more than what is currently in the plan, it should make a decision soon. He also noted that his company has just become the operator of Europe's Columbus module on the ISS, and looks forward to future opportunities to play an operational role in human space flight.

### **Committee Deliberations – Narrowing the Options**

The committee spent its last hour and a half listening to committee member Ed Crawley explain the current status of winnowing the various options before the committee into a subset for which cost and schedule estimates could be developed by NASA and the Aerospace Corporation.

Committee chair Norm Augustine opened the session by noting that based on what had been briefed to the committee the previous week, there were over 3,000 separate combinations available. In the days between the July 30 public meeting and this one, the leaders of the subteams (Augustine, Crawley, Lyles, Ride, and Behmuk) had narrowed it down to 864, and from there to the list of seven presented at this meeting.

Dr. Crawley's Powerpoint [presentation](#) is available on the committee's website and should be consulted for the complex details it contains. As the committee began to discuss the options, it became clear that nuances and caveats applied to each one and a much larger number of options are still in play.

The seven options he listed are:

- Baseline Derived from Program of Record (the existing Constellation program)
- ISS Focused
- Dash Out of LEO
- Use Shuttle Systems
- Deep Space
- Lunar Global, and
- Mars First

All of the options start with the assumption that the current schedule of space shuttle missions cannot be completed in Fiscal Year (FY) 2010, and the program will slip into FY2011. During the previous week's deliberations, Sally Ride stated that \$1.2 billion would be needed in FY2011, which is not currently in the President's budget.

Two of the seven options would retain 2015 as the date for terminating ISS, while five would extend it to 2020.

The other differences are:

- the extent to which the plan would rely on International Partners (IP), the U.S. Government, and/or the commercial sector to take astronaut crews to and from the ISS in low Earth orbit (LEO)
- whether NASA would continue to develop the Ares V heavy lift launch vehicle or switch to an alternative directly derived from the space shuttle or derived from the Atlas V or Delta IV Evolved Expendable Launch Vehicles (EELVs)
- whether building an orbital refueling depot is necessary or not

- whether the first destination beyond low Earth orbit should be
  - short (sortie) missions to the lunar surface and a lunar outpost
  - “free space” destinations such as Lagrange (L) points, lunar orbit, or asteroids (Near Earth Objects – NEOs)
  - “free space” destinations such as Lagrange (L) points, lunar orbit, or NEOs plus flying past another planet
  - short missions to the lunar surface followed by extended stays there, or
  - Mars, with the Moon used only for test flights of equipment needed for Mars
- whether the commercial sector should provide only cargo services to the ISS (COTS), or both crew and cargo services

The final scheduled public meeting of the committee is August 12, where it is expected to debate a further narrowed list of options.