

**Testimony of**

**Norman R. Augustine**

**Before the**

**Subcommittee on Science and Space**

**Committee on Commerce, Science and Transportation**

**United States Senate**

**On Behalf of**

**The Review of U.S. Human Spaceflight Plans Committee**

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**Washington, DC**

**September 16, 2009**

Mr. Chairman and Members of the Subcommittee, thank you for this opportunity to share with you the principal findings of the Review of the U.S. Human Spaceflight Plans Committee. I will speak on behalf of the members of our committee and will do my best to reflect our consensus views. As you are aware, our final report has not yet been published; however, our decision-making deliberations were all conducted in public under FACA rules so I believe what I have to say will come as no surprise to anyone.

First, I would like to acknowledge the contributions and extraordinary effort of each of my colleagues on the Committee. Their names and primary affiliations are appended to this statement. I would also like to acknowledge the forthright, responsive and highly professional support we received from NASA as well as from the Aerospace Corporation, the latter of which the Committee employed to provide independent technical and cost assessments.

The Committee was comprised of ten members having highly diverse backgrounds. It included astronauts, scientists, engineers, former presidential appointees, business executives, educators and an Air Force retired General Officer—each with considerable space experience. Due to the exigencies of the budget process we were asked to complete our task in ninety days—which we did, with the exception of finalizing and printing our report. The latter will be available soon.

Our assigned task was to identify alternative courses that the U.S. might pursue in the area of human spaceflight. One such alternative, of course, is to continue the present program. As noted in the Committee's report, changes to ongoing programs are generally warranted only for compelling reasons. Each alternative identified by the Committee is accompanied by a discussion of its strengths and weaknesses.

It was agreed that at least two of the alternatives would be compatible with the FY '10 budget plan extended through FY '20. We were also asked to examine the current plans for the Space Shuttle and International Space Station and, if appropriate offer alternatives thereto. It is important to note that we specifically were not asked to make a *recommendation* as to a future course of action. That decision is, of course, the purview of the President and the Congress.

Before addressing destinations and architectures the Committee sought to identify appropriate goals for human spaceflight. There are many possibilities that can be cited: strengthening the economy, conducting science, repairing and upgrading spacecraft on orbit, promoting international ties, protecting against asteroids and comets, encouraging science education, and more. It is, however, the Committee's view that although each of these benefits is important in its own right, none can, by itself, justify the cost and risk of human spaceflight. Rather, the *raison d'être* for such activity must, and in our view can, be founded upon charting a course for the expansion of civilization into the solar system. In so doing, one derives the leadership benefits of being among the world's space-faring nations—a nation that is committed to exploration, seeking knowledge, advancing engineering capabilities, inspiring its citizens, and motivating its young people to consider careers in science and engineering. To a not inconsiderable degree it is

intangibles that justify the human spaceflight program, intangibles such as those that today help maintain America as a leader among the world's nations. The Apollo Program is an appropriate example.

In carrying out the charge to identify options the Committee narrowed over 3,000 theoretically possible outcomes to a set of five alternative integrated space programs. These can be thought of as representative families, since one can interchange certain elements among the individual alternatives. The Committee's attempt was, of course, to keep the number of nominal options to a manageable size.

The alternatives offered include the ongoing program, Constellation—that is, the Program of Record and the Budget of Record—and four primary alternatives, some having derivatives or “sub-cases.”

Two of the five alternatives were in fact constrained to the current budget profile for human spaceflight. The first of these was the Program of Record; that is, today's program, modified to fly-out the Shuttle in 2011 rather than 2010 and including sufficient funds to de-orbit the International Space Station (ISS) in 2016 according to plan. Under this existing approach the Ares I launch vehicle and Orion capsule are unlikely to become available until after the ISS has been de-orbited. The heavy-lift vehicle, Ares V, would, in our judgment, become available in the late 2020's; however, there are inadequate funds to develop the exploration systems the Ares V is intended to support. The Committee concludes that this is not an executable option due to the incompatibility of the budget plan and the program plan.

The Committee's review noted that the Constellation Program has encountered technical difficulties of the type not unexpected of undertakings of this magnitude—problems which, given adequate funds and engineering attention, should be solvable. This was not, however, a significant factor in the overall conclusion with respect to the viability of the Program of Record.

The second of the options, also constrained to the current budget profile, flies-out the Shuttle in FY '11, but extends the use of the International Space Station for five years, to 2020. This option includes a robust technology development program—something the Committee believes has been lacking at NASA in recent years—and relies on commercial firms to launch cargo and crews to the ISS as soon as demonstrated capabilities exist. It includes development of a somewhat less capable version of the Ares V, known as the Ares V (Lite). This option is deemed capable of execution but cannot provide the space-borne hardware required to support a viable exploration program. In fact, the Committee could find no program within the current budget profile that would enable a viable exploration effort.

Given these findings, the Committee examined three options that exceeded the present budget plan. The most defensible funding profile, purely from a program execution standpoint, is one that linearly increases to \$3B above the FY '10 guidance by FY '14 and then increases by an estimated annual inflation rate of 2.4 percent.

The first of these budgetarily less constrained options is termed the Baseline Case. It is the present Program of Record with funds added to extend Shuttle operations into 2011 and, as now provided in the budget plan, to de-orbit the ISS in 2016. This program would permit a human return to the moon in the mid '20's and begin laying the groundwork for a flight to Mars.

The second of the budgetarily less constrained cases is actually a family of variants that would extend ISS operations to 2020, provide funds for its de-orbit, and fund a strong technology program in support of ISS utilization and an eventual human landing on Mars. It would use commercial launch services for new access to low-earth orbit. There are, however, significant differences between the two variants under this option. The first of these variants would develop the Ares V (Lite) to support a human lunar landing in the mid 2020's—after which focus would turn to a human Mars landing. The second variant would extend the use of the (recertified) Space Shuttle to 2015 and be accompanied by the development of a Shuttle Directly-Derived heavy-lift vehicle in place of the Ares family—with the eventual possibility of in-orbit refueling. This is the only practicable option the Committee could find to close the at least five-year gap during which the U.S. will, as currently planned, rely upon Russian launch services to lift U.S. astronauts to the International Space Station.

The third budgetarily less constrained case follows a rather different path of exploration from that heretofore pursued by the U.S. The Committee terms this option the “Flexible Path” and defines it as achieving periodic milestones prior to a Moon or Mars landing. These initial accomplishments could include a lunar fly-by, a Mars fly-by, a visit to a Lagrange point, an asteroid rendezvous, and possible landings on the moons of Mars, Phobos and Demos.

In summary, with the existing budget plan it would be reasonable to extend the use of the ISS for five years and to conduct a robust technology development program. The Committee concludes that no rational exploratory program can be funded under the existing funding constraint and that plans for America's space exploration program would de facto be halted and human operations limited to low earth orbit.

With the less constrained budget option, requiring approximately \$3B per year in additional funding, a sound exploration program could be conducted. The reason for this seemingly “dead space” between the two budget options is, simplistically stated, that for sixty percent of the needed funds, one cannot go sixty percent of the way to Mars.

Each of the implementable options that was identified has its own set of benefits and liabilities that the Committee has sought to address. The findings of this effort are discussed in the Summary Report. The assessment gives overarching priority to safety and, as is noted in the Summary Report, the Committee believes considerable caution is in order when comparing analytical results in this area with flight results. Similarly, the Committee has sought to be conservative in its cost estimation practices—reflecting dissatisfaction with historical experience on a broad spectrum of programs. Finally, in

defining a “Program of Record” the Committee has relied upon NASA’s current program plan and the President’s budget profile, the latter as provided by the Office of Management and Budget.

In the opinion of this Committee, as well as that of most of the persons with whom the Committee has had contact, NASA has for too long sought to operate in an environment where means do not match ends. In the unforgiving arena of human spaceflight this is a particularly hazardous policy to embrace.

The Committee also notes that NASA has become a mature organization, an organization long protected from restructuring Centers, facilities and personnel cadres. The consequence is an organization with high fixed costs of the type that make budgetary options highly limited. While NASA is unarguably the finest space organization in the world and a great national asset, it is overdue for a thorough management assessment of the type the aerospace industry underwent at the end of the Cold War.

The Committee’s report will contain more detailed information that it hopes will prove of value. On behalf of my colleagues, I thank you for the trust that has been placed in us to review a pursuit which for decades has come to be a symbol of America’s leadership.

## U.S. HUMAN SPACE FLIGHT PLANS COMMITTEE MEMBERS

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**NORMAN R. AUGUSTINE** was raised in Colorado and attended Princeton University where he graduated with a BSE in Aeronautical Engineering, magna cum laude, and an MSE. He was elected to Phi Beta Kappa, Tau Beta Pi and Sigma Xi.

In 1958 he joined the Douglas Aircraft Company in California where he worked as a Research Engineer, Program Manager and Chief Engineer. Beginning in 1965, he served in the Office of the Secretary of Defense as Assistant Director of Defense Research and Engineering. He joined LTV Missiles and Space Company in 1970, serving as Vice President, Advanced Programs and Marketing. In 1973 he returned to the government as Assistant Secretary of the Army and in 1975 became Under Secretary of the Army, and later Acting Secretary of the Army. Joining Martin Marietta Corporation in 1977 as Vice President of Technical Operations, he was elected as CEO in 1987 and chairman in 1988, having previously been President and COO. He served as president of Lockheed Martin Corporation upon the formation of that company in 1995, and became CEO later that year. He retired as chairman and CEO of Lockheed Martin in August 1997, at which time he became a Lecturer with the Rank of Professor on the faculty of Princeton University where he served until July 1999.

Mr. Augustine was Chairman and Principal Officer of the American Red Cross for nine years, Chairman of the Council of the National Academy of Engineering, President and Chairman of the Association of the United States Army, Chairman of the Aerospace Industries Association, and Chairman of the Defense Science Board. He is a former President of the American Institute of Aeronautics and Astronautics and the Boy Scouts of America. He is a current or former member of the Board of Directors of ConocoPhillips, Black & Decker, Proctor & Gamble and Lockheed Martin, and was a member of the Board of Trustees of Colonial Williamsburg. He is a Regent of the University System of Maryland, Trustee Emeritus of Johns Hopkins and a former member of the Board of Trustees of Princeton and MIT. He is a member of the Advisory Board to the Department of Homeland Security, was a member of the Hart/Rudman Commission on National Security, and served for 16 years on the President's Council of Advisors on Science and Technology. He is a member of the American Philosophical Society and the Council on Foreign Affairs, and is a Fellow of the National Academy of Arts and Sciences and the Explorers Club.

Mr. Augustine has been presented the National Medal of Technology by the President of the United States and received the Joint Chiefs of Staff Distinguished Public Service Award. He has five times received the Department of Defense's highest civilian decoration, the Distinguished Service Medal. He is co-author of *The Defense Revolution* and *Shakespeare In Charge* and author of *Augustine's Laws* and *Augustine's Travels*. He holds 23 honorary degrees and was selected by Who's Who in America and the Library of Congress as one of "Fifty Great Americans" on the occasion of Who's Who's fiftieth anniversary. He has traveled in over 100 countries and stood on both the North and South Poles of the earth.