

**TESTIMONY**

**OF**

**NORMAN R. AUGUSTINE**

**CHAIRMAN, REVIEW OF U.S. HUMAN SPACEFLIGHT PLANS COMMITTEE**

**ON AMERICA'S HUMAN SPACEFLIGHT PROGRAM**

**BEFORE THE**

**U.S. SENATE COMMITTEE**

**ON COMMERCE, SCIENCE AND TRANSPORTATION**

**WASHINGTON, DC**

**MAY 12, 2010**

Mr. Chairman and members of the Committee, thank you for this opportunity to address America's future human spaceflight plans. I, like you, have had the great good fortune to have lived in this tiny sliver of time when humans first began to explore space, and have had the even greater good fortune to have participated in some small part of that effort as an engineer and as a manager. I must confess to you that I am a proponent of human spaceflight—not so much because of its impact on the economy, its support of science, or its advancements in engineering—although it does all those things—but for the intangibles it offers, including the inspiration it provides to our nation's citizenry, particularly its young people; for the impact it has in paving the way for humans to move further out into the planetary system; and for what it says to the world about the American people and what we and our system of government and free enterprise can accomplish.

I should note at the outset that it would be difficult to gather a group of colleagues at this table for whom I have greater respect and admiration than those in whose company I find myself today. Nonetheless, as we have all noted, human spaceflight is a topic about which reasonable, caring people can, and do, sometimes disagree. In my opinion such healthy discussion can only help assure, as stated in the title of the report of the committee I recently chaired, that we have “a human spaceflight program worthy of a great nation.”

I have been requested to speak this afternoon from the perspective of the Committee on Human Spaceflight Plans, and to compare its findings and circumstances with those of a similar committee I chaired some twenty years ago. The most recent committee, which has now been formally disbanded, included scientists, engineers, managers, astronauts, professors, and a retired four-star Air Force General Officer. The findings in our report reflect our unanimous views.

I should note that in the case of the most recent study, our group was asked to provide *options* for consideration by the President, Congress and NASA. We were specifically not requested to provide recommendations—presumably so we could adopt a neutral stance in assessing the pros and cons of the various alternatives we might identify and not have to be advocates for any one proposed course. I have tried very hard to be faithful to that charge throughout the recent debate, albeit in some instances that has been impossible: for example, when narrowing the some 3,000 options our committee's methodology identified down to a set of five options offered in our report.

Let me begin with the review that was conducted twenty years ago that addressed the entirety of NASA's space activities, not solely the human spaceflight program as was the case in the more recent review. The earlier assessment was conducted in the shadow of the Challenger failure in which we lost seven of our friends and colleagues. It was also conducted as the Soviet Union—which had provided the impetus for much of America's space activities until that time—was breaking apart. And, while funding for NASA always seems precious, at no time during the space era has NASA found itself in so challenging a budgetary environment as exists today. This of course cannot be ignored.

Some of the relevant findings of that report of twenty years ago have a bearing on the purposes of this hearing today. These included the observations that:

- NASA is being asked to pursue goals that are not matched by the resources that are provided—a hazardous practice in a pursuit as demanding as human spaceflight.
- Based upon our skepticism of the Shuttle reliability calculations, the loss of another Shuttle appears likely.
- Construction of a true heavy-lift launch vehicle is the highest priority for future human spaceflight activities.
- The technology program that underpins spaceflight is being starved, thereby leaving future decision-makers with only limited options.
- America should have a balanced space program, using humans and robots where unique advantages are offered by each.

Turning to the present, the most important finding of the Committee on the Future of Human Spaceflight Plans was that the ongoing program is on an unsustainable trajectory. The reason is straightforward: when NASA began that program, for reasons it presumably believed sound, it predicated the effort on a future budget profile that each year has proven to be fully one-third less than planned. The impact of this has been exacerbated by NASA's very high fixed costs—in some part attributable to the Congress's practice of instructing the Administrator of NASA not to reduce NASA's workforce or facility structure.

The above approach contrasts with that at the end of the Cold War, when the aerospace industry, in pursuit of efficiency, lost 640,000 of its employees and two-thirds of its companies or divisions of companies within a few years. Make no mistake, NASA is the finest space organization in the world with an extraordinarily talented group of people. But it is also a large, mature organization without a strong competitor. At least in the business world that is usually a formula for complacency, not success. The consequences of funding mismatches in such an environment can be severe. For example, the mismatch of ends and means coupled with technical problems that were encountered on the Ares I program were such that during its first four years the program slipped between three and five years—depending upon whose schedule estimate is accepted. Further, the heavy-lift vehicle and lunar lander were largely deferred. The question that thus arises with regard to the resulting disconnect among the Ares I schedule and that of International Space Station and the planned lunar return becomes not one of *can* the Ares I be built, but *should* it?

While the committee did not offer a program that cancelled the Constellation program in its entirety, it did offer an option, referred to in the report as “5B,” that generally approximates the President's plan as it was described during his recent remarks at Cape Kennedy. This program appears to be a viable undertaking, one that ranked highly in our overall assessment...provided, and this is to be emphasized, that it is funded as stipulated and that decisions are made as scheduled (especially those regarding a heavy-lift vehicle). The funding profile identified in our report to support Option 5B adds to the baseline budget profile three billion dollars per year, phased in over the next four years and realistically corrected for inflation using the appropriate aerospace indices.

While the technical challenges of human spaceflight, especially beyond low-Earth-orbit, are immense—the determining factor in defining the program the nation is to pursue is the amount of funds the nation wishes to commit to the enterprise. At the higher or “enhanced”

budget level the human spaceflight program would cost each citizen about ten cents per day. Nonetheless, the aggregate sum is undeniably immense.

Try as we might, our committee could find no dynamic, responsible human space *exploration* program costing less than the program augmented by \$3B per year in inflation-corrected collars. That is not to say there are not important things to be done in space for lesser funds, particularly with robotics, but rather that human spaceflight programs under the more restrained funding profile will necessarily be confined to some 300 miles from the Earth's surface.

Option 5B clearly establishes a human landing on Mars as the primary objective for the human spaceflight program. Unlike Constellation, which sought to reach its initial exploration goal, the Moon, some 20 years in the future, Option 5B follows a path with interim accomplishments including docking with an asteroid; visiting an Earth-Sun Lagrangian point and conducting training operations there; circumnavigating Mars; orbiting Mars; landing on one of Mars' moons, Phobos or Deimos; and eventually landing humans on Mars. A return visit to the Moon is also quite possible, for technical and science reasons; however, it should be noted that our committee received many informal inputs, particularly from young people, questioning why we would have a space program whose centerpiece is something that was accomplished over a half-century earlier. Both China and India have announced plans to land humans on the Moon and it seems unrewarding for the U.S. to participate in a second race to the Moon.

Option 5B, like the President's proposed program, provides for the commercialization of transportation between the Earth and low-Earth-orbit. The reason for this is that sooner or later NASA must free itself from operating a logistics line to low-Earth-orbit or it will not have the funds needed to meet the grand challenges that await beyond low-Earth-orbit and which NASA and only NASA is equipped to address: namely, the exploration of the solar system.

Our committee's report explicitly states that commercializing transportation to LEO is not without risk. Nothing in space is without risk. But it is the committee's belief that with *proactive oversight by NASA*, such an approach is feasible and responsible. From a purely *business* standpoint, we draw the analogy to the federal government's guaranteeing a market to carry the mail to the fledgling airlines—an action that made airline travel commercially practicable.

When including this concept in some of the options in our report we noted that all companies, large and small, should be allowed to compete for the market created as just described. We noted that throughout its history NASA has performed the critical role of providing direction and oversight for industry—but it has been industry, not NASA, that has built the overwhelming preponderance of America's space hardware. Further, one wonders what message our government sends in the increasingly competitive global marketplace if it concludes that America's industry is not capable of safely carrying our astronauts into orbit, yet it is comfortable having Russia's industry do so.

I will not seek to repeat the contents of our 154-page report this afternoon. But I would like to conclude with our most strongly held over-arching conviction, and that is that it would be

a disservice to NASA and to this nation to yet again initiate a space program where the means do not match the ends. Doing so merely guarantees that we will be meeting here still another time five to ten years hence. It is one thing to preserve jobs...it is another to conduct a space program. In this case, the former is easy...the latter is difficult.

Assuming that this principle of matching goals and resources is embraced, I have the utmost confidence that the extraordinary people of NASA, under Charlie Bolden's exceptional leadership, can successfully carry out whatever program you who lead our nation may select. And I am hopeful that it will be a program that, as the title of our committee's report states, is "worthy of this great nation."

Thank you for this opportunity to speak on behalf of my colleagues on the Review of the U.S. Human Spaceflight Plans Committee.

**REVIEW OF U.S. HUMAN SPACEFLIGHT PLANS COMMITTEE**  
**-- MEMBERS --**

Mr. Norman R. Augustine  
Retired Chairman & CEO  
Lockheed Martin Corporation

Dr. Wanda M. Austin  
President & Chief Executive Officer  
The Aerospace Corporation

Mr. Bohdan I. Bejmuk  
Chair, NASA Constellation Standing Review Board

Dr. Leroy Chiao  
Former Astronaut, Former International Space  
Station Commander and Engineering Consultant

Dr. Christopher F. Chyba  
Professor of Astrophysics Sciences  
And International Affairs  
Princeton University

Dr. Edward F. Crawley  
Ford Professor of Engineering  
Massachusetts Institute of Technology

Mr. Jeffrey K. Greason  
Co-founder & Chief Executive Officer  
XCOR Aerospace

Dr. Charles F. Kennel  
Director and Professor Emeritus  
Scripps Institution of Oceanography  
University of California, San Diego

General Lester Lyles  
United States Air Force (Retired)

Dr. Sally Ride  
President & Chief Executive Officer  
Imaginary Lines

**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 24 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.

(Rev: May 2010)