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"Reauthorizing the Vision for Space Authorization"

Senate Committee on Commerce, Science & Transportation

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Good Morning Mr. Chairman and members of the Committee. I am Major General (USAF-Ret) Robert Dickman, Executive Director of the American Institute of Aeronautics and Astronautics (AIAA). Thank you for inviting me to testify on this important issue. I would also like to thank all the

members of Congress and their staff for taking the time to meet with AIAA members during our annual Congressional Visits Day. We come to Congress every year in April and consistently have been welcomed with hospitality and a willingness to engage our members in open and thoughtful dialogue about important issues.

As Executive Director of the American Institute of Aeronautics and Astronautics, I represent a constituency of over 35,000 aerospace professionals and students, located in all fifty states and 89 countries internationally. During my tenure as Executive Director, I have heard many members at our technical conferences and other venues voice their concerns about the fiscal health and future viability of NASA.

At a funding level of only a fraction of a percent of the annual federal budget, NASA is being systematically starved. NASA is being forced to eliminate or severely reduce some very important work, to the detriment of critical aerospace research and development, and more broadly to the detriment of our aerospace strength and our industrial base. The Vision for Space Exploration was an aggressive, forward-looking proposal when offered by the President and endorsed by the Congress. However, while

NASA has undertaken a positive exploration agenda, funding levels have not been at all sufficient to meet those goals. Thus, in order to come even close to meeting the requirements for the Constellation program, NASA has been forced to cut funds from other programs, programs that have been at the core of American excellence in aerospace for half a century.

For example, research cuts since 2003 have reduced fundamental space-related life science and physical science research programs by 85%, affecting over 1,700 scientists and nearly 3,000 students. NASA is the sole steward of this research. If NASA doesn't do it, it won't get done – at least not in this country. At the same time, China, Japan and other nations are continuing robust research in these areas, and those countries are poised to assume the scientific and technological leadership that we are letting slip away.

Furthermore, the federal aeronautics budget reflects NASA's need to focus its resources on other priorities. In 1994 NASA's aeronautics budget was $1.54 billion. By FY07 the aeronautics budget was cut to $594 million. The FY09 budget reflects further cuts at $447 million. With less than a third of its prior budget in this area, critical needs are going unmet.

It is AIAA's position that stable, robust, long-term federal civil aeronautics research and technology initiatives funded at the level that will assure U.S. leadership are critical to sustaining a strong national economy, maintaining a skilled workforce and ensuring our national security. NASA must continue to have a leadership role in this effort. The Administration has approved a policy on aeronautics research and an implementation plan to achieve the stated goals. These were drafted with the collaboration of the best talent from academia, industry and government. However, if we cannot execute these programs, and continue to lose our advantage in the basic understanding of aeronautics that has allowed us to develop the world's finest commercial and military aircraft for the past 60 years, it will be the result of inadequate funding, not the absence of a well thought out plan.

Turning from aeronautics to space, our domestic space transportation capability is achieved using a very limited number of vehicle types. Launch vehicle reliability has improved in recent decades, but the cost of space access remains very high, even with the Evolved Expendable Launch Vehicles. Operational constraints and the price of these vehicles limit incentives and opportunities for expansion of space operations, in-orbit

capabilities, and space commercialization. Meanwhile, government investment in advanced launch concepts and associated technology that could make space access significantly more robust has dropped to nearly zero, as we focus our attention on the near-term needs of exploration and assured access to space. Absent investment in the truly breakthrough science and technology that would lead to revolutionary changes in space transportation, US access to space in 2040 will not look significantly different from 2020, or 2000, or 1980.

This is not a new problem. Our government-funded launch systems are based on most of the same principles and technologies as the rockets that launched Sputnik or Apollo or the Shuttle in 1981. A little over 50 years after the Wright Brothers' first flight, the jet-powered passenger aircraft that became the 707 was being tested. By way of comparison, fifty years after the first Delta rocket put the Echo satellite into orbit, the Delta II is still the most used American launch vehicle. We have been evolving the technology of the 1950's ballistic missile programs for half a century. Without investment in basic science and technology, that's what we will be doing for the next half century. We've already lost almost the entire commercial space launch market – a market that was once 100% based in the United States. If

we are still flying legacy-based rockets thirty years from now, our only payloads will be from the government. Anyone with a choice will have gone overseas.

Space transportation is the key to our future role as a space-faring nation. We can regain our leadership role if we apply our technical strength to the problem, but it will not happen without significantly increased NASA investment.

Human spaceflight is an inspiring manifestation of our species' urge to reach and explore new destinations, which also enables discovering much about how we came to be and what might be our future. The US has been a leader in this endeavor from the beginning. This has led to advances in our educational system, it has inspired some of our youth into advanced technology careers, and it has showed the world how US aerospace prowess can benefit all of humanity.

There are some who would draw a distinction between education, the quality of our technical workforce, and programs such as NASA's. However, the economic growth of this country in the latter half of the last century

demonstrates the fallacy in that thinking. It would be difficult to find any significant growth sector that didn't benefit, directly or indirectly, from the emphasis this country placed on scientific and technical skills in the early days of the space age. NASA's programs inspired generations of young people to study what today we call STEM – science, technology, engineering and mathematics. Government programs provided scholarships, loans and funding for university and industrial research programs that were the incubators not only for technology, but also for technologists, the scientists and engineers that make it all happen. Without NASA, this country would be a very, very different place now.

Looking ahead, though, continued US leadership in human spaceflight is clearly threatened. I am not concerned that other nations are launching humans to space, anymore than I am concerned that other nations can launch satellites to space. It is a natural evolution of an exciting endeavor. What I am concerned about is that NASA is so under-funded that virtually every area in aeronautics and astronautics is at serious risk.

In human spaceflight we expect at least a four-year gap between retirement of the Space Shuttle and the first piloted flight of the Crew Exploration Vehicle (CEV). Current plans are to rely on Russian systems for crew

rotation in the interim. Use of the CEV to provide crew rotation for the International Space Station (ISS) is not projected after 2017, jeopardizing the opportunity to reach the full benefit of this unique research facility. There are alternatives to the Ares-Orion for access to the ISS, including commercial and government approaches. However, none will be available without additional funding. Meanwhile, other nations are not standing still. Other countries are working vigorously to develop and/or expand a human presence in earth orbit, on the moon, and beyond, with the clear potential to eclipse the US leadership status in this area of human achievement and economic opportunity. In this case, the issue isn't whether we have the systems to sustain US access to space and continue use of ISS once the Shuttle is retired; it is a matter of funding.

In 2003, there were over 1,000 research projects focusing on basic non-exploration space physical and life sciences across the United States, which supported over 1,500 scientists, and over 3,000 students. Today, only five years later, there are 85 such research projects, supporting approximately 300 students. This is a decrease of 90%. NASA is justifiably fond of speaking of the current crop of researchers who were motivated to pursue careers in space-related research by their fascination with the Mercury,

Gemini and Apollo programs that culminated in landing astronauts on the moon. But with the absence of NASA-oriented research programs in our universities, where will the next generation of these researchers come from?

Before leaving the area of the science programs, I want to applaud Administrator Griffin for several decisions he's made to keep very capable scientific satellites functioning. Obviously, the decision to do the Hubble repair mission was the most expensive and probably most difficult choice. However, Dr. Griffin has also sustained operating funds for the Mars Rovers and other satellites. I spent most of my professional life engaged in activities related to the development, launch and operation of satellites. The idea of turning off a perfectly good spacecraft that may have cost hundreds of millions of dollars to build and launch, has gotten past the incredibly dangerous trip to space and initial deployment and can still perform a useful mission even when past its intended life in order to save a comparatively small annual operational cost simply makes no sense. The fleet of spacecraft NASA is operating to look at our planet, our solar system and the universe beyond is unprecedented and truly remarkable. NASA deserves nothing but compliments for fielding them – and for continuing to operate them.

I'd like to say a bit more about education. AIAA has worked to advance the state of aerospace science, engineering, and technical leadership for over 75 years. As such, we are keenly aware of the difficulty facing our industry with respect to attracting and maintaining a competitive workforce. Addressing this looming crisis is a major priority for our Institute.

The Report of the National Academies, "Rising Above the Gathering Storm" done at the request of the Congress, documented the problem of the weakness of Science, Technology, Engineering and Mathematics in our educational system and in the areas of interest in our young people far better than anything I could say. The America COMPETES Act is an excellent step – but it is just a step. The more recent "Is America Falling Off the Flat Earth?" by Norm Augustine reminds us that no nation has an inherent right to greatness. Generations of Americans worked to achieve our greatness, and generations must work equally hard to sustain it. What has this got to do with NASA? Everything!

The technical cohort that came into the American workforce during the Apollo era, not the people that built Apollo, but the scientists and engineers who were inspired during that era, are leaving the workforce, without

sufficient replacements in the pipeline. While NASA is certainly not the sole source of funding for technology, it provides without doubt the most visible motivation for young people to decide to study STEM-related subjects.

Science, Technology, Engineering and Math education in our nation's classrooms provides the critical foundation needed for our future national security and economic competitiveness. However, we are too quick to consider these as interchangeable disciplines, and assume the traditional curricula in mathematics and science will provide understanding about technology and engineering.

To oversimplify, a scientist wants to know something that hasn't been known; an engineer want to build something that hasn't been built, wants to satisfy a societal need. The scientific mind will tell you that in your kitchen there is sodium chloride – salt – and lots of other compounds. It will tell you that things melt or boil when heated, that eggs come from chickens, and so forth. But it takes an engineering mind to address the societal need of producing a meal – of translating scientific knowledge into a useful product.

It is important that NASA funds research. So does the National Science Foundation. It is enormously important that NASA be able to take that

research and develop useful things from it and provide the information for others to do the same. The list of useful things that have been derived from the space program is too long to be repeated here, since NASA research has led to more than 6,000 patents. My point is simply that increased emphasis and funding must be directed to the Technology and Engineering components of STEM if the nation is to reap the full benefits of STEM spending. In particular, STEM legislation should provide strong support for Technology and Engineering education at all levels from kindergarten through university. NASA can and must play a central role in this effort, just as it is important that the America COMPETES Act of 2007 be fully funded.

To summarize, I will repeat my comments reported in the April 28 edition of *Space News*:

> "NASA is more than stretched, they are just terribly under-funded. Rather than being funded at a fraction of a percent (of the Federal Budget), if they were funded at one percent of the budget, they'd still be stretched.
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> - We are not doing the work we should be doing in basic aeronautical research and development.

- We are not doing the right kinds of things for education.

- We are not doing the right kinds of things for life sciences.

- We are not doing the right kinds of things for space sciences.

- We are not doing the right kinds of things for solar science.

- And we are not going to be able to succeed at the exploration program with the budget we've got."

NASA is too important to this nation – to our education, to our overall technical strength, to our long-term economic growth and to the many things that are more directly in its mission to continue to be so under-funded. I have identified areas that I believe to be most at risk. I am not at all suggesting that NASA funds be reallocated to these areas, because the money is simply not there. Instead, I believe the so-called NASA top line – the total budget of NASA – needs to go up to a level consistent with NASA's importance to the nation, and to America's future.

Mr. Chairman, I appreciate this opportunity to share my views and those of the American Institute of Aeronautics and Astronautics on this enormously important legislation. I welcome the opportunity to answer any questions you may have.