NASA: SOARING TO THE NEXT CENTURY?

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For the House Appropriations Subcommittee on
Veterans Affairs, HUD and Independent Agencies
February 26 and 27, 1997

Mr. Chairman and members of the Subcommittee, thank you for the opportunity to present the views of the National Space Society on the Administration's FY 1998 budget request for NASA.

Last July, the House Science Committee convened a hearing to examine the space agency's out-year funding projections. At that time, the White House proposed cutting NASA to $13.09 billion in 1998. Spending further declined the following two years, then reversed direction in 2001, climbing to $13.9 billion in 2002 ($12.6 billion in 1998 dollars).

The National Space Society warned the proposed out-year budgets would savage NASA, forcing the cancellation of major programs and research centers. We urged members of Congress and the Administration to reject the severe cutbacks and to stabilize funding for NASA.

To its credit, the Administration revised its numbers upward and now proposes to spend $13.5 billion in 1998 - still a $500 million reduction from current spending when adjustments are made for inflation. In 1999, funding for the space agency drops to $13 billion, then $12.5 billion in 2000, $12.2 billion in 2001, and $11.9 billion in 2002 (1998 constant dollars).

Overall, the Administration seeks to slice $2 billion more from NASA's budget in real terms. The space agency has been downsized every year since 1992 and the Clinton budget continues to shrink America's space program by an additional 12 percent.

After the White House announced its new numbers, members of Congress suggested NASA is out of the woods, that its financial difficulties have been resolved. But clearly this is not the case. Costs are continuing to increase while spending shrivels. NASA cannot stay on this path, each year absorbing deep rollbacks in spending and maintain its level of performance. Five more years of thin gruel is a road to disaster both for NASA and our leadership in advanced technology.

Funding for the space agency represents a core investment by America in science and technology. While we are cutting back on spending, global competition is increasing. More and more countries are investing heavily to build technology-based economies, patterned after Japan's successful model of development. Once compromised, our nation cannot quickly rebuild its competitiveness. The seed of a new technology can take years to germinate.

By investing today in science and engineering, we are creating opportunities for the road ahead. And likewise, by defunding science and engineering, we are weakening our economic health, lessening opportunities for the next generation.

While the Administration's budget for NASA is gloomy, funding levels projected by the House and Senate are even worse. Congress last year proposed spending $13.1 billion in 1998, ratcheting down to $10.9 billion in 2002 (1998 dollars).

The proposed spending cuts -- both by the Administration and Congress -- are especially undeserved given NASA's recent rebirth. The space agency has implemented a vast array of reform measures to improve its performance. Programs are being privatized and streamlined. The agency is squeezing every penny's worth from its budget, doing more with less, innovating new technologies and new ways of doing business.

The funding cuts proposed over the next five years occur at the worst of all possible times. We are in the process of transitioning to a new era of exploration and commercial development of space. Last year, NASA began launching a new generation of low-cost probes to explore our solar system. In the months ahead, two spacecraft will reach Mars. In September, the Lunar Prospector will fly to the Moon to map its surface elements and search for water-ice in the polar regions enshrouded in permanent darkness. In October, NASA plans to launch the Cassini spacecraft to explore Saturn. Then in November, if all goes as planned, we will begin to assemble the International Space Station.

INTERNATIONAL SPACE STATION

The International Space Station is a sophisticated, unique orbiting laboratory. In addition to biological research, scientists will conduct a broad range of microgravity materials and process experiments. Aboard the Space Station, the influence of gravity is all but eliminated. On Earth, gravity causes: 1) sedimentation, in which heavier particles settle to the bottom of a container, and: 2) convection, where heat rises, forcing particles to swirl upward. These forces act as barriers on Earth, preventing scientists from uncovering the fundamental physics of many processes, such as combustion and the formation of metallic alloys. By conducting experiments in space, without the effects of sedimentation and convection, researches will be able to learn about basic phenomena, which then can be applied to industry to improve lives on Earth.

Knowing the fundamental principles governing material science, for instance, will allow engineers to more precisely control and manipulate the formation of new alloys on Earth, reducing flaws in structures and improving physical properties, such as hardness, thermo-strength, and corrosion resistance.

In a microgravity environment, researchers can produce larger and higher quality protein crystals, which are used by pharmaceutical companies to generate three-dimensional molecular maps of proteins and enzymes. With this data, companies can design drugs in a laboratory to target viruses and treat diseases. On Earth, because of gravity, crystals often are too small or contain defects, and thus fail to provide a detailed picture of a protein or enzyme structure.

The Space Station will dramatically expand our access to a microgravity environment for research. The station offers many advantages over the Space Shuttle. On Earth, for instance, it can take six days to six weeks to produce a single protein crystal. The Space Shuttle, however, can remain in orbit for only a couple weeks at a time, restricting the selection of proteins that can be grown in space. The shuttle, when returning to Earth, generates violent g-forces and shaking that can damage crystals. On the Space Station, researchers will have substantially more time to conduct research and produce crystals that require weeks to mature. Instead of returning the delicate crystals to Earth for examination, they will be analyzed aboard the Space Station. Data will be transmitted to Earth, eliminating potential damage during re-entry of the atmosphere.

The National Space Society believes that, in addition to microgravity research, priorities on board the Space Station should be focused on life sciences. We believe that the Station's primary importance lies in its ability to host a wide variety of life science research activities focused on the human effects of long duration space living. The Space Station must continue to receive full financial and political support to ensure its completion in a timely manner. Full advantage should be taken of the contingency plans NASA has already developed in coordination with the project's other 13 participating nations.

SPACE COMMERCE

The International Space Station will open the door to the commercialization of space. Support of space commerce and the incubation of new commercial technologies and business ventures on the International Space

Station can benefit the U.S. economy through new businesses, increased tax base, new products, jobs and growth.

Opponents of the orbiting laboratory claim there is little commercial interest in space research. But this is inaccurate. Many companies have invested substantial sums to investigate how space can be used as a tool to enhance their competitiveness and produce unique products. There are many promising technologies.

Learning to use a microgravity environment for commercial applications has been a long and complex process. First, hardware for experiments must be designed to generate specific data. There are strict limitations on mass and power. The hardware must operate safely in space with a minimum of human involvement and withstand violent shaking during launch and re-entry.

NASA's commercialization program did not begin until 1985. Many early experiments produced completely unexpected results. In January of 1986, the Challenger accident grounded all Space Shuttle flights for 30 months. When operations resumed, few payloads were dedicated to microgravity research. Not until the early 1990s did scientists get a chance to fly experiments with any regularity.

The Spacehab module, a private sector laboratory designed specifically for commercial experiments, did not fly aboard the Space Shuttle until 1993. In recent years, NASA has averaged only one mission annually dedicated to microgravity research, of which most experiments have not been for commercial applications. Overall, industry has been able to only whet its appetite, conducting a limited number of experiments to validate hardware and gather preliminary data.

Some commercial hardware has yet to be flown in space, while other fields of research are much further developed, such as protein crystals. NASA conducted the first protein crystal experiment in space in 1984, using a hand-held device. The following year, the Space Shuttle carried hardware to orbit that produced three protein crystals that were better than any grown on Earth, validating the technology. In 1991, NASA, in partnership with industry and academia, introduced second-generation hardware that achieved orders of magnitude better crystals than possible on Earth. Each flight of the hardware now produces 128 samples, of which 85 percent of the protein crystals are better than the best crystals grown terrestrially.

Not until the Space Station is constructed can industry have a predictable, continuous presence in space, at which time the development of commercial research can be expected to rush forward. In the interim, while NASA is building the Space Station, access to space to conduct commercial research is severely curtailed, threatening projects.

Private industry cannot afford to do nothing, wasting time and money, while NASA assembles the Space Station. If arrangements are not made to fly commercial payloads during the interlude, the development of space commerce may be dealt a severe setback. Skilled personnel will leave projects to work in other areas, and we will have to rebuild a pool of expertise to promote the commercializing of space.

Delays in the development of space commerce will impact American companies that are hoping to use space research to gain a competitive advantage in the global marketplace. At stake are many high-paying jobs. Space research promises to give U.S. businesses a leg up in competition. But the embers of commercial space commerce will dim if we shut out research opportunities during the next several years.

The National Space Society believes that, in the interests of commercial development:
_ Competitive bidding should be allowed for supplying transportation to and from the station;
_ NASA must realize the importance of consulting with user communities to ensure the availability of maximum Space Station resources as early as possible (power, communications, rack volume, etc.);
_ A Space Station pricing schedule needs to be developed.

REUSABLE LAUNCH VEHICLE

Possibly the most important and far-reaching program now funded at NASA is the development of a single-stage-to-orbit Reusable Launch Vehicle (RLV). The cost of traveling to space remains the single, largest impediment to the commercial development of space. Each flight of the Space Shuttle now costs in the neighborhood of $400 million. The shuttle requires a slew of technicians to rebuild its powerful engines and make repairs to the orbiter after each flight.

The RLV, like the Space Shuttle, will launch vertically and land horizontally. But, unlike the shuttle, it is being designed to substantially reduce maintenance costs. It is the classic example of the U.S. need for superior technology to compete with low-wage economies. While it takes 60 to 70 days to prepare the shuttle for a new mission, the RLV will require only 50 people and a week's time. The next-generation launcher, if successful, promises to reduce space transportation costs to one-tenth the current level. The vehicle will give America a competitive advantage in the launch of commercial satellites, as well as propel the development of space commerce.

To build a fully reusable launch vehicle, NASA is funding, in partnership with industry (Lockheed Martin Skunk Works), the construction of a half-scale test vehicle, called the X-33. Its purpose is to validate key technologies to pave the way for private industry to fund and build a full-scale RLV - dubbed the VentureStar - based on the X-33 design.

The X-33 program's five-year budget totals $979 million. The suborbital vehicle is scheduled to begin flight tests in March of 1999 and will reach speeds in excess of Mach 15. About a dozen flight tests, planned for launch from Edwards Air Force Base in the California desert, will land at sites in Montana, Utah, Washington and California.

The X-33 program mirrors a successful strategy employed by NASA in its aeronautical research programs, where engineers build a little then test a little. But unlike these programs, NASA is constructing only one test vehicle. If a disaster should occur and the X-33 is lost, the program will come to a grinding halt. Without a backup vehicle, the vision of a low-cost space transportation system to replace the Shuttle will be jeopardized.

Given NASA's ongoing budget problems, additional money to build a second X-33 appears highly unlikely. As an alternative, the NSS supports funding a complete set of major spare parts, which would cost about $50 million. If the X-33 is damaged, a replacement vehicle can be quickly assembled. The spare parts are an insurance policy to reduce the risk of failure and will ensure America successfully develops a reusable launch vehicle.

ON TO MARS

A human mission to Mars long has been a dream for many Americans. In 1989, President George Bush committed our nation to return to the Moon, then push on to Mars. At the time, unfortunately, our vision failed to match our pocketbook. Engineers proposed an elaborate mission to the red planet with little regard for costs. The mission configuration, when committed to paper with specific plans, proved to be too complex and cumbersome. While the Mars mission never got underway, the effort nevertheless proved beneficial. It was the first time we seriously put together a human mission to Mars, gaining insight to the technical challenges.

Since Bush's announcement, NASA has undergone a revolution in the way it does business. Today, cutting costs is central to its every decision. NASA is pushing the bounds of technology, finding faster and better solutions, boosting performance while reducing expenses.

NASA has yet to apply its new methodology to a human mission to Mars, which would include the participation of our international partners. Discussions about a Mars mission still rely on the old data, which can be deceiving. As a first step to correcting this deficiency, NASA recently completed a 300-page study of a

prototypical Mars mission to serve as a reference point for technology research and development plans.

The National Space Society urges NASA to now go the next step and complete a "Phase A" study of a human mission to Mars, which would include design architectures and an independent estimate of costs. A Phase A study will update our thinking and give policymakers the facts they need to understand what is required technically and financially to send humans to explore Mars. Its goal is to figure out how, and to identify, the high-leverage technology initiatives that would put us in a position to actually implement such a program. The goal should be to do an international mars mission for about the same NASA budget level as the Space Station -- approximately $2 billion per year. However, while necessary for planning, this Phase A study does not obligate the U.S. to any schedule or budget.

After NASA's sample return mission to Mars in 2005, plans for the further exploration of the red planet remain unclear. It is the view of the NSS that robotic probes, while important in the near term to gather scientific data, are limited in their capacity to search for the fossil remains of life. Only humans have the ability to navigate the rough and varied terrain of Mars, which includes mountain peaks three times higher than Everest and a super "Grand Canyon" that stretches more than 2,000 miles.

That humans will one day set foot on our sister planet is no longer a question. The technology to send a crew to explore Mars is within our grasp. What remains unknown are the timetable, mission structure, and cost -- questions we can begin to answer with a Phase A study.

CONCLUSION

Over the last five years, NASA has restructured itself from top to bottom. The agency is now poised to soar to the next century. NASA soon will begin launching a half-dozen, low-cost, robotic probes each year to explore our solar system, including a series of spacecraft to investigate Mars. The International Space Station's assembly is getting underway and will inaugurate a new era in space science and the development of commercial enterprises. The RLV program is on a fast track to validate new technologies to substantially reduce the cost of space transportation.

Early in the next century, America will be in a position to undertake, with its international partners, an affordable human mission to explore Mars. This leap forward in exploration will open unimaginable new vistas for our children and future generations.

The National Space Society, in the strongest terms possible, urges members of the House and Senate to look beyond the horizon, to invest in the future by fully supporting NASA.

If the Administration and Congress cut another $2 billion from the space agency, as now proposed, it will begin to lose its vigor. Our nation's competitive edge will dull. Alternatively, if NASA's budget is stabilized, a dynamic future of exploration and commercial development will become reality. Untold opportunities will be available to the next generation of our citizens -- particularly our youth. America's spirit will take flight, as will its dreams and hopes.
