A Post Cold War Assessment of U.S. Space Policy

A Task Group Report

VICE PRESIDENT'S
SPACE POLICY ADVISORY BOARD

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DECEMBER 1992

Vice President's
Space Policy Advisory Board

December 17, 1992

The Honorable Dan Quayle
Vice President
The White House
Washington, D.C. 20500

Dear Mr. Vice President:

On August 31, 1992 you charged a special task group of the Space Policy Advisory Board to review the nation's space policies in the context of the end of the Cold War and other developments. We were directed to report to you by December 20, 1992. We are pleased to present you with our report, *A Post Cold War Assessment of U.S. Space Policy*.

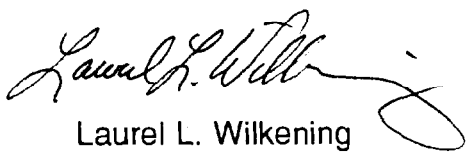
Our Task Group was comprised of individuals with considerable space policy experience including a former Congressman, a former Secretary of the Air Force, the current Chairman of the Defense Science Board, former leaders of the national security space program, a former director of NASA's Jet Propulsion Laboratory, current and former industry executives, and other space policy experts. Because of the limited time available for our task and the nature of your charge, our Task Group relied heavily on its own expertise augmented by two recent reports of the Space Policy Advisory Board, *The Future of the U.S. Space Industrial Base* and *The Future of the U.S. Space Launch Capability*; the *1990 Report of the Advisory Committee on the Future of the U.S. Space Program*; and a series of briefings by senior Administration officials from departments dealing directly and indirectly with the U.S. space program. Every effort, including the composition of the Task Group, was taken to ensure that its results were non-partisan.

Our report focuses on four recommendations. While we have identified implementing actions for each recommendation, we recognize that the incoming administration may wish to re-validate these suggested actions and measure them against their own policy goals before acting. However, we note that the world's political and economic situation as it affects space programs is evolving rapidly and that our own domestic and military agendas are also changing. So action is needed sooner rather than later. Failure to act will result in continued inefficiencies, higher costs than necessary, slower progress in using and understanding space, less competitiveness, and further uncertainty in our space industry.

Our four principal recommendations are that: (1) major changes be made in the way government space activities are organized and managed, eliminating duplication and fostering synergism among civil, military, intelligence, and commercial space programs; (2) the government seek to reduce, and where possible eliminate, security constraints associated with national security space programs; (3) the government take a series of

actions on an urgent basis to create a more cooperative and productive relationship with the U.S. space industry; and (4) the United States take the initiative in shaping a common international agenda in selected areas of civilian and national security space activity to address global problems and to maintain U.S. influence.

Finally, we unanimously urge that discussions begin immediately between the current and incoming Administration and with the Congress on these recommendations in order to enable timely actions by affected agencies.



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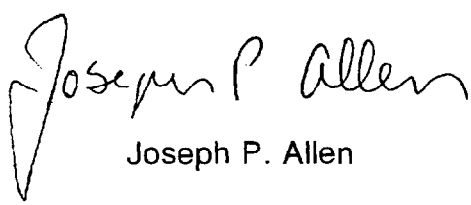

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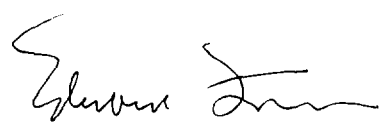

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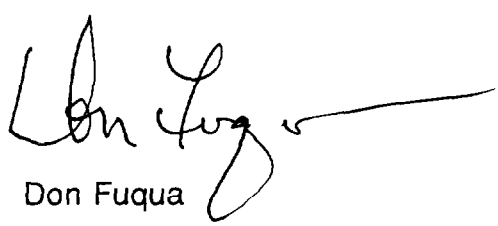

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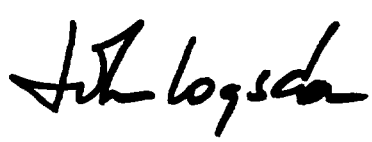

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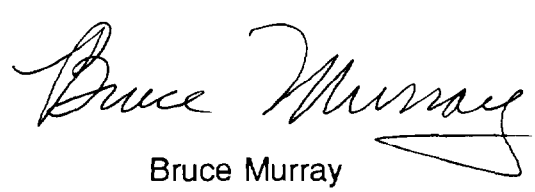

Bruce Murray

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Summary

The fundamental principles which have guided U.S. space activities were established nearly 35 years ago in the aftermath of the 1957 launch of Sputnik 1 by the Soviet Union. These principles provided for two separate space programs: one aimed at civil, peaceful purposes; the other aimed at using space systems and capabilities to enhance national security. Each program was to be carried out by a separate organization with its own research and development, acquisition, launch, and operations capabilities. Coordination between the civil and military space programs was to occur at several levels, including a presidential-led policy organization, the National Aeronautics and Space Council.

Since that time, the U.S. civil and national security space programs have evolved within a policy framework that reflected the international tensions, as well as the economic and technological constraints and alliance relationships of the Cold War period. A separate, highly classified, organization to develop and operate the U.S. space reconnaissance program was created in the early 1960's. More recently, a distinct non-governmental commercial space sector achieved policy recognition.

The U.S. space program now functions in a profoundly changed context. Space offers opportunities to address global problems on a global scale and its frontier challenges the scientific, technological, and problem-solving genius of humans. The end of the Cold War, advances in technology, and other developments present new opportunities for cooperation and progress in space. The continuing budget deficit and

changes in the aerospace industrial base associated with lessened defense spending impose new constraints on such progress.

Recognizing these changes and knowing that, more than ever before, the United States must ensure that it gets maximum return from its investments in space Vice President Dan Quayle, on August 31, 1992, asked his Space Policy Advisory Board to conduct a broad review of current national space policy. He charged the Board with making policy recommendations that would: (1) increase the efficiency of federal government space activities to enable the best space program possible for the funds available; (2) maintain U.S. leadership and competitiveness for the 21st century; and (3) sustain an industrial base capable of supporting future national security, civil, and commercial space requirements.

The Task Group has completed this review and found that space systems and missions remain important, and in some instances vital, elements of government activity. The Task Group also found that the dramatic changes in the geopolitical environment, the heightened sensitivity to issues affecting U.S. economic and technological competitiveness, increasing concerns about the global environment, the world-wide proliferation of space technologies, systems, and capabilities, and, not least, increased budgetary constraints have seriously changed the context for the U.S. space program.

Among the specific findings of the Task Group are that:

— The current U.S. government organization of space activities is not appropriate for the post Cold War era. A strong, cross-agency coordinating function is needed at the White House level. Additionally, significant institutional and structural changes are required.

— The economic competitiveness of the U.S. space-related industrial sector promotes the civil and national security interests of the nation and government actions are needed to foster its continued well being.

— Enhanced international cooperation in both the civil and military space sectors presents a strategic opportunity for the United States which should be pursued; but, the U.S. approach toward cooperation should be modified to better suit post Cold War interests.

Based upon these findings, the Task Group's four principal policy recommendations are that the U.S. government:

— Change the way space activities are organized and managed. The need to maintain distinct civil and national security space sectors remains valid but planning should be centralized across sectors and its execution streamlined within the respective sectors, thereby eliminating duplication and fostering synergism among civil, military, intelligence, and commercial programs.

— Reduce, and where possible eliminate, security constraints associated with national security space programs.

— Revitalize, on an urgent basis, a more productive cooperative relationship between the U.S. government and the space industry to meet the increased challenge of international competition and cope with reductions in defense spending.

— Take the initiative in shaping a common international agenda in selected areas of civil and national security space activity to address global problems and to maintain U.S. influence.

These recommendations provide a strategic direction and should guide policy makers as they transform the U.S. space program to meet the challenges of the new post Cold War era. The Task Group has also identified a number of specific implementing actions which are described in the recommendation section of this report.

While the recommendations and accompanying implementing actions might benefit from additional fact-finding and review, the Task Group urges that at least the initial steps toward broad, sweeping change be taken soon. The magnitude of these changes will almost certainly make them institutionally unpopular and difficult to implement. However, business as usual will not serve the country well. Failure to take prompt action along the lines identified in this report will undermine the U.S. space program and deny its potential benefits to future generations of Americans.

1

The Evolution of U.S. Space Policy and Programs

Leadership as the Overriding Goal of U.S. Space Policy

The goals set for the U.S. space program were initially a product of the Cold War. Early Soviet successes, culminating in April 1961 with the first orbiting of a human, galvanized the U.S. political leadership to confront the appropriate response to this powerful Soviet challenge to U.S. global leadership. In May 1961, President Kennedy accepted the recommendation of Vice President Lyndon B. Johnson, NASA Administrator James Webb, and Secretary of Defense McNamara that the United States not only be "a leader in space," as was mandated by the 1958 Space Act, but that it become the leader in all areas of space exploration. A centerpiece of this recommendation was that the United States enter and win the race for spectacular space achievement. Webb and McNamara argued that:

> *"Dramatic achievements in space, therefore, symbolize the technological power and organizing capacity of a nation...*
>
> *It is for reasons such as these that major achievements in space contribute to national prestige. Major successes, such as orbiting a man as the Soviets have just done, lend national prestige even though the scientific, commercial, or military value of the undertaking may by ordinary standards be marginal or economically unjustified.*

> *This nation needs to make a positive decision to pursue space projects aimed at enhancing national prestige. Our attainments are a major element in the international competition between the Soviet system and our own. The non-military, non-commercial, non-scientific but "civilian" projects such as lunar and planetary exploration are, in this sense, part of the battle along the fluid front of the cold war. Such undertakings may affect our military strength only indirectly if at all, but they have an increasing effect upon our national posture."*[1]

Two weeks later, President Kennedy initiated the Apollo program which culminated in the first lunar landing on July 20, 1969. In parallel, the United States successfully flew the first robotic expeditions to Mars and Venus and began robotic efforts that reached Mercury and Jupiter in the 1970's and Saturn, Uranus, and Neptune in the 1980's.

In the 1960's, and for most of the next two decades, space leadership clearly meant besting the USSR in visible, challenging space exploration endeavors. Each statement of national space policy issued since 1961 has identified leadership as a major goal of U.S. space policy; for example, the November 1989 space policy approved by President George Bush noted that "a fundamental objective guiding United States space activities has been, and continues to be, space leadership."

The Origins of Separate Civil and Military Programs

Heated debate followed the launch of Sputnik 1 regarding the best way to organize the U.S. space program. In those years, all U.S. space capability resided within the various military services and their laboratories and contractors. As a temporary measure to minimize interservice rivalry for the new space mission, the Secretary of Defense in February 1958 established an Advanced Research Projects Agency (ARPA) as the central organization for space projects.

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[1] Memorandum from Robert McNamara and James E. Webb to Vice President Lyndon Johnson, *Recommendations for Our National Space Program*, May 8, 1961.

President Eisenhower initially favored centralizing space efforts within the Department of Defense (DoD) on the grounds that he wanted to avoid needless duplication of activities and capabilities and that the most pressing space requirements were military in character. His advisors subsequently persuaded him of the benefits of a U.S. posture of openness — conducting as much of its program as possible openly under the auspices of a civilian agency, while also continuing a strong, yet less public, military space program within the Department of Defense. A bill proposing that a civilian space agency be created was sent to Congress in April. Following extensive debate in both houses of Congress, the President signed the National Aeronautics and Space Act of 1958 into law on July 29, 1958. Even in this founding legislation, Congress was particularly concerned about the need for policy and program coordination between separate civil and military space programs and included in the bill a White House National Aeronautics and Space Council, chaired by the President, to oversee such coordination.[2]

Between 1958 and early 1961, existing and planned space projects, facilities, and personnel were allocated to the new agency, the National Aeronautics and Space Administration (NASA), if they were predominantly civil in character, and retained within the Department of Defense if their primary application was national security. Most military programs were assigned to the individual services and ARPA quickly lost its role as a central DoD space organization. In the early 1960's a National Reconnaissance Office (NRO) was established within DoD to manage the country's highly classified reconnaissance satellite programs. In 1961 the Air Force was designated the executive agent for most DoD space efforts.

These organizational developments created a powerful, but expensive, national space program with overlapping programs and duplicate facilities. Such duplication was tolerated because:

— The foreign policy value was recognized of having an open, unclassified civil program that other countries could cooperate with, in contrast to the closed, secretive Soviet program.

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[2] The 1958 Space Act was revised in April 1961 to make the Vice President the Chairman of the National Aeronautics and Space Council.

— Protecting against Soviet knowledge of the character of U.S. military and intelligence space efforts through a high level of security classification was a key consideration.

— For the first decade or so, America's accomplishments in space were limited more by the availability of technology than by funding constraints. Overlapping programs (at least at the technology level) were thought to further desirable technical progress.

The policy decisions made in the early years of the space age resulted in the establishment of separate and distinct space sectors within the U.S. government:

— A civil space program managed by NASA and focused on demonstrating America's technological leadership through human space exploration and new scientific knowledge.

— A military space program focused on supporting strategic deterrence and an evolving role in supporting tactical forces.

— An intelligence space program focused on providing comprehensive surveillance of areas of the world closed to normal observation and on providing strategic indications and warning to National Command Authorities.

— In addition, a commercial sector emerged as private industry became involved in space programs.

Each of these sectors evolved under separate organizational structures for management, budgetary control, and policy oversight. Each of these separate "stovepipe" organizations contained within itself most or all capabilities required to perform its mission. Not surprisingly, the lack of strong coordination among these organizations encouraged both different solutions to similar problems and overlap in capabilities, particularly in areas such as technology development, launch, and support services.

Though successful, this "stovepipe" organizational structure has grown large and has spawned excess bureaucracy and as new applications of space have been developed, new "stovepipes" have been created (Figure 1).

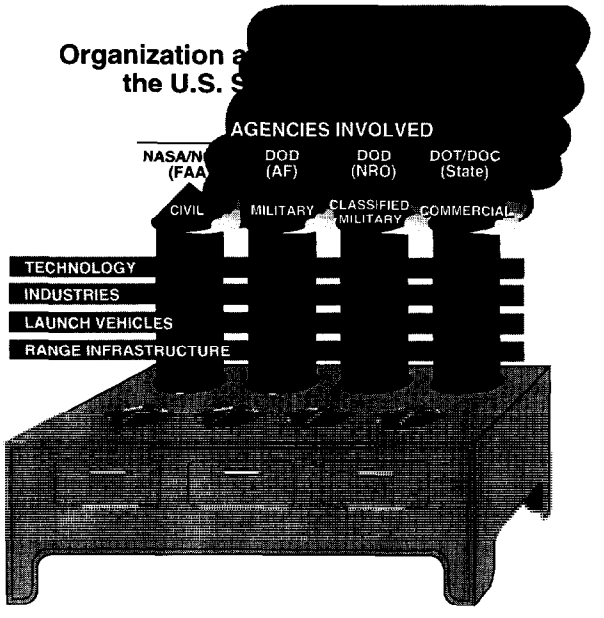

Figure 1. "Stovepipe" Organizational Structure

Increasing layers of policy oversight and review have been added. Congressional review has increased; as many as ten congressional committees now have jurisdiction over some portion of the three government space sectors, with each committee enforcing its own priorities. Each space organization has carried out its acquisition, operations, technology development, command and control, and other functions in a manner optimized for the missions it was charged with conducting. In short, each space organization now has its own institutional culture.

The scope and character of government space activities have changed significantly during the past 35 years. These changes have been reflected in annual spending levels for space (Figure 2). Three major factors have had an overarching effect on funding levels.

The first was the Apollo program, which entailed a very large effort over a relatively short time and clearly dominated space spending through the 1960's. Apollo, together with an aggressive planetary science program, led to an early surge of funding for NASA that at its peak constituted approximately 1 percent of the nation's gross national product. This was

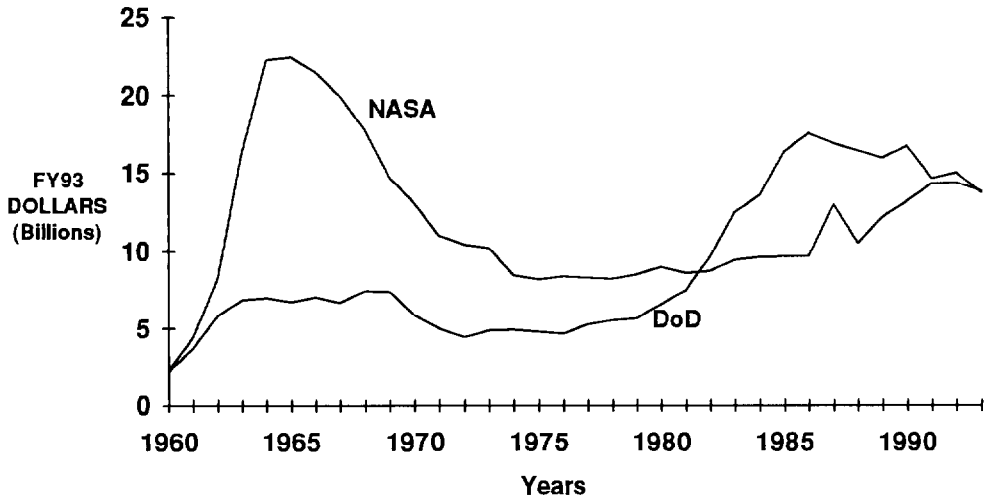

Figure 2. National Space Spending

an extraordinary investment which established the NASA institutional structure still in existence today.

The second was the Space Shuttle program which has had a pervasive effect on space spending over the past two decades. Beginning in the mid-1970's acquisition of national security satellites to perform new missions and necessary improvements to satellites performing existing missions were deferred until such time as they could be designed to take advantage of the Shuttle's unique capabilities. This deferment created a "bow wave" of unfunded requirements, suppressing DoD space spending in the 1970's and driving up spending in the early 1980's. The Challenger failure in 1986 and the actions necessary to recover from that failure added more than $12 billion in new funding requirements to the country's space budget, including, a new Shuttle (Endeavour), restoring expendable launch vehicle (ELV) production lines, developing and procuring the Titan IV, Delta II, and Atlas II launch vehicles, and redesigning satellites from configurations optimized for the Shuttle to configurations that could be launched on ELVs. The economic effect of the Shuttle is still being felt in

terms of the continuing high cost of Shuttle operations, currently consuming approximately one third of the total NASA budget.

The third major factor affecting space spending is DoD's increasing reliance on space to perform essential national security missions formerly accomplished using terrestrial or aircraft systems. This reliance, demonstrated during Desert Storm, is discussed in other sections of this report. As space has become the preferred means to accomplish essential military functions, the cost of additional space systems has been largely offset by phasing non-space alternatives such as terrestrial communications systems and reconnaissance aircraft out of the military inventory.

It is important to note that to date civil and national security space programs have not competed directly against one another for funds. Instead, each competes within its own sphere against other, non-space, alternatives for furthering U.S. national security, scientific, technological, economic, and political goals.

The Evolution of Commercial Space Activities

During the earliest years of the U.S. space program, the government played a catalytic role in bringing into being the first commercial application of space, using satellites to relay voice and video signals around the globe. The government agreed to launch any communications satellite developed by the private sector, thereby enabling the initial commercializing of space activity without requiring the private sector to bear the burden of developing its own launch capability. The government also funded research, development, and demonstrations of possible uses of communications satellites. Finally, the government took the initiative in developing the policy and institutional framework, both domestic and international, for operating communications satellites. The result of these farsighted government actions was the creation of a major new area of economic activity in which the United States has had, from the start, the dominant market share.

Indeed, satellite technology has revolutionized communications not just in the U.S. but throughout the world. The capacity and speed of domestic and international telecommunications have increased by orders of

magnitude, and the cost of an individual call has decreased substantially. Governments, the military, industry, and the individual consumer have all benefited. The communications satellite industry — satellites, launches, ground stations, and services — in the United States is nearly five billion dollars per year and is growing at a rate of about 20 percent per year.

The government also took the lead in facilitating a commercial industry built around the capability to sense the Earth from space for a variety of both public and private applications. The first Landsat satellite was launched in 1972, and Landsat 6 is scheduled for launch in 1993. There have been continuing policy challenges to finding the appropriate framework for bringing the benefits of remote sensing into widespread commercial use and a notable lack of success to date in demonstrating the economic viability of such an application. Nevertheless, the government devotes resources to technologies that, in the long run, could have substantial economic payoffs.

It was not until the 1980's that the overall commercial potential of space received specific policy attention. A series of policy and organizational initiatives over the past decade have made the government crucial to U.S. industry in developing new profit-making applications of space capabilities and services. The existence of a separate commercial space sector was first acknowledged in a 1988 statement of national space policy. The need to plan government space activities so that they enhance U.S. industrial competitiveness and to oversee commercial space activity in order to protect the public interest has added new complexities and new participants to the space policy process.

Other countries, recognizing the economic potential of space, are competing, often successfully, with the United States for a share of this growing market. U.S. taxpayers, through funding government's civil and national security space programs, and U.S. industry have spent large amounts of money to develop the knowledge, technology, manufacturing skills, and systems that underpin U.S. space competitiveness. U.S. policies and practices need to safeguard these investments and to facilitate continued U.S. competitiveness. In particular, as the United States contemplates enhanced international space cooperation, attention should be devoted to making sure that such cooperation does not compromise U.S. competitive advantage in the commercial space arena.

The Evolution of International Space Cooperation

From the earliest days of the space program, international cooperation has been a prominent feature of the U.S. approach to space, particularly in the civil sector. The United States invited its allies to participate in space science and applications programs and, after 1970, in its human space flight program. While there have, on occasion, been problems between the United States and its partners, on balance the benefits of cooperation clearly outweighed its costs and risks.

In both the civil and national security sectors, the United States has always approached international cooperation from a position of strength, at its own initiative, largely on its own terms, and usually as a discretionary, "value-added" activity that complemented core U.S. elements of a particular mission or capability. The size of the U.S. space program and the preeminence of U.S. space capabilities made such an approach possible. International partners were willing to accept American dominance in cooperative undertakings as the price of associating themselves with the recognized leader in space. This approach may not always be achievable in today's changed environment.

2

The Changing Environment

Several factors are having a profound impact on U.S. space activities including the dramatically changed geopolitical environment, the heightened sensitivity to issues affecting U.S. economic and technological competitiveness, increasing concerns about the global environment, the world-wide proliferation of space technologies, systems, and capabilities, and, not least, increased budgetary constraints.

More and more space programs such as the Space Shuttle and Space Station Freedom have faced tough competition for resources from other discretionary civil needs. Now, with the Cold War over and the Soviet Union itself gone, President Bush's goal of returning humans to the Moon to stay and human exploration of Mars has not yet received Congressional support. These are indications of the United States' changed view of the role of space programs as political tools.

While one powerful enemy may have disappeared, and with it much of the original motivating force for our past space efforts, competition in space has by no means disappeared as a legitimate and important factor driving our present and future efforts. Political concerns are being replaced by economic concerns.

Foreign nations, particularly in Europe and Japan, have targeted space, and indeed the entire aerospace industrial sector, as an area of strategic importance to their economic future. A similar emphasis on space industries is evident in many countries, notably the People's Republic of

China, Russia, and other former Soviet republics, where space systems are one of the very few areas in which these countries can field technologies capable of competing on the world market.

The commercial competitiveness of the U.S. private sector is increasingly challenged in terms of helping the nation's trade balance. The challenge is aggravated by the negative effects of reduced government spending for defense in the aerospace sector.

Another significantly changed circumstance is the economic and financial condition of the United States. The United States is burdened with a large debt, a large trade deficit, and increasing foreign ownership of business assets. Previous reports such as those of the National Commission on Space (Paine report) and the Augustine Committee assumed that increased federal support of the U.S. space programs was likely. However, U.S. fiscal problems cast considerable doubt on the assumptions that more funding will be available. Current budget projections for civil and military programs show little or no growth.

This new context for the U.S. space program is so dramatically different, that a comprehensive reexamination of the fundamental premises and principles upon which U.S. space policy and organization have been based is warranted. This report is a first step toward such a reexamination and focuses on four major policy questions:

— Whether leadership should remain "the fundamental objective guiding United States space activities," as specified in current national space policy;

— Whether the government is appropriately organized for the space programs of the next decade and beyond;

— Whether the way that the federal government interacts with the U.S. private sector is the most productive approach to ensuring the growth of the commercial space sector and future U.S. competitiveness in the global marketplace, and;

— Whether the U.S. approach to international cooperation in civil and national security space activities requires revision.

3

The New Meaning of Space Leadership

As noted previously, the quest for leadership has been a fundamental objective of the U.S. space program. For at least the past half century, U.S. ability to influence the shape and flow of events around the world has been a core national interest, and Presidents since Dwight Eisenhower have recognized the contributions that the U.S. space program made to the perception of the United States as a leading nation; one whose influence is exercised for the common good.

The measure of space leadership was straightforward when the United States and the Soviet Union were engaged in a bilateral contest for primacy in areas of highly visible space accomplishment. But with the end of the Cold War and the increased significance of economic competition among the industrial nations, the term "space leadership" takes on new meaning. To remain a leading nation in space continues to be in the U.S. interest as leadership creates a shared pride among Americans regarding their country's place on the cutting edge of accomplishment and also adds to this country's ability to influence the actions and opinions of others around the world. In addition, future economic benefits from being the leader in private sector space efforts could be substantial.

However, to desire leadership does not assure it. Space leadership must be earned. By maintaining unsurpassed technological capacities in key areas and using those capacities effectively and efficiently, the United States will have the capability to act independently, visibly, and impressively when and where it chooses.

In the future, the United States must be perceived as using its space capabilities effectively in addressing global environmental problems, managing renewable resources, supporting regional military operations, and verifying compliance with international agreements — both civil and military. As part of the United States' continuing post Cold War leadership, space achievements must be widely viewed as a key to an improved world future.

Another facet of future U.S. leadership is the ability of the U.S. space industry, working in a productive partnership with the federal government, to compete successfully in the global space marketplace. Fostering and supporting this industry through minimizing regulation, acquiring government systems using commercial-like practices, and protecting proprietary and government-provided technology and know-how are examples of the sort of actions the government can and should take to stimulate the competitiveness of U.S. industry in this area of growing economic importance.

The United States cannot maintain an appropriate level of technological leadership in space without the continuing influx of well educated scientists and engineers. Historically, many of the best young people have been drawn to the space program and have found in its challenges the inspiration to undertake the long and difficult years of education needed to make significant contributions to the field. The United States must signal to today's aspiring youth that it intends to continue to conduct a preeminent space program.

If the United States is to maintain its leading position in space, it must invest in diverse mission-oriented space research and development (R&D). The country cannot be a leader by slowing down the pace of its R&D or by broadly seeking to restrict the dissemination of R&D results. The most effective means of both ensuring that the best students are attracted to the space arena and of guaranteeing continuing scientific and technological advance is through undertaking a series of technologically demanding space missions on a timescale consistent with the pace of university training. This implies programs that are both small enough and inexpensive enough so that they can be developed and launched on a time scale of fewer than five years.

Future space leadership, then, requires combining challenge, openness, quality of execution, and productive application of results. Proceeding ahead with a well-conceived, successfully executed national space program aimed at concrete objectives that are scientifically, economically, and socially beneficial, and that serve important U.S. interests, is the best way to ensure leadership in space. Leadership, in this sense, becomes both a goal in itself and the result of excellence in formulating goals for space and achieving them as planned.

It is this concept of leadership that should guide future U.S. activities in space.

4

Federal Government Space Activities

The changed circumstances brought on by the end of the Cold War present new opportunities to achieve efficiencies in the way government space activities are organized and conducted. Realizing these efficiencies could increase the purchasing power of the funds available, thus substantially offsetting the effects of no-growth budgets. In assessing possible efficiencies, the Task Group has considered the structural relationships among different government space activities, regulations and procedures including those related to security classification of national security space activities, and opportunities to streamline the acquisition of space systems.

New Opportunities and Constraints

Federal government spending on space and space-related activities has increased significantly during the past decade. Many factors contributed to this increase, among them the technical advances enabling space systems to compete successfully with non-space approaches for addressing important needs in areas ranging from military support to environmental monitoring. There has also been some recognition of the fact that investments in space contribute to important national objectives, such as furthering educational goals by inspiring our youth and enhancing U.S. economic competitiveness in the international marketplace.

The federal government will invest approximately $30 billion in all space-related activities this year and funding is projected to remain relatively constant at this level for the foreseeable future. While $30 billion per year is relatively high when compared with past spending levels, these funds are increasingly committed to the continued development and operation of currently approved programs. No-growth budgets will increasingly preclude new initiatives and curtail investments needed to maintain space leadership and the nation's competitive, technological edge in the future unless efficiencies can be achieved.

For NASA, the effect of a no-growth budget is severe. In 1990, a comprehensive review of NASA's civil space activities was undertaken by the Augustine Committee. That Committee's recommendation, which was broadly endorsed by the Administration and the Congress, was that the United States should conduct a balanced space program composed of a strong space science component, two mission oriented undertakings — Mission To Planet Earth aimed at understanding the Earth's climate and related physical and biological systems and Mission From Planet Earth focused on human and robotic exploration of space — an enhanced technology program to support future endeavors, and development of a new launch system to off-load tasks from the Space Shuttle. In the judgement of our Task Group, these goals remain valid.

To support this agenda, the Augustine Committee recommended a number of management reforms. It also recommended increases in NASA's budget of approximately 10 percent per year throughout the decade of the 1990's, leveling off at about 0.4 percent of GNP. The management recommendations appear to have been taken seriously and the Task Group supports the actions that are being taken by NASA's current leadership to implement them. However, it is now probable that the recommended increases in funding for NASA will not be available in the near future.

At the same time, NASA is becoming increasingly committed to conducting routine, repetitive activities associated with operating and maintaining existing systems. This includes operation of Space Shuttle flights, which consumes nearly one third of the NASA budget, as well as operation of the Tracking and Data Relay Satellite System (TDRSS), the Deep Space Network, the Hubble Space Telescope and other observatory

programs, and the institutional cost of maintaining a large government infrastructure. Future operational commitments include the Earth Observing System, Landsat, and Space Station Freedom. These commitments are the result of NASA's pursuing large, complex systems that require years to develop and entail sustained high operating costs.

The situation in the DoD is similar in terms of operational commitments. While overall defense spending is being very substantially reduced, expenditures for space are actually projected to increase slightly. But this level of funding will probably be inadequate to meet current needs and to support required improvements in infrastructure.

The end of the Cold War has brought a change in the focus of national security space activities. For the past 35 years national security space requirements were focused on the strategic threat posed by the USSR. The technologically sophisticated, closed society which was the Soviet Union had the capacity to threaten directly the existence of the United States. To counter this threat U.S. space systems focused on strategic warning and on understanding the threat posed by the nuclear forces of the Soviet Union. Tactical forces, during the Viet Nam conflict and later, relied little on space systems, depending instead on conventional capabilities such as remotely piloted vehicles for weather information, reconnaissance aircraft, troposcatter communications systems, and TACAN navigation systems which were under the direct control of the combat commands. Today, while strategic needs remain important, the demise of the Soviet Union has made reconnaissance aimed at it less critical. But, the changing environment has created important new needs. Systems designed in response to the threat formally posed by the Soviet Union are now contributing to decisions regarding Yugoslavia, Somalia, and other areas. At the same time, tactical support has grown to be a significant mission. As demonstrated during Operation Desert Storm, space support to tactical forces is now an essential element of the nation's ability to wage war. The conventional systems on which tactical forces previously relied have, by and large, been phased out.

In addition to supporting national security needs, space systems have application for an increasing variety of non-defense uses. For example, the Air Force Global Positioning System (GPS) constellation of navigation satellites was designed from the start to accommodate civil users. Today,

this system assists surveyors, geologists, large and small boat owners, hunters, and campers. The system is used for automobile and truck fleet management and is already in use for air navigation.

The demonstrated capability of the U.S. GPS system and its Russian counterpart system, GLONASS, has caused the international air traffic control community to undertake numerous studies of ways to utilize Global Navigation Satellite Systems (GNSS) to improve efficiency and safety. The International Civil Aeronautical Organization has estimated that GNSS will provide billions of dollars of savings. At the request of the FAA Administrator, an industry task force has just completed its study on how to move to GNSS-based air traffic control with initial steps starting this year and next. The United States has committed to free international use of our GPS system for air traffic control for the foreseeable future.

There are additional examples of the potential civil benefits of military space systems. For example, geodetic as well as surface feature data gathered for security purposes could revolutionize both terrain and feature mapping as appropriate data is released. Other space derived security data can add significantly to civil scientific earth observation efforts, such as NASA's EOS program. The U.S. Space Command also routinely provides space debris data to U.S. and international space activities.

Conversely, civil programs will increasingly benefit our security efforts. During Operation Desert Storm, commercial communications satellites were used extensively by the military forces of many nations allied with the United States. Some scientific and commercial earth observing satellites also provided useful low resolution data for military mapping and broad area surveillance. Finally, exchanges of space derived weather data has long been a practice between the DoD and the National Oceanic and Atmospheric Administration (NOAA) and could become even more important in the future.

Investments in new capabilities are needed to support both military and civil requirements, particularly to improve space transportation. A Space Policy Advisory Board Task Group recently completed a comprehensive assessment of the nation's space launch capabilities and shortfalls. The conclusion of that assessment was that investments are needed both to upgrade current facilities and to develop a new generation space launch

vehicle. The new vehicle would serve civil and military needs, provide a basis for replacing the Space Shuttle for human spaceflight in the future, and enhance U.S. commercial competitiveness in the international market. A new management arrangement was also recommended to coordinate activities in this important cross-cutting area. The recommendations of the Advisory Board report on *The Future of the U.S. Space Launch Capability* should be implemented.

Achieving the existing civil and military space agendas without increases in funding will be very difficult. Risks will have to be carefully weighed against savings as such changes are considerable. For example, it might be possible to free some funds through merging of now separate but similar civil and military programs such as meteorological satellites. It might also be possible to reduce space budgets somewhat by slipping acquisition schedules for replacement satellites. But, the risks and consequences of gaps in coverage that could result from such cutbacks are substantial. And, historically, the inefficiencies induced by such schedule adjustments increase the total cost of programs.

Organization and Management

Development and operation of space missions and systems have historically been the responsibility of the government organization utilizing the space system or mission. Thus, civil weather satellites are acquired and operated as an element of the weather service (now NOAA), naval communications satellites are the responsibility of the Navy, and so forth. Each organization employing space systems has evolved the management, budgetary control, and many of the technical support capabilities required to conduct space activities in support of its mission. This situation was depicted earlier as a series of "stovepipes." As opportunities to use space assets to accomplish diverse missions have increased, so have the number of government organizations involved in the conduct of space activities. Figure 3 displays the current dispersion of space-related functions across the government.

For civil and commercial space, in addition to NASA, the Department of Transportation, the Department of Commerce (including NOAA), the Department of the Interior, and most recently the Department of Energy

	NASA	DOE	DOC	DOT	AF	Army	Navy	NRO	SDIO	DARPA
R & D	✓	✓	✓		✓	✓	✓	✓	✓	✓
Acquisition	✓		✓		✓		✓	✓	✓	✓
Launch[1]	✓			✓	✓		✓		✓	✓
Operations	✓		✓		✓	✓	✓	✓	✓	✓

[1] Launch includes regulation or procurement of commercial launch services

Figure 3. Agency Functions and Responsibilities

have evolved space-related functions. Within the national security community, the Air Force (with separate development and operational elements), the NRO, the Strategic Defense Initiative Office (SDIO), and the Army, Navy, and the Defense Advanced Research Projects Agency (DARPA) are all actively involved in the development and operation of space systems. Each organization has a distinctly different culture. Technical requirements, acquisition procedures, and technical operations differ. Institutional arrangements encourage overlap and discourage cooperation and synergism.

A number of actions have been taken over the years to coordinate some of these diverse activities. For example, one approach has been the establishment of joint programs, managed and funded partially by DoD and partially by NASA, as a mechanism for gaining synergism when needs were similar or overlapped. The Space Shuttle was intended to support all government launch needs. While the core program was managed and funded by NASA, the Department of Defense added its performance requirements and was responsible for developing and operating a West Coast launch facility and a new upper stage (the Inertial Upper Stage or IUS) to support all users of the Space Shuttle. More recent examples of

joint programs have included the National Aero-Space Plane Program, the New Launch System, and the Landsat remote sensing satellite system.

These joint programs have proven difficult to implement and have often become a source of conflict among agencies. Differing agency priorities have often resulted in budget mismatches. Another factor complicating joint programs is the need for support from several different congressional committees, each of which with its own priorities. The process through which Congress allocates funds also complicates the execution of joint programs because subcommittees have tended to cut "their" agency's requests for a joint program in the hope that the subcommittee with jurisdiction over other participating agencies will make up the difference.

Within the DoD, a Unified Space Command has been created with responsibility for the use of military space assets. However, its responsibilities encompass only a segment of the national security space systems and even within that segment it is limited to operational matters.

To date, joint programs and umbrella organizations have not been effective in coordinating the broad range of national security space activities.

Security and Classification

The security classification requirements created to protect U.S. space and intelligence capabilities during the Cold War contribute to inefficiencies in the conduct of the nation's space program and limit the broader utility of certain systems. The objectives of national security systems have evolved over time, and the number of people allowed access to classified information relating to them has increased substantially. With the end of the Cold War, the original rationale for many of the current security safeguards is less compelling and the potential benefits from removing many security constraints are substantial.

In addition, many of the technical capabilities subject to security protection have proliferated despite their being subject to classification. For example, Russia is marketing imagery with a spatial resolution of approximately two meters. In the coming decade, the cutting edge in

technologies and systems designed to sense the Earth may increasingly be found in NASA's unclassified Earth Observing System (EOS).

Security constraints drive up the cost of U.S. government space programs in many ways. Physical and personnel requirements and their administration necessitate special building construction, extensive background checks, and systems for producing, processing, and storing material. They restrict the transfer of technical knowledge within the government and to and within industry. For industry, security requirements encourage the creation of separate facilities and a dedicated workforce, thus contributing to costly duplication and overlap.

U.S. industrial competitiveness in the world marketplace is also affected because, for the most part, foreign sales and commercial spin-offs of highly classified space capabilities are not allowed. This contrasts with other sophisticated military equipment such as fighter aircraft where foreign purchases offset a portion of U.S. investment costs thus helping to maintain a production base in this country and contributing positively to the U.S. balance of trade.

There have been some benefits of classification. Because of the sensitive aspects of high security systems, a more streamlined management structure was employed for overseeing their acquisition and operation. This streamlining reduced overhead costs, eliminated unnecessary paperwork, reduced decision time, and yielded high quality, high performance systems. These practices should be preserved and could be applied more broadly across the U.S. space program to reduce the cost and shorten the development time for other civil and military space programs.

While many potential benefits could be gained by reducing security requirements, it remains important to protect certain sensitive national security space capabilities. Because of increased threats posed by proliferation of the technologies associated with weapons of mass destruction, stemming the proliferation of ballistic missile technology remains a major concern.

The Task Group endorses recent actions by the Administration to reduce security requirements including the declassification of some information concerning the NRO and the launch of national security satellites. Relaxing additional security constraints could:

— enable industry to more easily move employees between civil and national security development programs

— ensure that technology and experience developed for one government application are easily transferable to other government or private sector applications

— reduce the overhead costs associated with maintaining strict physical and personnel security

— increase the data available to support public benefit applications

— provide an opportunity for U.S. industry to market systems or capabilities, either through some form of foreign military sales or through sale of information. The export of some advanced satellite technologies and systems would strengthen the competitiveness of the U.S. private sector in the international marketplace.

Federal Acquisition Regulations

A third area of possible savings relates to the processes and procedures associated with the acquisition of space systems by the government. Current acquisition rules create a burden on space programs — adding cost and time to everything. Many previous advisory group reports have contained specific recommendations for improvements in this area. Implementing the recommendations put forward by the Packard Commission, the Augustine Committee, and recently by the Vice President's Space Policy Advisory Board Task Group report on *The Future of the U.S. Space Industrial Base* could yield substantial savings in the cost of conducting the space programs of the nation.

Findings

1. The U.S. government's organization of space activities is not appropriate for the post Cold War era.

— Government resources committed to space are not being efficiently used. Government space-related organizations have proliferated and they have too many facilities and too many employees focused on redundant oversight and operational activities.

— No process exists to ensure: that agency space efforts utilize other agency-developed capabilities and technologies; that programmatic and facility redundancies are removed; or, that other synergism is gained among diverse space efforts when possible.

— Space launch capabilities are required by all users of space. Current launch capabilities cost too much, lack responsiveness and flexibility, and are not sufficiently safe or reliable. A coherent national effort to improve launch capabilities is desperately needed.

— No coordinated national effort currently exists to encourage the sharing of government-sponsored space technology among U.S. government agencies or between the government and the private sector.

— With the overall decline in general defense spending, procurement practices and acquisition decisions related to any single program will effect the industrial capacity for other programs. No mechanism exists to ensure cooperation and consultation among the space sectors prior to individual agency actions affecting the space industrial base.

2. A focus specifically on space issues within the Executive Office of the President is required to develop policies and strategies for coordination of civil, commercial, and national security space activities.

3. The demands on space budgets associated with operating and maintaining successful ongoing programs will increasingly consume available resources. Without significant management adjustments, focussed on reducing the operational costs of missions, the nation will not

be able to develop the advanced technologies and capabilities which form the underpinnings of space leadership in the future.

4. Current government guidelines regarding the classification of national security space activities, including secrecy surrounding organizational and contractual relationships, the existence and capabilities of space programs, operating procedures, and technology increase costs, restrict coordination and cooperation, and limit opportunities for productive synergism.

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5

The Relationship Between Government and Industry

The U.S. government accomplishes its space goals in cooperation with industry. It is through industry that policies and plans are transformed into the hardware and software of actual space programs. In turn, the space industry in this country is almost totally dependent on the government. The civil space sector and the military space sector combined spend $30 billion per year of federal funds in pursuit of space goals. The U.S. commercial space sector represented $5 billion in 1992 sales and is growing at double digit rates. However, of these commercial sales, approximately 30 percent are made directly to the federal government. The remainder are heavily influenced by the government through regulatory processes, export controls, financial incentives, and licensing requirements.

U.S. government space programs benefit from commercial sales by the industry. For example, sale of commercial space launch services enables stable production rates thus reducing unit costs and increasing reliability. The same is true for production of satellite components which can be used for both commercial and government satellites. Other examples include value-added processing for meteorological and remote-sensing data and ground terminals for communications and navigation systems.

However, the United States no longer dominates the international marketplace for space hardware and services. 60 percent of all commercial space launches are performed by Europe's Ariane rocket. A decade ago,

the United States had more than an 80 percent share of the worldwide commercial communications satellite market. The U.S. share of that market for the 1990 to 1993 time period is estimated to be just over 50 percent. French firms have captured about 20 percent of this important and growing market. In addition, Japan has the worldwide lead in providing large satellite ground stations. These shifts in market share are largely the result of focused decisions by other industrial nations to pursue commercial space activities. Russia, Ukraine, and Kazakhstan take justifiable pride in considering their space industries to be the "Crown Jewels" of their industrial base.

Government and industry are indeed partners in space. But factors resulting from the changed domestic and international circumstances are straining this partnership and the relationship between industry and government is perceived by industry to be less cooperative than it was in the past. This relationship is governed by a myriad of complex laws and frequently changing policies, processes, regulations, restrictions, and requirements some of which were established to foster expanded competition. The need for simplification and reform to these laws and regulations is accentuated by the ongoing contraction in the aerospace industry. Without question, the efficiency of the contraction process is adversely affected by current government regulatory practices.

Additionally, the government's interest in protecting commercially valuable proprietary information is probably greater now than in the past because of the heightened economic implications of space industry competitiveness in the international marketplace.

The Vice President's Space Policy Advisory Board report, *The Future of the U.S. Space Industrial Base,* recently addressed these and other issues affecting the relationship between the U.S. government and its industrial partners. In preparing that report, the task group solicited the views of a broad spectrum of industrial firms, both large and small, that provide space systems and services in the civil, military, and commercial space sectors. One of the recurring themes in these presentations was that the government is not a particularly good partner and that friction between partners becomes more critical in an era of restructuring and contraction. Fifteen specific recommendations were presented in six generic categories. Many of these recommendations dealt directly with improving the efficacy

of the partnership between government and industry; including easing antitrust laws to permit efficient consolidation within industry, implementing many previously recommended improvements to the acquisition process, and actively promoting a robust commercial space industry. Other significant recommendations included maintaining a strong emphasis on research and technology by both DoD and NASA during this period of contraction; stressing the importance of DoD and NASA working more closely together; and emphasizing the need for a modern and cost-effective expendable launch system. The industrial base report, released in November 1992, should be considered a companion piece to this policy assessment.

Findings

1. The continued international competitiveness of the U.S. space industry strengthens the U.S. space program and promotes the civil and national security interests of the nation.

2. For over a decade, the government fostered expansion of the space industrial base resulting now in substantial overcapacity in many segments of the industry. A number of current government laws and regulations serve as disincentives for effective industry contraction.

3. Government acquisition laws and regulations continue to foster inefficiencies and to contribute unnecessarily to the cost and complexity of space programs.

4. Government procedures and security regulations deter use of government-funded space systems and technologies for commercial applications, adversely effecting the global economic competitiveness of U.S. industry.

5. The DoD budget strategy for general defense programs is to reduce production while maintaining a robust research and technology base. However, DoD acquisition policies do not encourage the industry to invest in or otherwise support research and development.

6. Security constraints inhibit U.S. industrial competitiveness resulting in lower foreign sales of security-related space hardware and services and, thus, increased costs to the U.S. government.

7. Restrictions surrounding industrial proprietary information should be respected by government as they are needed to safeguard U.S. industrial competitiveness.

6

International Cooperation

Current national space policy states that "the United States will conduct international cooperative space-related activities that are expected to achieve sufficient scientific, political, economic, or national security benefits to the nation." This policy makes clear that international cooperation is a means to achieve additional benefits from the U.S. space program, not an end in itself.

The United States cooperates with many countries in both civil and national security space efforts. Such cooperation takes a wide variety of forms, depending both on the character of the cooperative activity and on the identity of the international partner. Among the approaches to cooperation that have been employed are:

— Data exchange (e.g., U.S.-USSR in life sciences, SCUD warning to allies in Desert Storm);

— Providing technical assistance or services (e.g., foreign use of the Deep Space Network; reimbursable launches of non-U.S. spacecraft supporting civil and military needs);

— Joint projects with the United States in control of the critical path for mission success (e.g., Space Station Freedom; Cassini);

— Joint projects with shared control of the critical path (e.g., Apollo-Soyuz, satellite tracking, telemetry, and control systems);

— Joint projects with others in control of the critical path (e.g., Topex/Poseidon).

Throughout the space age, the United States has been, by and large, forthcoming in sharing its space expertise with other nations. While avoiding unwarranted technology transfer, the United States has been willing to provide its partners access to scientific data, services, and capabilities. For this reason, the United States has been the partner of choice for most countries, and this has given the U.S. space program significant influence and prestige.

Basis For Future Cooperation

There is, thus, already substantial experience with a wide variety of cooperative mechanisms, and it is reasonable to expect more opportunities to emerge in the future. Because the challenge of competition exists along with opportunities for cooperation, an overall strategy is needed to determine how best to obtain substantive benefits for the United States while minimizing the added complexities and risks that are unavoidable in cooperative agreements.

Increasing budgetary pressures have, not surprisingly, heightened U.S. interest in benefitting from the capabilities and resources of other countries in achieving objectives in space. The United States will want to continue to cooperate with its traditional partners and to initiate cooperation with some newer ones like the former Soviet republics and emerging spacefaring countries such as Korea and Taiwan.

Other nations are also experiencing funding pressures, thus increasing their interest in collaborative ventures in space with the United States. Indeed, the country with perhaps the most to offer as a cooperative partner — Russia — is the one faced with the most daunting financial challenges. A consequence thereof is Russia's intense interest in collaboration with the United States.

Like the choice of a cooperative mechanism, the choice of a partner or partners for the United States should be approached from a strategic perspective. Engaging other countries in cooperative ventures is an

effective demonstration of space leadership provided that the United States is able to sustain its part of the cooperative agreement.

Military and Civil Opportunities

Although the realities of the Cold War and the classification boundaries surrounding national security space systems have placed constraints on cooperation, the benefits of many U.S. military capabilities in space are provided today to the United States' closest allies. Additional opportunity now exists in the post Cold War environment to extend U.S. national security capabilities to many other countries. These opportunities include use of military space assets — navigation, communication, meteorological, and surveillance systems — for non-defense applications such as search and rescue assistance, environmental monitoring, emergency communications, and disaster warning and relief coordination. Peacetime uses by other countries of U.S. national security space systems could include tactical or strategic missile warning, navigation, weather forecasting, and routine communications. In times of conflict space support to U.S. allies could include defense against ballistic missiles, surveillance, intelligence, highly precise navigation, targeting, and other applications.

In addition to the obvious benefits of such cooperation, a U.S. initiative in this direction would allow U.S. industry to compete with others around the world who are already marketing space systems and technologies with security capabilities. Inviting other countries to cooperate with the United States in the national security space arena might also discourage the proliferation of independent military space capabilities and provide incentives for countries to comply with the Missile Technology Control Regime and related measures to make the world a safer place.

NASA, operating in a very different context, has included some degree of international participation in almost every project it undertakes. The result is a vigorous and largely successful range of cooperative undertakings with both spacefaring and other countries. As suggested above, civil space cooperation covers a wide range of activities, from simple data exchanges to the largest ever cooperative undertaking in the technological sector, Space Station Freedom. Civil space cooperation has been structured in accordance with a set of principles that were established

early on by NASA to reduce risks such as unwanted technology transfer and U.S. dependence on others for mission success, as well as to protect other U.S. interests. Key elements of the NASA approach include clean technical and managerial interfaces, limited technology transfer, no exchange of funds, and, in most cases, U.S. management control and provision of critical path hardware. These principles are likely to require revision or flexible interpretation if there is to be enhanced civil space cooperation in the future and if the United States is to take full advantage of the capabilities of its international partners.

For example, other countries have developed various advanced space capabilities, and they argue that making those capabilities available to the United States in a cooperative undertaking needs to be accompanied by a significant role in the control and execution of that undertaking. The United States needs to give careful consideration to ways that non-U.S. capabilities can be more effectively used, together with those of this country, to achieve more than would be possible without cooperation. However, the United States must also recognize that at least one motivation of foreign governments in developing their own space capabilities will continue to be to enhance their own technological and economic competitiveness. Further, a strong motivation for engaging in cooperative ventures with the United States is gaining access to U.S. technologies and know-how that complement and improve their own indigenous capabilities.

Findings

1. Expanded international cooperation presents strategic opportunities for the United States.

— All space-faring countries are feeling political and financial pressures that limit their space aspirations. By taking the lead in shaping future cooperative undertakings so that working together in the civil and military aspects of space becomes more common and widespread, the United States can enhance its foreign policy, economic, and national security interests, as well as advance its programmatic objectives in space.

— Expanded cooperation in military uses of space, could dampen the proliferation of independent space launch, warfighting, and support systems while offering a new set of opportunities for the United States to take a leading role in shaping cooperative undertakings that provide economic, political, and security benefits to this country.

2. U.S. approaches to international cooperation in the civil and national security uses of space should be modified to better suit U.S. interests.

— It is becoming increasingly difficult to create and sustain productive cooperation when U.S. projects extend over long time spans and are very expensive, requiring international partners to make lengthy, expensive commitments. Cooperation is likely to be more feasible and productive when it is focused on undertakings that can be accomplished in a relatively short time and with modest budgetary requirements.

— Increasing cooperation will proliferate technical knowledge and may enhance others nation's ability to challenge U.S. industry in the international marketplace.

— Future cooperative projects will more often be developed and implemented on a multilateral basis, rather than the bilateral basis that has characterized much cooperative activity in the past.

— Certain future projects can only be pursued through significant reliance on international cooperation and many others can benefit from such cooperation.

— Although a comprehensive strategy should guide the development of the U.S. approach to collaboration, there is also a need for a case-by-case approach to developing specific cooperative agreements.

— If U.S. partners make significant financial and technical contributions to future cooperative undertakings, they will expect some revision in the traditional U.S. demands for control over critical path items and management arrangements.

3. The United States has developed a range of space assets that have the potential for broad public service applications. Sharing these assets can save lives and otherwise improve the quality of life on this planet; doing so would add to U.S. prestige and the perception of the United States as a worthy leader in other global undertakings.

7

Recommendations

Policy Recommendation 1

Major changes should be made in the way government space activities are organized and managed. The need to maintain distinct civil and national security space sectors remains valid but planning should be centralized across sectors and its execution streamlined within the respective sectors.

Implementation

1. Strengthen the Executive Office coordinating function currently being performed by the National Space Council to oversee the actions called for in this report and to develop cross-sector strategies in areas such as space technology, environmental monitoring and other applications, international relationships, design commonality and standards, and the sharing of systems and data among agencies.

2. Create a national space launch management arrangement led by an individual with responsibility and authority for planning and coordinating U.S. space launch capability as recommended by the Vice President's Space Policy Advisory Board's Task Group Report, *The Future of the U.S. Space Launch Capability*.

3. Begin the process of reducing overlap and duplication by centralizing the technical management of space systems (i.e., development, acquisition, launch, and spacecraft control functions) into fewer organizations with the long term goal of having two space organizations, one civil and one military. Continue to expand the use of space by encouraging broad agency involvement in the definition of system requirements and the identification of applications for space-derived products.

4. Establish a non-partisan commission modeled after the Base Closure Commission to recommend actions to "right-size" U.S. government space infrastructure, whether government or contractor operated. This review should include all DoD, NASA, and DOE laboratories and centers.

5. Support ongoing reform efforts within NASA. Additionally, NASA should be encouraged to establish success milestones and objectives for major programs and supported in phasing out programs promptly upon completion of those objectives. More generally, NASA should improve the efficiency of its programs in order to create opportunities within projected level budgets for new initiatives. New initiatives should be designed in ways which minimize operations costs and should include smaller, shorter duration, less expensive missions which can be developed and launched within fewer than approximately five years.

Policy Recommendation 2

Seek to reduce, and where possible eliminate, security constraints associated with national security space programs.

Implementation

1. The President should establish policy guidance which limits the classification of all but the most sensitive technologies, systems, and information concerning space-related activities.

2. The Director of Central Intelligence and the Secretary of Defense should develop a plan for implementing the new policy guidance. The plan should identify cost savings, opportunities for synergy, and the minimum

level of classification needed to safeguard the national security interests of the nation.

3. This plan should be independently reviewed prior to its implementation to assess the appropriate balance between national security needs and the benefits to civil and commercial space of synergism and cost efficiencies.

4. Recognizing the continuing sensitivity of certain space-derived information, as well as its potential civil and scientific benefits, a mechanism should be established to facilitate access to unclassified versions of sensitive data for public use.

Policy Recommendation 3

Revitalize, on an urgent basis, a more productive cooperative relationship between the U.S. government and the space industry to meet the increased challenge of international competition and cope with reductions in defense spending.

Implementation

1. Implement the recommendations contained in the Vice President's Space Policy Advisory Board's Task Group Report, *The Future of the U.S. Space Industrial Base.*

2. The Administration and Congress should take additional actions to improve the relationship between government and industry in at least the following areas.

— Appropriate interpretations of existing antitrust regulations as an aid to efficient contraction by industry.

— Extension of antitrust exemptions to include consortia engaged in production.

— Implementation of the backlog of procurement reform recommendations to improve acquisition efficiency and reduce burdensome procurement procedures.

— Review of research and development recoupment policies to eliminate disincentives to commercialization of DoD-developed technologies.

— Seek to strengthen incentives for industry to conduct mission oriented research and development.

— Review policies such as munitions lists, export controls, and security restrictions that inhibit the competitiveness of U.S. industry.

— Review the federal tax code to identify and eliminate disincentives to industry downsizing.

Policy Recommendation 4

The United States should take the initiative in shaping a common international agenda in selected areas of civil and national security space activity. One goal is to find ways to use the space capabilities of the world for common objectives. Enhanced international cooperation should be sought not only for its programmatic benefits, but also because it is the preferred way for the United States to influence the direction of future space undertakings around the world. Broader national security, political, technological, and economic benefits for the United States can flow from a carefully crafted "cooperative strategy" which balances the realities of economic competition with the potential benefits of cooperation.

Implementation

1. The United States should develop a "cooperative strategy" as a central element of its future approach to overall space policy. This strategy should balance the benefits of cooperation with the recognition that other countries often cooperate with the United States to enhance their own future capabilities by gaining access to U.S. technology and know how.

2. The United States should be selectively willing to be dependent on foreign suppliers for essential components or systems, but should retain control over systems integration in cooperative missions for which it provides the majority of funding and maintain a technology base that will reduce risks associated with foreign dependence.

3. In the course of structuring cooperative relationships, care must be taken not to distort the programmatic content of cooperative programs, endanger U.S. industrial competitiveness, or compromise the objectives of the Missile Technology Control Regime and other non-proliferation regimes in order to achieve policy objectives not related to space.

4. The United States should employ the existing space assets and capabilities of the former Soviet Union on a selective basis when they offer unique programmatic benefits, and should encourage collaboration between U.S. industry and the privatizing space organizations of the former Soviet Union in developing future space capabilities.

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Hon. Marc Stanley	Deputy Under Secretary of Commerce
Hon. Aaron Cohen	Acting Deputy Administrator, NASA
Amb. Henry Cooper	Director, Strategic Defense Initiative Office
Mr. Jimmey Hill	Deputy Director, National Reconnaissance Office
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Appendix I

Task Group Members

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Dr. Wilkening is the chair of the Vice President's Space Policy Advisory Board and is Provost and Vice President for Academic Affairs of the University of Washington, where she is also Professor of Geological Sciences and Adjunct Professor of Astronomy. In 1985, President Reagan appointed her Vice Chairman of the National Commission on Space. In 1990, she served as Vice Chair of the Advisory Committee on the Future of the U.S. Space Program (the Augustine Committee). Prior to going to the University of Washington, she was Vice President for Research, Dean of the Graduate College, and Professor of Planetary Sciences at the University of Arizona. She also served as Director of the Lunar and Planetary Laboratory there from 1981 - 1983. She is a fellow of the Meteorological Society and the American Association for the Advancement of Science. As a planetary scientist, her areas of research are meteorites, asteroids, and comets. The book *Comets,* which she edited in 1982, is a widely used reference on the topic. Dr. Wilkening earned a Ph.D. in chemistry from the University of California, San Diego, and a B.A. in chemistry from Reed College, Portland, Oregon.

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Appendix I

Task Group Members

Laurel L. Wilkening
Dr. Wilkening is the chair of the Vice President's Space Policy Advisory Board and is Provost and Vice President for Academic Affairs of the University of Washington, where she is also Professor of Geological Sciences and Adjunct Professor of Astronomy. In 1985, President Reagan appointed her Vice Chairman of the National Commission on Space. In 1990, she served as Vice Chair of the Advisory Committee on the Future of the U.S. Space Program (the Augustine Committee). Prior to going to the University of Washington, she was Vice President for Research, Dean of the Graduate College, and Professor of Planetary Sciences at the University of Arizona. She also served as Director of the Lunar and Planetary Laboratory there from 1981 - 1983. She is a fellow of the Meteorological Society and the American Association for the Advancement of Science. As a planetary scientist, her areas of research are meteorites, asteroids, and comets. The book *Comets*, which she edited in 1982, is a widely used reference on the topic. Dr. Wilkening earned a Ph.D. in chemistry from the University of California, San Diego, and a B.A. in chemistry from Reed College, Portland, Oregon.

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Lieutenant General Abrahamson, USAF (Ret.), is Chairman of the Board, Oracle, Corporation. Prior to joining Oracle, he served as Executive Vice President for Corporate Development of the Hughes Aircraft Company. After a 33-year career, he retired in 1989 while serving as the first Strategic Defense Initiative director, where he provided policy direction and

supervised key research and development programs and the acquisition process. Prior to that, he served as Associate Administrator for NASA's Space Transportation System and was responsible for the Space Shuttle Program. He also directed the F-16 consortium for the North Atlantic Treaty Organization co-production of this aircraft. He is a Massachusetts Institute of Technology graduate with a B.S. in aeronautical engineering and an M.S. in the same field from the University of Oklahoma. He was the 1986 recipient of the Goddard trophy.

Edward C. ("Pete") Aldridge

Mr Aldridge is currently President and CEO, Aerospace Corporation. He chaired the Vice President's Space Policy Advisory Board Task Group which prepared *"The Future of the U.S. Space Launch Capability."* Prior to joining the Aerospace Corporation, Mr. Aldridge was President, McDonnell Douglas Electronic Systems Company, in McLean, Virginia. From 1986 to 1988, Mr. Aldridge served as Secretary of the Air Force. He joined the Reagan Administration in 1981 as the Under Secretary of the Air Force, in which one of his key responsibilities was coordinating the Air Force and national security space activities. Mr. Aldridge was in astronaut training before the Challenger accident. He has held numerous management positions in government (Office of the Secretary of Defense, Office of Management and Budget) and the aerospace industry (System Planning Corporation, LTV Corp and Douglas Aircraft Co.) Mr. Aldridge was an advisor on the Strategic Arms Limitation Task (SALT I) in 1970-72. He holds a B.S. in Aeronautical Engineering from Texas A&M University and an M.S. in Aeronautical Engineering from the Georgia Institute of Technology.

Joseph P. Allen

Dr. Allen is President and Chief Executive Officer, Space Industries International, Inc., in League City, Texas. From 1967 until 1988, Dr. Allen served as an astronaut with NASA. His management duties involved astronaut candidate selection and training and he additionally served as a ground support crewman and CAPCOM for Apollo 15, Apollo 17 and STS-1. He flew as a prime crew member on STS-5, the first Shuttle flight to deploy cargo in space, and on STS 51-A, the first space flight to salvage equipment from space. Dr. Allen also served at NASA Headquarters as Assistant Administrator for Legislative Affairs from 1975-1978. He is the author of "Entering Space", a personal account of the space flight

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Mr Fink is President of D. J. Fink Associates, Inc., which provides management consulting to technology based industries. He chaired the Vice President's Space Policy Advisory Board Task Group which prepared *"The Future of the U.S. Space Industrial Base."* Mr. Fink's over 40 years in aerospace engineering and management include service in the DOD as Deputy Director, Defense Research & Engineering, Strategic & Space Systems. Following his government service he joined the General Electric Company in 1968. He was Vice President of that company where he first led GE's Space Division, then its Aerospace Group, and later was Senior Vice President Corporate Development and Planning. Mr. Fink served on the Defense Science Board and is a former Chairman of the NASA Advisory Council. He is a Member of the National Academy of Engineering and was Chairman of the NRC Space Applications board and its Board on Telecommunications and Computer Applications. His honors and awards include the DOD Distinguished Service Award, the NASA Distinguished Public Service Medal and the Collier Trophy (for his work on Landsat). He is an Honorary Fellow of the American Institute of Aeronautics & Astronautics and a former President. He received his B.S. and M.S. in aeronautical engineering from the Massachusetts Institute of Technology.

John S. Foster, Jr.
Dr. Foster is a former Director of Livermore Laboratory and Associate Director of Lawrence Berkeley National Laboratory. He served at the University of California's Lawrence Livermore National Laboratory from 1952 through 1965. In 1965, Dr. Foster was named Director, Defense Research and Engineering for the Department of Defense and served in that position for eight years. After leaving DoD, Dr. Foster joined TRW where he served for 15 years retiring as Vice President, Science and Technology. He has served on the President's Foreign Intelligence Advisory Board for 14 years and is presiding Chairman of the Defense Science Board. He is a member of the Industrial Advisory Committee on SDI, the National Advisory Board of the American Security Council, and

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Edward Frieman

Dr. Edward Frieman is Director of the Scripps Institution of Oceanography of the University of California at San Diego and is Vice Chancellor of Marine Science. Prior to his appointment at Scripps, he was Executive Vice President of Science Applications International Corporation in San Diego, California. He served as director of energy research with the U.S. Department of Energy and as the department's Assistant Secretary during 1979-81. Dr. Frieman was professor of astrophysical sciences and Deputy Director of the Plasma Physics Laboratory at Princeton University from 1952 to 1979. He is a member of the Secretary of Energy's Advisory Board, the White House Science Council, the President's Science Council, the Planning and Steering Group of the Advanced Technology Panel for the Vice Chief of Naval Operations, the National Academy of Sciences Ocean Studies Board, the California Council on Science and Technology, and is chairman of the Secretary of Defense's Task Force on Anti-Submarine Warfare. Dr. Fireman earned his bachelor's degree in engineering from Columbia University in New York and received Master's and Doctoral degrees in physics from the Polytechnic Institute of Brooklyn, New York.

Don Fuqua

Mr. Fuqua is President and General Manager of the Aerospace Industries Association and serves as a leading spokesperson for the U.S. aerospace industry. Before joining AIA, Mr. Fuqua served 12 terms as a U.S. Congressman, representing Florida's Second Congressional District. He was elected Chairman of the House Science and Technology Committee in 1979 after serving on the Committee since joining Congress in 1963. He is a member of the NASA's Advisory Council and is a founding member of the Challenger Center for Space Science Education. Mr. Fuqua has received numerous awards including the Rotary National Award for Space Achievement in 1988, and the National Aeronautics and Space Administration Distinguished Public Service Medal and the National Science Foundation Distinguished Public Service Award, both in 1986. Mr. Fuqua graduated from the University of Florida with a degree in agriculture economics. He also has honorary doctorates from the University of Notre Dame, Florida Institute of Technology, Florida State University, Florida A&M University, and the University of Florida.

Donald J. Kutyna
General Donald J. Kutyna, USAF (Ret.), retired after 35 years in the Air Force after having served as commander in chief of the North American Aerospace Defense Command (NORAD) and the United States Space Command. His military assignments include command of the Air Force Space Command, Vice Commander of the Space Division of Air Force Systems Command where he oversaw all space system acquisitions, with particular emphasis on programs associated with the Strategic Defense Initiative, and Director Space Systems and Command, Control, and Communications within the Office of the Deputy Chief of Air Force Research and Development. General Kutyna served on as a member of the presidential commission investigating the Challenger accident in 1986. He is a qualified command pilot with more than 4,500 flying hours in 26 different fighters and bombers. He received the National Geographic Society's General Thomas D. White United States Air Force Space Trophy in 1987 and the Air Force Associations's Schriever Award in 1991. General Kutyna earned his B.S. from the United States Military Academy and a M.S. from the Massachusetts Institute of Technology.

John M. Logsdon
Dr. Logsdon is Director of the Center for International Science and Technology Policy and the Space Policy Institute of George Washington University's Elliott School of International Affairs, where he is also Professor of Political Science and International Affairs. He is author of *The Decision to Go to the Moon: Project Apollo and the National Interest*, and has written numerous articles and reports on space and science and technology policy. He is a member of the International Academy of Astronautics, the Board of Advisors of The Planetary Society, the Board of Directors of the National Space Society, and the Aeronautics and Space Engineering Board of the National Research Council. He is a former chairman of the Committee on Science and Public Policy of the American Association for the Advancement of Science and of the Education Committee of the International Astronomical Federation. Dr. Logsdon is the first holder of the Chair in Space History of the National Air and Space Museum. He earned a B.S. in physics from Xavier University and a Ph.D. in political science from New York University.

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Bruce C. Murray

Dr. Murray is Professor of Planetary Science and Geology at the California Institute of Technology. From 1976 to 1982, he was Director of the NASA/Caltech Jet Propulsion Laboratory. As JPL Director, he oversaw the Viking landings on Mars (1976 - 1980) and the Voyager flybys of Jupiter and Saturn (1977 -1980). Dr. Murray was co-investigator on Mariner 4 which flew by Mars in 1965, the first television probe to another planet. His involvement in both the science and technology of spacecraft imaging increased successively with the Mariner 6 and 7 Mars flybys (1969), the Mariner 9 Mars Orbiter (1971-72), and the Mariner 10 flyby of Venus and Mercury (1974-75), for which he was Imaging Team Leader. Dr. Murray is author or co-author of over 100 papers dealing with earth and space science and technology, and of six books; *The View from Space* (1971); *Mars and the Mind of Man* (1973); *Navigating the Future* (1975); *Earthlike Planets* (1981); and *Journey Into Space* (1989). He is a member of the American Astronomical Association, a fellow of The American Academy of Arts and Sciences, and the American Geophysical Union. Dr. Murray earned his Ph.D. in Geology at the Massachusetts Institute of Technology.

Appendix II

Task Statement

A Task Group of the Vice President's Space Policy Advisory Board is being formed to conduct a broad review of current U.S. national space policies in the context of the end of the Cold War and other factors.

The fundamental principles which have guided the conduct of U.S. space activities were initially established nearly 35 years ago. The civil, commercial, and national security space programs of the United States have evolved within a policy framework that reflected the international tensions, as well as the economic and technological constraints and other factors of the time.

The situation has now changed. The end of the Cold War, the revolution in electronic and other space-related technologies; the international demand for space capabilities along with the proliferation of space technology to other nations, the lessons learned concerning the military use of space during Desert Storm, and other factors present new opportunities for cooperation and progress. The budget deficit and changes in the aerospace industrial base associated with lessened defense spending impose new constraints. More than ever before, the United States must ensure that it gets maximum return from its investments in space.

The Vice President's Space Policy Advisory Board recently assessed two critical areas that are building blocks for a successful space program. One Task Group examined ways that America's critical space-related industries are being affected by the defense build-down. A second Task Group sought to defy the limits of scarce resources by identifying ways to provide the nation with low cost launch systems that are safer and more reliable than the aging systems of today and more responsive to military and civil needs. The findings and recommendations of these assessments will provide a solid foundation for this comprehensive policy review.

In considering the affect of the new opportunities and constraints on U.S. national space policies, the Task Group should make policy recommendations which would have the affect of increasing the efficiency of federal government space activities to enable the best space program possible for the funds available; maintaining U.S. leadership and competitiveness for the 21st century; and, maintaining an industrial base capable of supporting future national security, civil, and commercial space requirements.

The following policy areas should be among those considered.

a. Policies affecting the synergism between civil, commercial, and military space activities in areas such as:

   - Cooperative development and sharing of new technology;

   - Greater use of common infrastructure such as launch facilities and ground tracking and data relay capabilities;

   - Greater use of common components, possibly adopting the commercial practice of using standard design satellites with mission unique payloads or establishing common design standards;

   - Shorter acquisition timelines that might be achieved by adopting the best attributes of commercial, military, and civil government procedures;

- Improved industrial productivity and accelerated transfer of technology and experience among space programs, possibly through some prudent adjustments in security and classification requirements and procedures;

- Enhanced international competitiveness of the U.S. private sector through the easing of government restrictions on the export of satellites and space technology; and,

- Increased use of commercial services to support federal government space requirements.

b. Policies affecting international space cooperation including:

- The potential for achieving U.S. space goals at lower cost or at higher levels of performance and reliability;

- The potential for the U.S. private sector to benefit from technologies developed in other countries;

- The potential implications for the U.S. domestic aerospace industry sector of federal government use of foreign suppliers to achieve U.S. space missions; and,

- The potential risks associated with dependence on foreign governments and their private sector industries for components, systems, or the development of advanced technologies essential for U.S. space missions.

c. Policies effecting the organization and management of government space activities which would enable faster, better, and less expensive programs. Considerations may include:

- Institutional roles and responsibilities;

- Acquisition oversight, particularly with regard to joint programs;

- Space operations; and,

- The appropriate role of state and local governments and the private sector in the conduct of federal government space activities.

d. Policies affecting the relationship between government and industry with a focus on ways to foster technological competitiveness and strengthen the overall U.S. trade stance in international markets.

In carrying out its assessment, the Task Group should review current space policy guidance and assess the current applicability of those fundamental principles and assumptions that have historically guided the U.S. space program. It should build on the findings and recommendations of the Vice President's Space Policy Advisory Board Task Groups currently assessing space launch and industrial base-related issues, and should consider recent reviews of U.S. space policy and program, when applicable, including the 1990 report of the Advisory Committee on the Future of the U.S. Space Program.

The Task Group should complete its assessment of U.S. space policy and provide a written report and briefing on its findings and recommendations by December 20, 1992.

Appendix III

Recommendations from *The Future of the U.S. Space Industrial Base*

Competency to Achieve National Objectives

Recommendation 1: To achieve the greatest leverage in maintaining the U.S. space industrial base, the DoD must be successful in implementing its policy to strongly support research and advanced technology; NASA should increase its efforts in space technology and work more closely with industry on technology transfer.

Recommendation 2: The government should promptly re-examine those laws and regulations that can inhibit efficient industry restructuring and "rightsizing" including areas such as antitrust regulations and tax treatment of excess facilities.

DoD/NASA Coordination

Recommendation 3: The DoD and NASA should address space industrial base issues in a closely coordinated format. This should be a continuing effort to enable appropriate government action when critical capabilities are threatened.

Recommendation 4: The DoD and NASA should jointly review the availability and capabilities of unique government and private space test facilities with the objective of developing a management plan for the

rational "rightsizing" of the facility base consistent with projected needs. A revitalized AACB would be an appropriate vehicle for such an effort.

Individual Agency Measures

Recommendation 5: The DoD and NASA should accelerate their adoption of the many past recommendations that have been made to increase the value received from contracted efforts. These should include minimizing unique requirements, using performance rather than design specifications, and greater use of commercial business practices and components.

Recommendation 6: The decision criteria for contract awards should give higher weighting to the preservation of critical capabilities through measures such as evaluation of past performance, available facilities and skills, and the potential industry restructuring that could result from the award.

Recommendation 7: Greater emphasis should be given to managing and reducing the operating costs of space systems. Minimizing such costs should be a major design criterion for new systems.

Recommendation 8: Government agencies should promptly assess the commensurate downsizing of the in-house and support contractor base in light of industry restructuring and the efficiencies that can be achieved by the adoption of more commercial procurement practices.

Space Launch

Recommendation 9: The United States should implement a fair-trade agreement to provide interim insulation of the U.S. commercial launch industry from unrestricted market access by NMEs and define a "rules-of-the-road" agreement with other governments.

Recommendation 10: Through a coordinated NASA and DoD effort, the United States should improve existing launch vehicles and upgrade the operating infrastructure in order to drive launch costs down with improved reliability.

Recommendation 11: The United States must develop and make operational a modern low-cost launch system in order to reduce the cost of government space missions, provide the nation with a highly competitive commercial launch capability, and stimulate the increased use of space by lowering the cost of access.

Commercial Space

Recommendation 12: The government should take action to remove impediments and implement policies in areas such as export regulations, trade financing, and market-opening measures in order to improve the competitiveness of U.S. firms.

Recommendation 13: Government agencies should seek procurement opportunities that promote the development of a robust commercial space industry through anchor tenancy, buying services and data rather than hardware, and using risk-shared technology demonstration programs.

Recommendation 14: Government agencies should encourage multiple, small programs in developing space technology and systems in order to encourage innovation and accelerate the translation of ideas into useful products.

Engineering Education

Recommendation 15: The government should initiate a study by the National Research Council to assess the effect of the current defense drawdown on the selection by undergraduates of future technical career paths and the impact on our future ability to accomplish national objectives in space.

Appendix IV

Recommendations from *The Future of the U.S. Space Launch Capability*

1. Revalidate the 1991 National Space Launch Strategy and establish a national policy and goal to remain internationally competitive in the space launch marketplace. The National Space Policy Directive 4, which establishes the National Space Launch Strategy continues to be valid guidance for developing the space launch system for the United States and the implementation of that strategy to remain internationally competitive should continue to receive priority within the affected government agencies. Alternatives to the strategy to either a) forgo new vehicle development and maintain existing launch vehicles, or b) attempt to "leap-frog" existing launch vehicle capability with reusable, and high-risk technology, we reject as inconsistent with maintenance of an effective, competitive, and high confidence space program.

2. Create a more formal "national" space launch management arrangement led by an individual with responsibility and authority for the planning and coordination of U.S. space launch capability. There is a need to provide a more centralized planning, integration, and coordination function for implementing the National Space Launch Strategy and associated programs. Several management models could achieve the desired results. The Task Group recommends the following actions. First, establish an Executive Committee consisting of the heads of major agencies involved in space launch (DoD, NASA, and the Space Council) to provide overall space launch guidance, review and approve

plans and program guidance, and adjudicate disputes among agencies involved. Second, designate a single authority (a "space launch authority") responsible to the Executive Committee for planning, coordinating, and integrating U.S. space launch capabilities. This individual should: 1) be an Executive-Level appointee assigned within either NASA or DoD who reports directly to the agency head 2) have the authority to recommend an overall plan and agency funding allocations to the Executive Committee and, within the guidance provided by the Executive Committee, provide program direction to each organization or agency acquiring or operating space launch systems, and oversee program execution 3) be responsible for planning and coordinating space launch technology programs for both existing and new launch vehicles 4) be a focal point for factoring the interests of the U.S. commercial launch industry into government space launch plans, and 5) be responsible for government support of a small launch vehicle program.

3. The space launch range modernization program being planned in the Air Force, known as the Range Standardization and Automation (RSA) project and related activities, should receive the highest priority in the space launch strategy implementation. Without the RSA modernization effort and other improvements that will support both the existing and future space launch vehicles, it is doubtful the necessary and desirable safety, reliability, and cost reduction improvements in space launch operations can be achieved. Furthermore, these improvements will enhance the competitiveness of commercial launches that share these facilities.

4. <u>Terminate the NLS development</u> within the government agencies and establish a new space launch capability program within the United States, consistent with the revalidated strategy, and under the planning responsibility of the new "space launch authority." The NLS program was oriented to develop a family of vehicles and design concepts that would lead to an ultimate heavy-lift launch vehicle. The Task Group rejects the near-term requirement for such a vehicle and believes that almost all of the government and commercial space launch requirements for the foreseeable future can be achieved with a vehicle in the lower range of payload performance being considered in the NLS program.

5. A <u>single</u> "core" space launch vehicle should be pursued that, through modular performance improvements, can meet <u>all</u> the medium and heavier lift requirements (20,000 to 50,000 pounds to low earth orbit) of civil, DoD, and commercial users. The new space launch vehicle program, to be known as *"Spacelifter,"* should have the following characteristics:

— employ applicable NLS technology and operational concepts that would reduce its hardware and launch costs and increase its reliability to the maximum extent reasonable and affordable

— compatible with both cargo and manned payloads, and have a performance capability that ranges from 20,000 pounds to 50,000 pounds to LEO with modular concepts (such as strap-on boosters or other innovative modular approaches to achieve the range of performance desired)

— a new high-energy upper stage to satisfy the full range of payload requirements

— a "design-to-launch-cost" goal of a factor-of-two below existing U.S. launch vehicles

— utilize appropriate commercial practices for the acquisition and operation

— extensively instrumented to minimize down-time if failure should occur

— man-rateable

— a very desirable goal is to be as nearly "environmentally clean" as possible

— Initial Launch Capability planned for the 2000 period to be consistent with depletion of comparable performance launch vehicle inventories and satellite block changes (such as the Follow-on Early Warning System (FEWS), or planned commercial satellites) required at that time

— a transition plan to the new launch vehicle that continues technology applications to improve near-term launch vehicle capabilities, reduces costs, improves reliability, and maintains high confidence in existing launch vehicles and supporting infrastructure until cost and performance of a new space launch vehicle has been demonstrated.

The Spacelifter vehicle will establish U.S. commercial competitiveness, reduce government launch costs, and provide the momentum to move modern technology and operations concepts from the drawing board to real operations. Higher priority should be placed on the design of launch base facilities using improved operational concepts.

If the United States is to depend on the Spacelifter/PLS for all future manned space flight and a majority of the unmanned space missions, the launch vehicle must have attributes that minimize the impact of potential launch failures. The probability of failure must be reduced and the return to operational space flight after the failure must be as quick as possible.

6. The Air Force should be designated as the manager of the Spacelifter vehicle development and operations. Since the first payloads to transition to this vehicle will be those produced by DoD, it is more appropriate that the Air Force manage the development of this vehicle. With the termination of NLS, the Air Force should develop a revised acquisition strategy based on performance rather than design specifications. It should encourage the widest application of technology, new contractor arrangements to preserve the space industrial base, and the application of the appropriate commercial practices to the development and operation of the new vehicle.

The acquisition model the Task Group suggests for Spacelifter has three phases. First, competition for Spacelifter would be open to all interested U.S. companies and these companies would be asked to submit conceptual designs, either individually or in teams. Companies would be permitted to incorporate the STME or any other technologies in their design. Second, the Air Force would select at least two organizations or teams to continue the competition for a short period of time, finalizing their vehicle design and operations concept. Finally, at the competition's conclusion, the Air Force would select the winning concept and industrial organization or team to complete the Spacelifter development and procurement.

7. NASA should immediately initiate and manage a two-phased space launch program to deploy and sustain the Space Station.

— **The first phase would continue to utilize the Shuttle for the deployment and man-tended phases of the Space Station.** Developing a heavy lift expendable vehicle based on Shuttle components to launch the Space Station would significantly increase the risk to the deployment schedule for the Space Station, divert resources from a more effective long term "national" solution to efficient launch operations, and be "dead-ended" in its application to future manned and unmanned heavy lift requirements. The Task Group questions whether the development of the heavy lift vehicle would be cost effective relative to continuing with the Shuttle to deploy and resupply the Space Station during the early phases of deployment and notes the difficulty and risks of transitioning the Space Station design, optimized for the Shuttle, to a new launch configuration associated with the heavy lift vehicle. Therefore, the Task Group does not recommend the development of a heavy lift launch vehicle based on Shuttle components for deployment of the Space Station. NASA should investigate the feasibility of introducing contingency plans to mitigate the effects of failures during the initial deployment and operation of the Space Station.

— **The second phase would utilize a man-rated version of the Spacelifter, a Personnel Launch System (PLS), and a Cargo Transfer and Return Vehicle (CTRV) to augment and then replace Shuttle support for the sustained operation of the Space Station.** The Spacelifter/PLS/CTRV would become the primary, long-term support to the Space Station. Funding within NASA for the PLS and CTRV developments needs to be provided immediately if these systems are to be available to support Space Station operations after the year 2000. In order to minimize the negative impact of down-load requirements on CTRV, NASA should undertake a study of options to dispose of non-essential materials from the Space Station.

8. To offset some of the development costs of the Spacelifter components and vehicles and to demonstrate the commitment to the Spacelifter development, plan for the following changes:

- **a major near-term reduction in the costs of Shuttle operations by contract incentives, reduction in Shuttle flights at the earliest opportunity, and the reallocation of personnel from Shuttle to the PLS, ACRV, and CTRV programs;**

- **plan to phase out the Shuttle at the earliest opportunity after the introduction and operational demonstration of the Spacelifter/PLS/CTRV capability;**

- **terminate MLV III, avoiding the potential of an additional U.S. launch vehicle, and continuing with the existing medium lift vehicles until Spacelifter becomes available;**

- **review the IELV competition and modify it to account for the transition of appropriate NASA payloads to a Spacelifter configuration;**

- **slow Titan IV production to about 3 per year and terminating further production upon transition of Titan IV payloads to a Spacelifter configuration;**

- **terminate the Advanced Solid Rocket Motor program;**

- **terminate the procurement of Shuttle structural spares and mothball the production tooling.**

A substantial part of the near-term investment to develop the Spacelifter vehicle can be offset by these reductions and the redirection of NASA personnel from Shuttle support to planning for the PLS and CTRV. The Task Group recognizes that some of these offsets will be controversial but it believes investments which add only marginally to current capabilities while diverting resources and attention from the required fundamental improvements just cannot be supported. The Task Group also believes MLV III will neither substantially reduce cost nor increase responsiveness

and may add to an already overcrowded infrastructure base. With regard to the ASRM program, there is considerable doubt that it will provide significant improvements in safety or reliability. Since Shuttle would be phased out shortly after ASRM became operational, ASRM development costs would not be recovered. Further, ASRM is not environmentally clean. The Task Group also suggests that the existing Shuttle solid rocket motor recovery system and associated refurbishment operations be eliminated at an appropriate point prior to Shuttle system final phase out.

9. Establish a government-supported, small payload launch program, using low cost launch vehicles, to encourage and promote space research and experimentation that will have a positive long term benefit to the overall national space program. Military satellite technology, civilian space research, university space research projects, and commercial space applications are focusing more and more on small satellites and associated small launch vehicles. Yet, as in the case of the larger launch vehicles, there is a lack of centralized planning for the use of small launch vehicles resulting in performance gaps and redundancy. The Task Group believes the government should establish a centralized small launch vehicle program that would better plan, integrate, and coordinate government-wide efforts for this class of vehicle. The planning for this program would be the responsibility of the "space launch authority," but management would remain within the agencies utilizing these capabilities.

10. To augment the small payload launch program, the Administration should permit the use of excess ballistic missiles for use as space launch vehicles for government sponsored research or commercial applications under specifically controlled conditions. The Task Group recognizes the controversial nature of this issue but believes that the long-term benefit to the space program and ultimate positive impact on the overall space launch industry in the future justifies use of these assets under certain conditions. Space research and experimentation and new mission concepts will be encouraged and "enabled" by the use of very inexpensive launch vehicles of the class represented by excess ballistic missiles. The use of these assets should be permitted when the following conditions are met: 1) the missions and payloads for such launch vehicles are for government authorized or sponsored research, technology development and test, experimentation and/or education and training, 2) there are no commercially available U.S. space launch vehicles that meet

the performance and cost requirements of the mission, 3) the use of more expensive commercially available launch vehicles in lieu of the excess missiles would have precluded the accomplishment of the mission, and 4) the conversion of the excess missiles and all of the launch services are performed by commercial companies selected under competitive processes. The "space launch authority" would determine if these conditions were being met on a case-by-case basis and, if so, recommend that DoD release the assets. The affected government agencies should be encouraged to develop arrangements that would facilitate use of these assets and that would minimize government exposure and liability.

11. Within the context of the overall approach outlined by these recommendations, the "space launch authority" should continue to plan technology efforts to: 1)improve performance, decrease cost, and improve reliability, safety, responsiveness, and competitiveness of existing space launch vehicles (SRMU, new low pressure engine concepts, materials, avionics, electronics, testing, etc.), and 2) provide for the next generation of low cost, reliable space launch vehicles that would fully exploit the value of reusability (NASP, SSRT, and HSCT). Our existing space launch vehicle fleet should continue to receive reliability and cost reduction improvements until the cost and performance goals of Spacelifter are demonstrated. This will provide a hedge against failure to achieve Spacelifter's performance and cost goals and maintain a viable contractor base to support the existing launch vehicle fleet. The Ten Year Space Launch Technology Plan, currently in coordination within the government, would form an acceptable baseline for budget planning and implementing this recommendation. NASA should continue to study heavy lift options for future application to manned and unmanned lunar and planetary missions. The Space Nuclear Thermal Propulsion (SNTP) program is an enabling technology for future manned exploration missions and should be continued to validate the feasibility, cost, and performance consistent with this future requirement.

12. A vigorous effort must be undertaken to reach a consensus with all government agencies and Congress to pursue and fund the recommended space launch program. If the restructuring efforts, including termination of on-going programs, are accepted without the full commitment to pursue and fund the new Spacelifter efforts, the entire military and civilian space program could be seriously damaged

with unacceptable gaps in space system operations. As stated previously, failure to fund this plan is equivalent to an implicit policy decision to forgo U.S. competitiveness in space launch and increase the long-term cost to the government. Once government funding stability can be achieved, industry will be encouraged to invest its own resources, leveraging government funds and further enhancing launch vehicle capabilities and competitiveness.

13. While the use of Russian space components might be appropriate on a one-time basis for technology assessment and transfer, or for a very few unique space missions, the Task Group does not recommend the use of Russian manufactured equipment on multiple, routine, or critical space missions. Russian equipment in the form of engines, space qualified components, and launch vehicles appears to be capable, effective, reliable, and available at competitive prices. This equipment may provide opportunities for positive technology transfer and licensing agreements, and could, in limited situations, advance the U.S. launch industry in technology and capability. However, the uncertainty of a sustained industrial base in Russia and the Ukraine (as well as access to launch facilities in Kazakhstan), the uncertainty of a stable long-term political relationship between the United States and Russia, and the detrimental impact such an arrangement could have on the U.S. industrial base and U.S. competitiveness demand caution and restrictions on cooperative arrangements.

14. Create a mechanism for downsizing both the space launch industry and supporting government infrastructure while continuing to satisfy future space launch requirements of the United States and taking into account commercial competitiveness of U.S. industry. Industry has indicated the government has certain impediments to the proper "right-sizing" of U.S. industry (e.g., antitrust laws) and political pressures will inhibit government from taking necessary steps to reduce or eliminate unnecessary government organizations or facilities that support launch development and operations. Participation of the launch vehicle industry in determining cost-sharing options and unique management arrangements to facilitate a new launch vehicle development should be solicited and encouraged. Since it is expected that industry would benefit from the introduction of a highly competitive Spacelifter, there should be some incentive for industry to share in the development cost.

Appendix V

A Summary of Recommendations from the *1990 Report on the Future of the U.S. Space Program*

The following are the recommendations of the Augustine Committee as summarized in the *Report of the Advisory Committee on the Future of the U.S. Space Program* issued in December, 1990.

Principal Recommendations

This report offers specific recommendations pertaining to civil space goals and program content as well as suggestions relating to internal NASA management. These are summarized below in four primary groupings. In order to fully implement these recommendations and suggestions, the support of both the Executive Branch and Legislative Branch will be needed, and of NASA itself.

Principal Recommendations Concerning Space Goals

It is recommended that the United States' future civil space program consist of a balanced set of five principal elements:

- a science program, which enjoys highest priority within the civil space program, and is maintained at or above the current fraction of the NASA budget (Recommendations 1 and 2);

- a mission to Planet Earth (MTPE), focusing on environmental measurements (Recommendation 3);

- a Mission from Planet Earth (MFPE), with the long-term goal of human exploration of Mars, preceded by a modified Space Station which emphasizes life sciences, an exploration base on the Moon, and robotic precursors to Mars (Recommendations 4,5, 6, and 7);

- a significantly expanded technology development activity, closely coupled to space mission objectives, with particular attention devoted to engines (Recommendation 8);

- a robust space transportation system (Recommendation 9).

Principal Recommendations Concerning Programs

With regard to program content, it is recommended that:

- the strategic plan for science currently under consideration be implemented (Recommendation 2);

- a revitalized technology plan be prepared with strong input from the mission offices, and that is be funded (Recommendation 8);

- Space Shuttle missions be phased over to a new unmanned (heavy lift) launch vehicle except for missions where human involvement is essential or other critical national needs dictate (Recommendation 9);

- Space Station Freedom be revamped to emphasize life sciences and human space operations, and include microgravity research as appropriate. It should be reconfigured to reduce cost and complexity; and the current time limit on redesign should be extended if a thorough reassessment is not possible in that period (Recommendation 6);

- a personal module be provided, as planned, for emergency return from Space Station Freedom, and that initial provisions be made for two-way missions in the event of unavailability of the Space Shuttle (Recommendation 11).

Principal Recommendations Concerning Affordability

It is recommended that the NASA program be structured in scope so as not to exceed a funding profile containing approximately 10 percent real growth per year throughout the remainder of the decade and then remaining at that level, including but not limited to the following actions:

- redesign and reschedule the Space Station Freedom to reduce cost and complexity (Recommendation 6);
- defer or eliminate the planned purchase of another orbiter (Recommendation 10);
- Place the Mission from Planet Earth on a "go-as-you-pay" basis, i.e., tailoring the schedule to match the availability of funds (Recommendation 5).

Principal Recommendations Concerning Management

With regard to management of the civil space program, it is recommended that:

- an Executive Committee of the Space Council be established which includes the Administrator of NASA (Recommendation 12);
- major reforms be made in the civil service regulations as they apply to specialty skills; or, if that is not possible, exemptions be granted to NASA for at least 10 percent of its employees to operate under a tailored personnel system; or, as a final alternative, that NASA begin selectively converting at least some of its centers into university-affiliated Federally Funded Research and Development Centers (Recommendations 14 and 15);
- NASA management review the mission of each center to consolidate and refocus centers of excellence in currently relevant fields with minimum overlap among centers (Recommendation 13).

It is considered by the Committee that the *internal* organization of any institution should be the province of, and at the discretion of, those bearing ultimate responsibility for the performance of that institution. Hence, the following possible internal structural changes are offered for the consideration of the NASA Administration:

- That the current headquarters structure be revamped, disestablishing the positions of certain existing Associate Administrators in order that:
  - — an Associate Administrator for Human Resources be established, whose responsibilities include making NASA a "pathfinding" agency in acquisition and retention of the highest quality personnel for the Federal Government (Item K);
  - — an Associate Administrator for Exploration be established, whose responsibilities include robotic and manned exploration of the Moon and Mars (Item C);
  - — an Associate Administrator for Space Flight Operations be established, whose responsibilities include Space Shuttle operations, existing expendable launch vehicle operations, and tracking and data functions (Item E);
  - — an Associate Administrator for Space Flight Development be established, whose responsibilities include Space Station Freedom and other development projects such as the Advanced Solid Rocket Motor and the new Heavy Lift Launch Vehicle (Item D);

- an exceptionally well-qualified independent cost analysis group be attached to headquarters with ultimate responsibility for all top-level cost estimating including cost estimates provided outside of NASA (Item B);

- a systems concept and analysis group reporting to the Administrator of NASA be established as a Federally Funded Research and Development Center (Item A);

- multi-center projects be avoided wherever possible, but when this is not practical, a strong and independent project office reporting to headquarters be established near the center having the principal share of the work for that project; and that this project office have a systems engineering staff and full budget authority (ideally industrial funding, — i.e., funding allocations related specifically to end goals) (Item G).

In summary, we recommend:

1) Establishing the science program as the highest priority element of the civil space program, to be maintained at or above the current fraction of the budget.

2) Obtaining exclusions for a portion of NASA's employees from existing civil service rules or, failing that, beginning a gradual conversion of selected centers to Federally Funded Research and Development Centers affiliated with universities, using as a model the Jet Propulsion Laboratory.

3) Redesigning the Space Station Freedom to lessen complexity and reduce cost, taking whatever time may be required to do this thoroughly and innovatively.

4) Pursuing a Mission *from* Planet Earth as a complement to the Mission *to* Planet Earth, with the former having Mars as its very long-term goal — but relieved of schedule pressures and progressing according to the availability of funding.

5) Reducing our dependence on the Space Shuttle by phasing over to a new unmanned heavy lift launch vehicle for all but missions requiring human presence.