THE FUTURE OF THE U.S. SPACE LAUNCH CAPABILITY

A TASK GROUP REPORT

VICE PRESIDENT'S
SPACE POLICY ADVISORY BOARD

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NOVEMBER 1992

Vice President's
Space Policy Advisory Board

November 18, 1992

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

Dear Mr. Vice President:

In July, 1992, you directed that a special task group of the Space Policy Advisory Board review the nation's Space Launch Strategy approved by the President in July, 1991. The enclosed report contains the findings and recommendations of the Task Group.

While the United States is meeting the basic needs of launching payloads into space to support government and commercial missions, we are not taking advantage of the efficient, effective, reliable, and cost competitive space launch concepts that our technology is capable of providing, and our nation is not keeping up with the international competition. Furthermore, the government is not accomplishing effective planning, integration, and coordination of the space launch programs across all the agencies involved.

The Task Group has provided a set of recommendations from a "national" perspective that will improve our nation's space launch capability, make us more competitive in the international marketplace, and reduce the cost of government space launch operations. The U.S. should start a single, completely new, "Spacelifter" space launch vehicle program that differs from the New Launch System (NLS) program that has been pursued in the last few years. The Spacelifter program would focus on the medium performance range, but be "modular" in its performance capability, to satisfy nearly all the government and commercial space launch needs from 20,000 to 50,000 pounds to low earth orbit. The Task Group also recommends a transition plan to phase out the older and expensive space launch vehicles, including Shuttle, when the performance and cost goals have been demonstrated for the new "Spacelifter" program, including the manned Personnel Launch System and Cargo Transfer and Return Vehicle.

The Task Group also recommends that a centralized management structure be established to oversee Spacelifter and other space launch activities. A single "Space Launch Authority" should be established to be responsible for the planning, integration, and coordination of space launch requirements and programs across all the government agencies that use this capability. This authority would report to the appropriate government agency head but would delegate the responsibility for managing, developing, and acquiring the space launch capability to selected government agencies.

The Task Group has also identified a number of existing activities that are of relatively low priority and should be considered as funding offsets to the expeditious development of the Spacelifter program.

It is extremely important that a consensus be developed between the current and forthcoming Administrations, the affected government agencies, Congress, and industry for the nation's new space launch program. Failure to reach this consensus and provide the fiscal support needed will result in the U.S. being non-competitive in the commercial space-launch marketplace and having to pay more than is necessary for the launch of government payloads on vehicles that are less responsive, reliable, safe, and flexible than could be achieved.

The recommendations of this report should be implemented immediately to reduce the risk of perpetuating an inefficient space launch program and to further demonstrate the U.S. commitment to competitiveness and leadership in space.

E.C. Aldridge, Jr., Chairman

Paul J. Coleman

Robert T. Herres

Richard M. Ringoen

Joseph F. Shea

Thomas P. Stafford

"The most fundamental building block without which there can be no future space program is the transportation system which provides our access to space."

Report of the Advisory Committee on
the Future of the U.S. Space Program,
November 1990

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Introduction

Over a year ago, on July 24, 1991, the President approved a National Space Launch Strategy, National Space Policy Directive 4, that had four major elements

- ensuring that existing space launch capabilities, including support facilities, are sufficient to meet U S. government manned and unmanned space launch needs
- developing a new unmanned, but man-rateable, space launch system to reduce costs and improve performance
- sustaining a vigorous space launch technology program that would apply to both existing and new space launch systems
- actively considering commercial space launch needs and factoring these needs into the decisions on improvements in space launch facilities and launch vehicles

The President directed that all affected government agencies implement these elements of space launch strategy within constraints of overall resource availability and other policy guidance

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The New Environment

The space launch capability of the United States is the most critical aspect of our overall space program, for without the ability to reliably deliver payloads to orbital velocities, the U.S. space program would not exist It was only after the United States demonstrated it had the ability to launch payloads, even very modest ones, in the 1958 period that the space program began to emerge and flourish. And only if we have the ability to continue to provide reliable, safe, and relatively inexpensive access to space will technologists, experimenters, and innovators find ways to fully exploit the benefits of space.

We are at a major decision milestone for our future space launch capability We now have a mixed fleet of space launched vehicles — variants of expendable vehicles that were derived from military ballistic missiles, a manned space transportation system using the technologies of the 1970s, and a new class of small payload launch vehicles using variants and derivatives of existing missiles. These vehicles meet the fundamental lift requirements of the payloads they launch, but the larger vehicles are expensive to operate and do not have the operational flexibility that would otherwise be desirable

Since approval of the launch strategy in 1991, world events have changed the environment in which the strategy was approved and in which we must implement the strategy These changes include the intensification of the competitive environment, the realization of the advantages of commercial practices, the availability of excess missile assets for space launch, the reflection of the latest, and reduced, demands on

space launch capabilities by a new mission model, and the growing uncertainty of the industrial base that supports production of U S space launch vehicles.

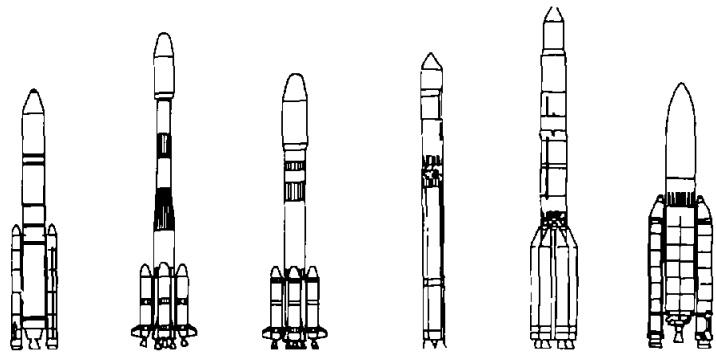
Any decisions on the implementation of a space launch capability must be based on the "national" perspective, that is, what is in the best overall interest of the nation rather than the individual interests of the government agencies affected, the programs involved, or the commercial space industry. That was the fundamental objective and focus of this Task Group's review.

Competitive Environment

Changes in the world environment have brought new challenges to the space launch capability of the United States. These challenges exist in the form of a variety of existing and new foreign space launch vehicles, shown in Figure 1, which are priced below comparable U.S launch vehicles.

While price competition from Ariane has been felt in the United States for years, Ariane could not absorb all commercial payloads being planned around the world For this reason, and the fact that commercial satellite builders were concerned over a potential monopoly for Ariane, the United States continues to receive launch orders for some of the world's commercial payloads at a rate of three to five per year.

New competition has now emerged which could significantly threaten both the United States and the foreign launch vehicle marketplace That competition is from the tremendous excess ballistic missile and derived space launch vehicles from the Confederation of Independent States, particularly Russia, and from the very inexpensive launch vehicles in the People's Republic of China. Russia has an impressive space launch infrastructure that could be used to seriously challenge U S competitiveness However, questions exist as to whether we want to take advantage of these new products for U.S. space launches, whether we could rely on these products being in production for long periods, and whether we should place great reliance on the existing but fragile near-term political relationships to commit critical space missions to these components for the long term.



Vehicle / Capacity	H II	Ariane 44L	Long March LM 2E	Zenit (Cape York)	Proton	Ariane 5
GTO (lb)	8 800	9 200 (7 deg incl)	7 500	9 500	12 000 (51 deg incl)	15 000
Country	Japan	Europe	China	Russia	Russia	Europe

Figure 1. Foreign Commercial Launch Service Competition

Figure 2 illustrates international launch vehicle competitiveness. If the United States is to remain competitive, it must reduce its cost (and price) to launch payloads by a factor-of-two, as shown by the "Low-cost ELV Goal" line in Figure 2.

Commercial Practices

There have been suggestions by Congress and industry that the government should take advantage of "commercial practices" to reduce the cost of launch vehicles and services. Five distinctions separate commercial from non-commercial practices:

— First, the procurement process, whether the government procures custom-built products priced by negotiation or off-the-shelf products priced by the manufacturers in an open marketplace.

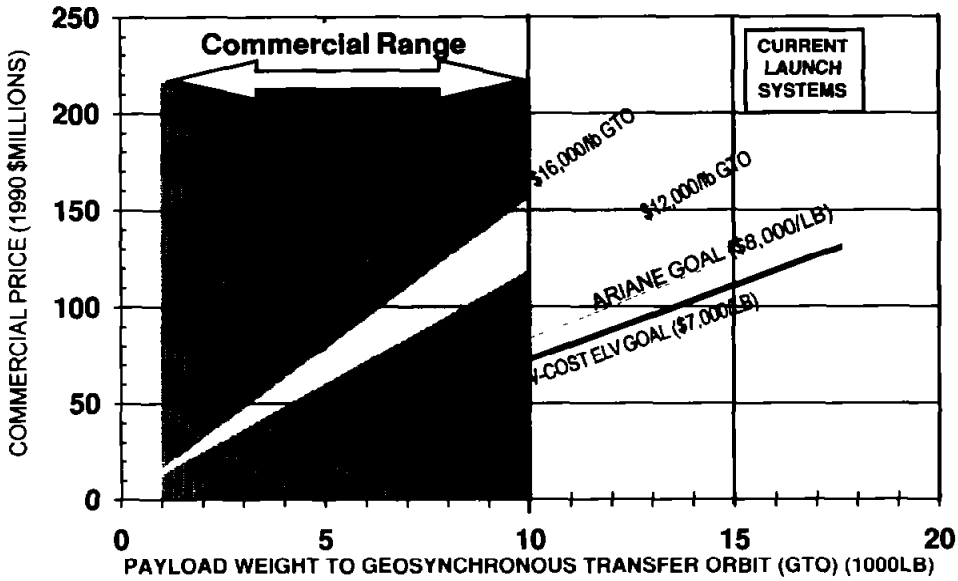


Figure 2 Launch Vehicle Recurring Price versus GTO Payload Weight

— Second, wide requirement ranges placed on manufacturers by the government with numerous multi-tier design specifications in government procurements versus only end-product or on-orbit performance specifications in commercial procurements.

— Third, the extent of oversight of the manufacturing process, with extensive oversight in government procurements and much less oversight in commercial procurements.

— Fourth, the government limitation on the operating profit of launch vehicle manufacturers under government contracts, which is uncontrolled in commercial contracts.

— Fifth, the financial risks of failure, which are borne by the manufacturer in a commercial contract and are mostly borne by the government in a government contract.

To minimize its risks the government requires more oversight of the launch vehicle manufacturer's processes and specifications Because mission success is more important in government operations than recovery of resources, as is the case in commercial operations, the government is

unlikely to accept the full range of commercial practices for space launch operations

However, U.S space launch is already "commercial" to some degree. Virtually every U S space launch vehicle launching satellites into Earth's orbit is built by a U S. commercial firm — Martin Marietta, General Dynamics, McDonnell Douglas, Rockwell, LTV, Boeing, or Orbital Sciences — and all of these companies participate extensively in the launch process

One question that must be addressed, is what can the government do, as it works towards its own space launch objectives, to take advantage of the potential cost savings from more application of the commercial practices outlined above and, at the same time, make the U S launch vehicle manufacturers more competitive in the commercial world market

Excess Ballistic Missiles

The phase down of the intercontinental and submarine-launched ballistic missiles (ICBM and SLBM) forces, such as the Titan II, Poseidon, and Minuteman, has provided assets that could and are being used for space launch vehicles Contracts already exist to convert 15 Titan IIs to space launch vehicles and a contract has been let to begin the conversion of the Minuteman to sub-orbital test vehicles There is some concern that these "free" vehicles will compete with the production of newer space launch vehicles by reducing the production rate, decreasing the number of production units, and increasing costs Opponents of using these assets argue that a more efficient, lower cost space launch production program could be built if the government would deny the use of these assets for competition with newly producted space launch vehicles In addition, using the excess assets perpetuates a "dead-end" program at the expense of longer range, small payload space launch programs

Proponents argue that the use of these surplus assets will facilitate lower cost access to space and, in so doing, foster more space-related research and development in both the commercial and university-based sectors than would have been the case without these assets. This additional activity will generate significant and profitable business for the fledgling commercial launch industry as it converts surplus assets and provides the

associated launch services. Finally, proponents argue that this demonstration of the market for launch services would allow entrepreneurial launch services companies to raise the capital needed for the development of new, more cost competitive launch vehicles and services.

Both positions have merit and a balance between the two points of view must be found.

Future Mission Model Requirements

Projections for the future show a stability in the annual space launch rates for the Department of Defense (DoD), civil, and commercial payloads at about 40 per year (Figure 3). Of these, about seven to eight flights are attributed to the Shuttle and about eight to ten per year are based upon the assumption that commercial satellite manufacturers, United States and foreign, will continue to rely on U.S. space launch vehicles in the future. The DoD launch rate of 15 to 17 per year is based on a revised estimate of space requirements and funding based on projected future national security needs in a new world environment

These launch plans are, of course, very dependent on the projected costs of future launch vehicles. U.S. commercial satellite launch rates will either decrease if U S launch vehicles can no longer compete financially with foreign launchers or the demand could or might increase if the United States makes a significant reduction in launch costs, thus encouraging the exploitation of space.

Industrial Base

As DoD resources decline, and the industrial organizations that support defense systems shrink and question their future, more and more attention will be placed on options to protect the critical and unique parts of that industry that might be required in the future The maintenance of a healthy launch industry through the development of new space launch vehicles would appear to be a responsive and efficient way to alleviate the defense conversion problem of our former missile industry. Expansion of

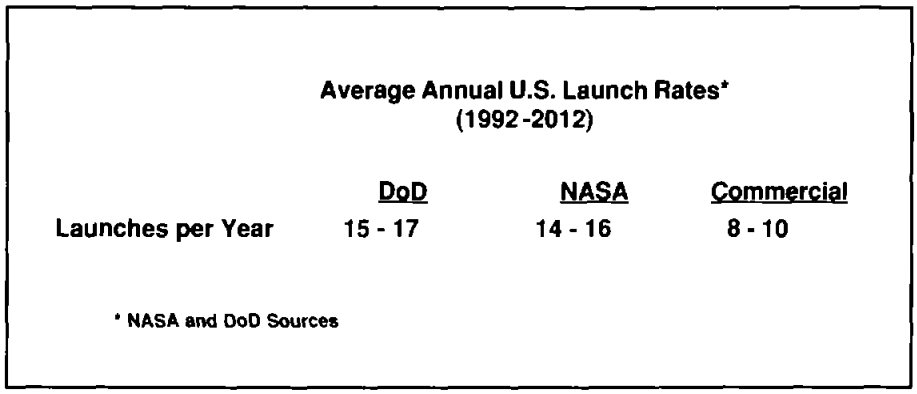


Figure 3. Average Annual U.S. Launch Rates (1992 - 2012)

the space launch vehicle industry through new technology for upgrades to existing vehicles, or the initiation of new vehicle developments to make the U.S. industry more competitive, would be a direct, expeditious, and valuable way to protect this section of the industrial base for future national security requirements. The United States is a world leader in space technology and the conversion of defense resources to protect that leadership would be a valuable way to enhance U.S. competitiveness.

Space launch vehicle contractors have been lacking in incentives to participate actively in, or even argue for, the development of a new launch vehicle The current contractors for Titan, Atlas, Delta, and upgrades to these systems are worried about their current business base and are reluctant to abandon near term business for an uncertain future program. Also, they are worried about the potential "winner-take-all" aspects of a future vehicle competition and the lack of Congressional support for the program. It is understandable that they have a cautious viewpoint and have been somewhat unenthusiastic about a new system without some changes in the management approach, political support, or investment incentives.

A recent National Security Industries Association (NSIA) study on the space transportation system made observations that give a more positive assessment of the industry's perception of the space launch situation. The more pertinent observations from the NSIA study are as follows:

— A new launch system is required.

— The current fleet does not meet DoD, NASA or commercial cost, responsiveness, availability, and operability requirements.

— Some of the present fleet should be retained until a new launch system is proven operational and price competitive.

— A new launch vehicle, with performance in the range of 20,000 pounds to low-earth orbit is of major interest for DoD, NASA, and commercial users.

— If industry invests in the new program, it will expect an adequate return on investment.

Not only did this study indicate a more positive view of a new launch system, it implied that industry might be willing to share in the development costs.

A New Direction

The 1991 National Space Launch Strategy was based on the conclusion that if the United States is to compete effectively in the future it must take near-term actions that will improve the efficiency of its space launch operations, maintain its reputation for reliability, and significantly reduce the cost (and price) to launch. The issue facing the Task Group was whether the conditions leading to this strategy continue to be relevant in today's environment.

Developing a "New" or "National" Launch System (NLS) will be relatively expensive and many related programs are currently underway that will compete for the same scarce fiscal resources The Task Group knows that it will be difficult for DoD to step up to a multi-billion dollar development program when its resources are declining rapidly DoD has

acceptable alternatives that meet its near-term needs in the Delta, Atlas, and Titan family of vehicles and its projected launch rates are declining which will extend the life of this existing fleet. It has been equally difficult for NASA to find the resources to support its share of a new launch vehicle Congress has been reluctant to give NASA increasing resources and the demands on NASA's budget for Shuttle operations, the Space Station, Earth observation, and planetary missions will consume the majority of its available resources. So far, there has not been a strong economic imperative or a critical payload requirement to drive the development of a new space launch capability.

3

Task Group Charter

The fundamental purpose of the Task Group was to review progress on implementation of the National Space Launch Strategy, to look broadly at launch activities, and, as a minimum, address the following issues:

- actions that have been taken or are being planned to assure that current launch systems and infrastructure remain capable of meeting U.S. launch needs into the early years of the next decade.

- progress on New Launch System (NLS) development including management arrangements, system design considerations, and performance projections. An assessment is desired of whether the objectives of cutting launch costs in half while increasing reliability and responsiveness remain valid and attainable

- plans for the transition of unmanned payloads from current systems to NLS including the relationship between early use of NLS and current agency plans for the purchase of additional large and medium-sized launch vehicles for use in the year 2000 time frame.

- planned investments in aerospace transportation technology including an assessment of the proper scope, pace, and relationship between the National Aerospace Plane (NASP), the Single Stage Rocket Technology (SSRT) program, the Personnel Launch System (PLS), and the High Speed Civil Transport (HSCT).

- plans for continuing human space flight into the early 21st century including transition from the current reliance on the Space Shuttle to a new capability such as an expendable launch vehicle-based personnel launch system.

- plans for the possible use of excess ballistic missiles for space launch.

- current and planned activities implementing the policy goal of actively considering commercial space launch needs and factoring them into U.S government decisions on improvements in launch facilities and launch vehicles.

The Task Group was asked to provide recommendations on actions that should be considered to streamline development, reduce cost, or otherwise strengthen the implementation of the Administration's policy objectives. The Task Group limited its review, primarily, to launch strategies that would be applicable to achieving low-earth or geosynchronous orbits, thus eliminating consideration for those launch capabilities necessary for future human flight to the Moon or Mars This report summarizes the findings from the review and provides recommendations to satisfy space launch objectives and to fully implement the space launch strategy.

4

Current Space Launch System Status

Manned Launch Vehicles

Since the return to flight operations in 1988, the Space Transportation System, or Shuttle, is launching and is planning to launch seven to eight flights per year. An Advanced Solid Rocket Motor (ASRM) program is in development, orbiters are being modified for use as Extended Duration Orbiters (EDO), there are plans to introduce a new turbopump for the main Shuttle engines, and development work is underway to improve some of the Shuttle instrumentation and avionics. In addition, there is activity within NASA to find ways to reduce the cost of Shuttle operations by more than 3% per year.

Planning for the Space Station calls for the Shuttle to be the exclusive launch and resupply system starting in 1996. About 17-20 Shuttle flights are planned to deploy, resupply, and man the Space Station until permanent manned presence, after which about five resupply flights per year will be required. Support of the Space Station has been "optimized" around the unique performance and capacity of the Shuttle. The Space Station modules have been designed to be compatible with the Shuttle bay size performance. Additionally, the Space Station operation's concept relies on the ability to return to Earth, in an empty Shuttle, a large fraction of the equipment, experiments, and products delivered to the station by prior Shuttle missions.

Some efforts are underway within NASA investigating a Personnel Launch System (PLS), a capsule concept for future manned flights on expendable launch vehicles, a Cargo Transfer and Return Vehicle (CTRV), a system to launch, deliver, and return cargo to and from the Space Station using expendable launch vehicles, and an Assured Crew Rescue Vehicle (ACRV), a concept for returning humans from the Space Station in times of emergency

Expendable Launch Vehicles

Upgrades and improvements are underway for the expendable launch vehicle fleet that supports DoD, NASA, and commercial customers.

— The Titan program, particularly the Titan IV heavy lift vehicle for DoD payloads, is being upgraded with a Solid Rocket Motor Upgrade (SRMU) to increase performance and improve reliability. In addition, launch pad modifications are almost complete at Cape Canaveral Air Force Station (Launch Complexes-40 and 41) to provide more Titan IV launch capacity to remove pad conflicts. Forty-one Titan IVs are currently under contract, providing launch capability until about the year 2000

— The Atlas II Medium Launch Vehicle (MLV) is being upgraded with strap-on solid rockets to increase lift capacity, and a launch pad modification is planned for Vandenberg Air Force Base to permit this improved vehicle to be launched to highly inclined orbits The eleven Atlas IIs under contract will provide launch capability until about 1996 at the planned launch rate.

— The Delta II Medium Launch Vehicle was recently upgraded with new solid rockets to improve its performance. Twenty-three Delta IIs are on contract but they will be depleted by 1995 at the current launch rates.

— A new Medium Launch Vehicle competition, MLV III, based on existing launch vehicle developments, is underway. Planned availability will be 1996.

- NASA is starting a competition for an Intermediate Expendable Launch Vehicle (IELV) to augment its ELV capability

- Fifteen Titan IIs are under contract for modification to space launch vehicles; three have already been launched.

- Upper stage programs such as Centaur and the Inertial Upper Stage (IUS) continue and technology work is focused on developing a new high energy upper stage and a Space Nuclear Thermal Propulsion (SNTP) stage for future application

- About $800 million of a $1.2 billion program to improve the space launch infrastructure within the Air Force, known as the Range Standardization and Automation (RSA) project, has been funded in future budget plans. This program would improve range support, reliability, and safety of ELVs and modernize facilities needing replacement and repair

- Small-ELV programs, such as Conestoga, Pegasus, and Taurus, are expanding to support the growing need to launch small space payloads.

- A program has been initiated by the Air Force to convert Minuteman missiles to sub-orbital launch vehicles initially, but contract options exist to convert these assets to space launch vehicles.

Technology Initiatives

The joint NLS program has been funded in both NASA and the Air Force at a total level of about $150 million per year, primarily for the Space Transportation Main Engine (STME).

Additional technology efforts in NASA and DoD are primarily aimed at supporting future generations of space launch vehicles and launch concepts A 10-year space launch technology plan is currently being coordinated throughout the affected government agencies The plan identifies roughly $700 million per year for investments in a variety of launch technologies.

Although funding levels have been variable, the National Aerospace Plane (NASP), the Single Stage Rocket Technology (SSRT) program, the Personnel Launch System (PLS), and the High Speed Commercial Transport (HSCT) technology programs will ultimately provide essential technology that will have useful application to future reusable manned and unmanned space launch vehicles.

The Issue

While it is apparent that much work is underway in the space launch area, it is questionable whether all this work is integrated and focused on achieving a cost-effective and balanced space launch strategy that supports the military, civil, and commercial requirements. As an indication of this lack of integration and coordination, the Congress recently approved the Defense Appropriation Bill that terminated the NLS effort in FY 93 and only $10 million has been appropriated in the FY 93 NASA budget to continue NLS technology.

5

Findings

Overall, the Task Group observes that the National Space Launch Strategy is **not being implemented in a cohesive, coordinated, and integrated manner** by the affected government agencies. Inconsistency in planning, lack of a formal coordination process for integrating plans and programs, and lack of program definition and priorities are indications that the management of the implementation of the strategy across government agencies has been inadequate.

The following findings, organized by tasks, provide an assessment of the overall situation with regard to U.S. space launch capability and the implementation of the space launch strategy

Current Mission Needs

1. The affected government agencies are taking the necessary actions to ensure that the current space launch systems remain capable of meeting the minimum projected U.S. space launch needs. Incremental improvements are underway in virtually all of our launch vehicles and significant improvements are being planned in future budgets for the space launch infrastructure that has deteriorated in the DoD. Technology efforts are being funded with various levels of success to support future generations of launch vehicles Reductions in launch rate demands for DoD payloads and restricting the use of the Shuttle to essential manned missions are increasing the likelihood that the current systems can meet launch schedules within acceptable limits It is clearly

understandable that current payload managers would not plan for launches if they did not feel confident that they had a launch vehicle that could meet their performance and schedule needs.

2. Although the near-term (through the year 2000) launch needs of the government are being met, the system is fragile, not as reliable or safe as it could be, more expensive than it need be, and inefficient in its operations. The combination of existing launch vehicle technology and dated operational concepts in launch facilities costs excessive time and money, reduces U.S. competitiveness, and keeps the United States from achieving low-cost access to and the full benefits of space The fundamental technologies of the 1960s and 1970s in launch vehicles and launch facilities are still being used These technologies result in frequent and unanticipated delays in planned launch dates. Delays on the launch pad, which have become more frequent over time, are often caused by repeated tests to enhance the confidence of success of a less-than-perfect launch vehicle with a very expensive spacecraft payload (e.g , trying to make a 95% reliable booster 100% successful) The delays increase cost and create launch pad conflicts. The impact of a Titan IV delay on the satellite program is about $8 million per day; the impact of a Delta II delay is about $1 million per day. The United States is using the same operational concepts for manned space flight developed for Apollo and the build-on-the-pad concepts developed for unmanned flights. This results in long periods between booster and payload delivery and launch If current or future U S launch vehicles cannot compete for commercial launches, then the cost to launch government payloads will increase through lower production and flight rates.

3. The current U.S. space launch industry has significant <u>overcapacity</u> in space launch vehicle production, based on projections of future government requirements and commercial expectations in launch rates. Shuttle flight rates have been reduced to a level such that each of four orbiters in the fleet fly on average twice per year. In addition, the United States has three major expendable launch vehicles that were planned to support a much larger flight rate than is currently projected We must find a way to downsize the industry to meet future demands while at the same time preserving competitiveness and providing a potential to increase launch rates if priorities, programs, and policies change. The government infrastructure, including the number of federal

government employees, supporting future launch capability is also larger than it needs to be to fully meet its management and operational responsibilities.

4. In light of the industrial overcapacity and the recent entry of very capable space launch vehicles from non-market economies into the launch vehicle competition, there is little hope for the United States to be price competitive in this market without major reductions in launch vehicle costs and mutual agreements on pricing guidelines and enforcement provisions. Current systems will not be competitive in the long term. Even with the introduction of new technology launch vehicles, it is doubtful that U S. industry can compete with the "flexible" prices than can be charged by the non-market economies without some type of government support for fair pricing provisions and mechanisms to enforce compliance.

5. The Shuttle is very expensive relative to its role in the U.S. space program. Hardware procurement and personnel levels required to support Shuttle refurbishment and reflight result in over 35% of NASA's budget (about $5 billion per year) being devoted exclusively to Shuttle operations to support only seven to eight flights per year planned for the future (See Figure 4). Until recently, adherence to the Roger's Commission recommendations has not permitted NASA to introduce incentives in the Shuttle operations contract to reduce these costs. The Task Group applauds recent efforts by NASA to find solutions to reduce Shuttle operations costs and supports NASA goals on cost reduction. The Shuttle has a unique and important role in manned space flight for the United States and it is inextricably tied to Space Station operations into the next decade. However, some solution to its high cost must be found.

6. Planning for Shuttle support of the Space Station is based on the assumption of no launch failure. There are no contingency plans for the possibility of launch failure, no Space Station spares, and the ACRV is not yet funded. While it is possible to have many additional Shuttle flights without failures, statistical analyses indicate it is likely that at least one failure will occur within the next 10 years. If so, there will be a significant period of time in which the Shuttle fleet would be grounded during the failure examination and recovery period. Following the return to flight, the Shuttle flight rate could be reduced because of the reduction in fleet

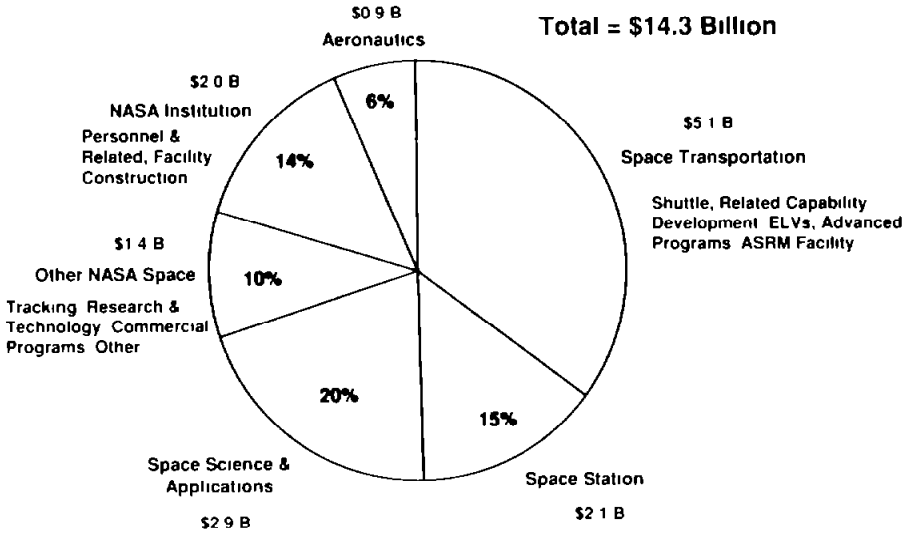


Figure 4. NASA FY 93 Budget

size. Space Station operation, especially after permanent manned presence, would be extremely risky following such an event, and the Task Group believes that planning the future strategy of manned space flight operations must account for the likelihood of a Shuttle launch failure. We must anticipate and plan for problems to occur in our space launch operations so that the impact of such events can be minimized. Because we had inflated expectations of performance and had not planned for an event such as the Challenger accident, the cost to the nation to recover was the loss of billions of dollars and many lost opportunities to fully exploit the advantages of space.

New Launch System

7. Extensive work has been underway in both NASA and DoD on the requirements and design concepts for the National Launch System. The fundamental approach to the NLS program has been to design a family of vehicles which would ultimately lead to a heavy lift launch vehicle. Over 600 people within NASA and the Air Force and approximately 150 contractor personnel have been working on the NLS

program, including the engine, flight vehicle, and operational concepts. Mission requirements have narrowed the range of NLS concepts to two fundamental design concepts — one based on launching 20,000 pounds to low earth orbit (LEO), called NLS-3, and the other based on launching 50,000 pounds to LEO, called NLS-2. A third, heavy-lift concept, called NLS-1, uses components of the other NLS vehicles to achieve a payload capability of about 135,000 pounds to LEO The Task Group observes that through the use of strap-on boosters and other innovative concepts in vehicle design, a single "core" vehicle configuration, using modularity, could satisfy the requirements to launch payloads in the range of 20,000 to 50,000 pounds to LEO

The STME, funded within the NLS program, is focused on providing an engine which would have application across a wide variety of launch vehicles, from the low performance NLS-3 configuration to the NLS-1, heavy-lift configuration. This engine is the long-lead item for the development of any of the NLS configurations The program has made good technical progress in demonstrating the potential for achieving the performance and cost goals necessary to make the NLS vehicle concepts viable and competitive The industrial consortium for the STME development is working well.

8. A heavy lift vehicle based on NLS technology would not be available to satisfy the initial deployment dates for the Space Station. So long as the Space Station remains on schedule for a late 1996 initial launch date, there is no NLS configuration that would be available to support the initial deployment. As an alternative to the Shuttle, and in attempt to minimize the number of Shuttle flights, NASA is studying the feasibility of a heavy lift launch vehicle concept using components of the Shuttle (modified external tank, Space Shuttle Main Engines (SSMEs), Redesigned Solid Rocket Motors (RSRM)s, existing kick-stages, and shrouds) that could meet the station launch needs and schedules without requiring Space Station redesign. If this vehicle became available, the number of flights to deploy the Space Station could be reduced by a factor of two (from 17-20 Shuttle flights to five heavy lift cargo-only flights and five Shuttle flights for construction).

9. The NLS program is not focusing fast enough on which NLS concept should have the development priority and there has been too

much engineering on the "vehicle" relative to the "operations" aspects of the launch system, including facilities, processes, and manufacturing. The NLS program office, NASA, and DoD have not yet determined, based on essential mission requirements, which of the NLS concepts should receive funding and development priority. The result is that the program office continues to work on all vehicles with equal priority, thus diluting attention and resources Relatively little priority has been given to NLS prelaunch operational concepts that could have a large impact on reducing launch costs The result of this lack of focus has given NLS a "tainted" name in the industry, government, and Congress. NLS has been incorrectly tied to "heavy lift", the Strategic Defense Initiative, and the Space Exploration Initiative with the inaccurate view that support for NLS was an implicit decision to pursue these other programs The Task Group believes that this lack of focus was a major factor in the Congressional decision to terminate the program

10. The data available at this point in NLS development continues to suggest that the launch cost of NLS class payloads could be cut in half while achieving improvements in reliability and responsiveness to mission needs. Current cost estimates for NLS-2 and NLS-3 are showing a factor-of-two reduction in launch costs over existing U.S. vehicles of comparable capability and launch rates and a 10-15% reduction over the best foreign competition (excluding Russian and PRC launch vehicles). However, these cost-to-launch estimates, essential for commercial competition, are critically dependent on the achievement of the cost goals of a new engine development and savings resulting from streamlined management and innovative operational concepts

11. NLS-derived vehicles <u>can</u> be justified on the basis of the economic replacement costs for the existing launch vehicle fleet if the system could lead to eventual phase-out of the Shuttle. A manned capability using NLS and PLS has the potential of improving reliability, safety, and downtime; reducing costs of manned space flight and permitting the phase-out of expensive Shuttle operations. With the phase-out of the Shuttle in the 2005 period (saving $3-4 billion per year) the cost to develop an NLS-type vehicle can be amortized over a reasonable period of time to justify, in economic terms only, the near-term investment required to bring a new launch system to an operational status. The Spacelifter launch system would have additional benefits of commercial

competitiveness and improved efficiency, safety, reliability, and responsiveness in launch operations. While it is difficult to quantify these factors, it can be anticipated that launch failures could be reduced by a factor-of-two — saving $1 to $3 billion over a ten year period. Moreover, increased responsiveness could allow a "launch on demand" vice the current "launch on schedule" replenishment schedule for DoD payloads, saving an additional $300 to $400 million per year. And transition to new systems enables the government to avoid the cost which would be required to purchase additional shuttle orbiters and otherwise maintain the existing fleet for an extended period of time

Transition Plan

12. The DoD has a plan, recently approved by the Deputy Secretary of Defense, to transition its operational satellites to a new launch vehicle at the block change for these satellites. Since NASA payloads tend to be different on each mission, a transition plan is not appropriate for NASA. The DoD transition plan reflects the expensive payload transition lessons learned from the ELV-to-Shuttle transition in the early 1980s, and Shuttle-to-ELV transition in the late 1980s. It is simpler, cheaper, and faster to transition operational space payloads to new launch vehicles at satellite block changes than during the normal production period of common satellite configurations. The one time cost of integration of a satellite to a new booster is comparable to the cost of the satellite. In addition, payloads must be designed to take advantage of the operational concepts, flexibility, and responsiveness of the NLS concepts. It makes little sense to use an NLS-type vehicle with its improved operational capability when the satellite it launches does not employ a comparable level of operational flexibility and responsiveness during the launch preparation period

Technology Investments

13. The technology efforts associated with NASP, SSRT, and HSCT are essential for application to future generations of <u>fully reusable</u> space launch vehicles. NASP, SSRT, and HSCT are not in competition with or a substitute for NLS since these technologies are not sufficiently

mature to risk "leap-frog" development until more confidence is demonstrated and uncertainties removed. However, reusability of space launch components has a potential high payoff and the technology efforts that could lead to reusable spacecraft, or components in the future, should be pursued. Assuming that the Administration and the Congress fund NASP at roughly the requested level, an SSRT program is instituted after the upcoming demonstration tests, and the HSCT continues to receive adequate priority, the technology availability will satisfy future development schedules for reusable launch vehicles after NLS. HSCT technology would be applicable to the first stage of a fully or partially reusable two-stage space launch vehicle.

Human Space Flight

14. The PLS, CTRV, and ACRV programs are not funded at a sufficient priority and level to meet any reasonable need date in the post-2000 period. In order to reduce the cost of manned space flight and to reduce Shuttle dependency at the earliest opportunity, PLS and CTRV development priority and funding will have to be increased to permit an operational availability in the post-2000 period. The ACRV, essential for permanent manned presence on the Space Station before 2000, is not yet funded.

15. The Advanced Solid Rocket Motor (ASRM) program to improve the reliability, safety, and performance of the Shuttle does not appear worth the additional investment required to bring it to an operational status. Independent assessments question whether the degree of added safety and reliability, and the $2 billion added investment needed to achieve the added lift performance, is essential for meeting Space Station deployment and resupply.

Excess Ballistic Missiles

16. The Administration has not taken a formal position on the use of excess ballistic missiles for commercial space launch, but in the interim has denied the use of these assets pending completion of their review.

Commercial Considerations

17. The DoD, particularly the Air Force, has been very active and supportive of the use of DoD assets for commercial space launch activities. Air Force procurement of expendable launch vehicles established the basic production capability that has enabled the commercial space launch industry to emerge. In addition, the Air Force has been using commercial-like practices in government launch vehicle purchases, offered the use of government facilities to commercial launch companies, and provided fuels, airlift, and test equipment at favorable rates In addition, the Air Force has, on occasion, rescheduled military launches to accommodate commercial launch schedules, facilitated access to restricted launch facilities to foreign visitors supporting U.S. commercial activities, and helped commercial firms deal with the federal bureaucracy. While the spirit of cooperation has been apparent, there is more that could be done to reduce the bureaucracy and streamline the process for further exploitation of space by commercial entrepreneurs.

18. The key to future <u>commercial</u> competitiveness of U.S. space launch vehicles is the development of an NLS-type vehicle in the 20,000 pound to LEO class. If the U S. government develops an NLS-class vehicle in the 20,000 pound class to support its civil and military space launch needs, the new vehicle, with its significantly reduced launch costs and improvements in reliability and responsiveness, should directly enhance the competitiveness of this U.S launch vehicle relative to foreign capabilities. Without such a vehicle it is doubtful that the U.S. space launch industry could compete much longer against the growing field of available foreign space launch vehicles.

Policy Considerations

19. Within the reasonable expectations of future funding available from the Administration or Congress, the United States must fund programs that are essential and critical to future space capabilities rather than trying to fund all the useful but non-essential programs currently being pursued. The United States simply cannot afford all the

elements of the existing space launch technology, development, and operational plans as projected (or anticipated) in future plans and budget estimates. It must be selective in funding the few programs that it can and must pursue.

20. Finally, and most importantly, a decision by the Administration or the Congress not to fund a new, reliable, low-cost operational space launch capability is a de facto policy decision to forgo U.S. competition in the international space launch marketplace, a mandate that the U.S. government will continue to pay higher prices than necessary to meet future government launch requirements, and acceptance of less reliability, less safety, and higher risks for space flight than our technology is capable of providing. Without the introduction of a new launch vehicle that meets cost and performance goals, we can write off future U.S. competitiveness in this area. U.S. national space efforts will continue to "limp along" with the burden of continuous criticism of high costs and high risks. The Task Group is extremely disappointed with the short-sighted decision of the Congress to terminate the NLS development, but views this event as an opportunity to redirect the effort toward a program based on well-defined performance and cost requirements and technical milestones.

6

Recommendations

Task Group recommendations respond to the findings outlined above and to Congressional action, which implicitly and explicitly terminates the NLS effort.

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 single "core" space launch vehicle should be pursued that, through modular performance improvements, can meet all 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 in the future 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 the 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., anti-trust 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.

7

Concluding Comments

The United States is in a very critical period in ensuring continued competitiveness in space launch in both the government and commercial marketplace. The Shuttle program is costing $5 billion per year (absorbing about 35% of the NASA budget) yet is planning to launch only seven to eight flights per year. The government is paying too much to launch government satellites on expendable launch vehicles. U.S. launch vehicles are not competitive with foreign launch vehicles and are receiving market share only because of rate limitations on the current foreign vehicles and fears of a monopoly by commercial satellite customers. New foreign space launch vehicle players have now entered the marketplace with even more competitively priced vehicles. U.S. government launch rates are declining which make U.S. vehicles even less competitive and government cost per launch even higher.

The technology developments in new launch vehicles and revised operational concepts give us confidence that we can produce a space launch vehicle that can save the taxpayer a significant amount in the future and make U S. space launch vehicles extremely competitive in the world market. The up-front development costs of new launch vehicles and manned spacecraft are high, but we will be able to achieve a very high return on this investment within a reasonable period of time by phasing out obsolete and expensive launch vehicles. Much of the initial cost can be offset with aggressive efforts to reduce current operating costs and termination of those programs that will not be necessary if we initiate the development of a new class of launch vehicles. Other near-term, indirect cost savings, resulting from elimination of launch delays, wasted efforts,

and failures resulting from the continued use of older technology vehicles can be achieved.

It is the unanimous view of the Task Group that <u>now</u> is the time to initiate an aggressive effort toward the development of a new generation space launch vehicle that will replace existing manned and unmanned launchers. The cost of this effort will be more than offset with the increased U.S. competitiveness, lower costs to government users, improved reliability, safety, and efficiency, and encouragement of additional research and experimentation to broaden our use of space. It is an essential step to ensure the United States enjoys the benefits of space exploration and exploitation, and it is the manifestation of the U.S. commitment to space leadership.

Appendix I

Task Group Membership

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Appendix II

Presentations to the Task Group

July 30-31, 1992

Task Group Charter
Brian D Dailey

Federal Advisory Committee Act
Llewellyn Fisher

Strategy Implementation Overview
Martin C. Faga

NASA Requirements Overview
Aaron Cohen

DoD Requirements Overview
Maj Gen Donald Hard

Existing DoD Launch Systems
Lt Col Wayne Eleazer

NLS Baseline and Status
Col Terry Graham

IELV
Charles Gunn

MLV III
Maj Sid Kimhan

Launch Manifest
Lt Col Rich Stibrik

NASA NLS Transition Plan
Mike Lyons

DoD NLS Transition Plans
Col Pete Gill

Launch Infrastructure
Maj Gene Powell

Shuttle Status and Plans &
Future Human Spaceflight
Mr Bryan O'Connor

Excess Assets
Mr Dennis Granato

Excess Assets Economic Impact
Mr. Richard Scott

Space Launch Technology Plan
Dr Gene Sevin

NASP
Col Phil Bruce

SSRT
Maj Jess Sponable

Single Stage to Orbit Technology
Mr Paul Holloway

High Speed Civil Transport
Mr Louis Williams

Upper Stage Technology
Maj Rich Perkins

August 17, 1992

STME Engine Design
John McCarthy / Fred Bachtel

NLS Program and Engine Costs
Lowell Zoeller /
Jerry Smelzer

SSF Shuttle Support
Richard Kohrs

Shuttle Flight Requirements
Lee Beach / Robert Davies

Heavy-Lift Launcher Requirements
Jay Greene

September 2-3, 1992

Earth-to-Orbit Transportation
Joseph G Gavin, Jr

Redesigned Solid Rocket Motor &
Advanced Solid Rocket Motor
Russ Bardos

Solid Rocket Motor Alternatives
Norm Parmet

NASA Spaceflight Safety Panel
John Blaha

Advanced Solid Rocket Motors
Laurence J Adams

Russian Soviet Space Capabilities
General Tom Stafford

Russian Business Opportunities
Scott Pace

Opportunities for Cooperation
Sam Keller

Russian Defense Perspective
Kent Stansberry

Russian Space Program
Stephen Tanski

Satellite Competitiveness
Scott Pace

Industry Perspectives
Ray Waldman / Lee Shearer

Aerospace States Association
Ed O'Connor

September 30, 1992

AFSPACECOM Spacelift Road Map
Maj Jim Knauf

Spacelift Infrastructure
Maj Reynolds

NLS Requirements
Maj Watkins

October 8, 1992

Shuttle Program Status
Tom Utsman

Air Force Commercial Launch Ops
Col John Angell