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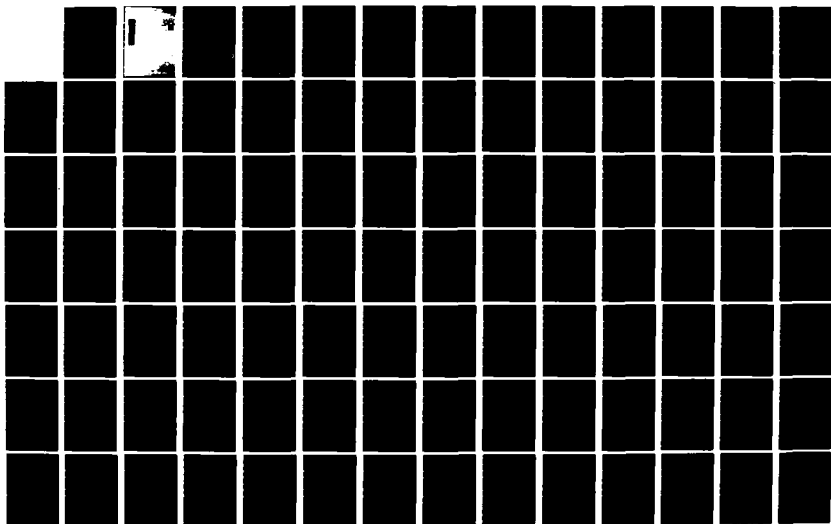
POLICY AND ORGANIZATION: THE NEXT STEP IN THE NATIONAL
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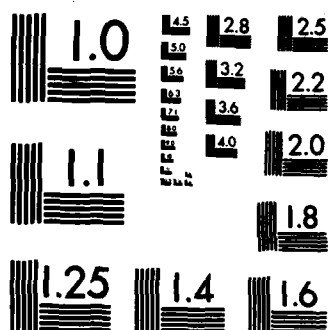
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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POLICY AND ORGANIZATION:
THE NEXT STEP IN THE NATIONAL SPACE PROGRAM

Research Report

by

Cass Schichtle
Colonel, USAF

1983

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National Defense University
Research Directorate
Washington, DC 20319

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Colonel Casper J. Schichtle, Jr., USAF, wrote this report while a Senior Research Fellow with National Defense University. He graduated from the AFROTC Program at Drake University, Des Moines, Iowa, in 1962, with a bachelor of arts degree in mathematics. In 1970 he received a master of science degree in Operational Research and Statistics from Texas A&M University, and in 1971 earned a Ph.D. in Operations Research and Management from the same university. Recent assignments have included Deputy Air Force Plant Representative at the Boeing Aircraft Company, Seattle, Washington; and Deputy Chief of Staff for Systems, Headquarters, Air Force Systems Command, Andrews Air Force Base, Washington, D.C. Colonel schichtle is currently serving as Director of Engineering and Projects, Ballistic Missile Office, Norton Air Force Base, California.



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CONTENTS

	Page
FOREWORD	iv
ABOUT THE AUTHOR	v
PREFACE.	vii
LIST OF ACRONYMS	x
CHAPTER	
INTRODUCTION	1
I. POLICY.	8
International Agreements.	11
Space Treaties and Conventions	11
Agreements with Military Implications.	13
International Programs.	17
Cooperation.	18
Competition.	21
Soviet Space Activities	24
Prospects for Future Policy	31
Civilian	31
Military	38
Recommendations	49
Update NASAct Along with New Policy.	51
Designate DOD Executive Agent.	53
Publish Air Force Doctrine	55
Establish Policy Review Mechanism.	56
II. ORGANIZATION.	64
Space Transportation System	65
Planned Shuttle Operations	65
DOD Involvement.	66
NASA Issues	71
Roles and Missions	72
Manpower	74
Organization	76
DOD Issues.	77
Operational Control.	78
Space Command.	82
Recommendations	84
NASA--Retain Capability, Reduce Scope.	84
Air Force--Plan for a New Command.	89

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura
REVISED: 3/25/83 OPERATOR: Dottie

CONCLUSIONS.	.93
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APPENDICES

A. Budget Tables and Figures.	.99
B. Texts of President Carter's Space Directives	106
C. International Space Treaties	113
D. Federal Agencies with Civilian Space Activities.	129
E. Space Organizational Figures	130
F. Space Systems Functional Flow Diagram.	132
G. Historical Background	133

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura
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FOREWORD

In 1978, President Carter announced his administration's National and Civilian Space Policies, along with the formation of a Program Review Committee within the National Security Council to periodically review those policies. Despite the initial criticism that too much emphasis was placed on the military program and the subsequent criticism that the civilian program lacked specific goals, these policies were never updated.

While three separate Congresses attempted to pass new space policies on their own, the Reagan Administration finally chartered an interagency working group to study the problem. Meanwhile, the space shuttle, as the nation's primary launch vehicle of the future, may be binding the military and civilian programs inextricably together; and for the first time in 20 years, funding for space efforts in support of national defense has not only caught up with the funding for civilian endeavors, it now exceeds it by nearly 25 percent.

In this paper, Colonel Schichtle supports a comprehensive national space policy that establishes realistic goals for the civilian space agency, as well as the establishment of a command within the Air Force to operationally control military space assets.

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PREFACE

This paper addresses the National Space Program, its confusing history, its current issues, and its probable future. The focus is on the government agencies charged with leading this nation's public and military programs, the National Aeronautics and Space Administration (NASA), and the Department of Defense (DOD), respectively. Although the legal role each agency plays can be found in the Space Act of 1958, the programs each pursues are most governed by national space policy. The central theme of this ^{report} ~~work~~ is policy, and the main purpose is to show the need for comprehensive civilian and military space policies along with the organizational changes required to implement them.

The Introduction discusses the complex space policy formulation process. Chapter I concentrates on prospects and recommendations for future policies. Chapter II looks at the Space Transportation System and institutional issues plaguing NASA and DOD.

To keep this work unclassified, there is no mention of the intelligence community's space work and program-specific data on military space systems are kept to a minimum. Although this self-imposed restriction does not alter the conclusions reached, it did limit the research to primarily open literature. Of the many space experts

AUTHOR SCHICHTLE
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informally interviewed and the nearly-100 authors cited, Arthur L. Levine's The Future of the US Space Program (New York: Praeger Publishers, 1975) influenced this volume the most. A former NASA employee and presently a university professor, as well as a noted author, Mr. Levine's views on the formulation of civilian space policies through the Nixon Administration and prognostications for the future were particularly incisive and helpful to me. To him, therefore, goes my first debt of gratitude.

This research would not have been possible without the further help and generous cooperation of the Congressional Research Service, especially Marcia S. Smith of the Science Policy Research Division. An author and specialist in energy and aerospace systems, Ms. Smith answered my many questions and provided literally volumes of information. I received valuable criticism from Colonels Charles Heimack, Robert Giffen, Christopher Branch, Stu Perkins, and Captain Robert Reed (USN), fellow students at the National War College, each of whom read a draft of the report. Special credit is due Colonel Fred Kiley, Professor of Research and hopefully a personal friend for many years to come, as well as the entire National Defense University Research Directorate, for reviewing, editing, and bringing this effort to press.

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Of greatest importance, I am grateful for the patience, understanding, and moral support of my wife, Linda, and my children, Julie, Chris, Mark, Nick, Matt, and Cassie. The time I took away from them to write this report while completing the resident National War College curriculum can never be restored. Although too little compensation, I dedicate this research effort to them.

AUTHOR SCHICHTLE
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LIST OF ACRONYMS

AACB	Aeronautics and Astronautics Coordinating Board
ACDA	Arms Control and Disarmament Agency
ABM	Antiballistic Missile
ABMA	Army Ballistic Missile Agency
ADC	Aerospace Defense Center
ADCOM	Aerospace Defense Command
AEC	Atomic Energy Commission
AFM	Air Force Manual
AFSATCOM	Air Force Satellite Communications
AFSC	Air Force Systems Command
ARDC	Air Research and Development Command
ARPA	Advanced Research Projects Agency
ASAT	Antisatellite
ASTP	Apollo-Soyuz Test Program
CSOC	Consolidated Space Operations Center
DARPA	Defense Advanced Research Projects Agency
DCSO	Deputy Commander for Space Operations
DMSP	Defense Meteorological Satellite Program
DOC	Department of Commerce
DOD	Department of Defense
DODD	Department of Defense Directive
DOE	Department of Energy

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DOS	Department of State
DSCS	Defense Satellite Communications System
ELV	Expendable Launch Vehicle
ESA	European Space Agency
FLTSATCOM	Fleet Satellite Communications
FOBS	Fractional Orbital Bombardment Satellite
GPS	Global Positioning System
ICBM	Intercontinental Ballistic Missile
IOC	Initial Operational Capability
IRBM	Intermediate-Range Ballistic Missile
IGY	International Geophysical Year
JPL	Jet Propulsion Laboratory (California Institute of Technology)
MAJCOM	Major Command (USAF)
MILSATCOM	Military Satellite Communications
MOL	Manned Orbital Laboratory
NACA	National Advisory Committee for Aeronautics
NACAA	National Advisory Committee for Aeronautics and Astronautics
NAS	National Academy of Science
NASA	National Aeronautics and Space Administration

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REVISED: 3/25/83 OPERATOR: Dottie

NASAct	National Aeronautics and Space Act of 1958 (Public Law 85-568)
NASC	National Aeronautics and Space Council
NCA	National Command Authority
NOAA	National Oceanographic and Atmospheric Agency
NRL	Naval Research Laboratory
NSC	National Security Council
NSF	National Science Foundation
OMB	Office of Management and Budget
OSD	Office of the Secretary of Defense
OST	Outer Space Treaty
OSTP	Office of Science and Technology Policy
PD	Presidential Directive
PPBS	Planning, Programming, and Budgeting System
PRC	Presidential Review Committee
PSAC	President's Scientific Advisory Committee
R&D	Research and Development
SAC	Strategic Air Command
SMOPS	Space Mission Organization Planning Study
SRF	Strategic Rocket Force
STG	Space Task Group
STS	Space Transportation System
TAOS	Thrust-Assisted Orbiter System
TT&C	Telemetry, Tracking, and Control

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INTRODUCTION

In July 1975, US and Soviet astronauts flew together in space, an historic first in international space cooperation. In contrast to the competitiveness of the 1960s, the Apollo-Soyuz Test Project (ASTP) demonstrated that nations could and should use space as a common ground for peaceful purposes and the amelioration of the human condition.

The beneficial aspects of the US space sciences and applications programs in providing early warning for natural disasters, predicting weather, increasing agricultural and mineral yields, monitoring pollution, improving worldwide communications and navigation, exploiting the untold riches of the oceans, and exploring the solar system have been well publicized. Even as these achievements mounted in the last decade, hope blossomed that further efforts would be undertaken increasingly on an international basis. Prior to the Carter administration, prospects seemed good that by the late 1980s there would be one or more large space stations in earth orbit, with the possibility that nationals of many countries would be participating in on-board activities, including earth-resources studies, manufacturing in space, weather and communications projects, astronomical observations, and various other scientific experiments.

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Although the outlook for such cooperative and beneficial space ventures appeared bright (six civilian government agencies were receiving space funding by 1970), the possibility could not be ruled out that space might become another arena for the arms race. Satellite support of military activities by the United States and the Soviet Union was extensive. The United States was strictly limiting its military space projects to defense-support missions for early-warning systems, reconnaissance, communications, and navigation. Even though international agreements prohibited weapons of mass destruction in orbit and other aggressive uses of space, satellites and space stations obviously had potential military capabilities. If rival powers began to use space for potentially aggressive purposes, despite international agreements, the United States would have to reconsider its own military space posture.

Whether the US space program had a civilian or a military orientation depended on the government's space policy. Similarly, whether the US developed its space projects to compete with those of other nations or for non-competitive uses--with or without the cooperation of other nations or international organizations--all depended on space policy. Within these alternatives, space policy also determined the priorities for exploration, science and practical applications, and the role of manned space flight in each. Many factors other than military security entered into the governmental decisions that shaped space policy, such as

international cooperation, technological prowess, scientific discovery, commercial applications, and national pride and prestige. These factors were molded chiefly by the National Aeronautics and Space Administration (NASA), the nation's civilian space agency, and the Department of Defense (DOD), especially the US Air Force. The influence enjoyed by NASA and DOD with the President, his staff agencies, and Congress, coupled with support from the aerospace industry, the scientific community, and the public, determined the thrust of the nation's space policy.

What happened? Official US policy towards space exploration fluctuated dramatically from the ^uculmination of President Kennedy's mandate to land men on the Moon by the end of the decade, to the current policy of low-level space budgets with few projects and no space spectacles.¹ The 1970s witnessed a shift away from a manned space flight emphasis toward unmanned "application" satellites. Not only were the last three Apollo lunar landing missions cancelled, but the once ambitious Apollo applications program, renamed Skylab, was also reduced in scope to a single space station. The ASTP international space flight in July 1975 heralded the end of the Apollo era. NASA acknowledged in the early 1970s that the "aerospace depression" had clearly begun and that the old days of "gung ho for space" were gone.² Despite this situation, on 5 January 1972 President Nixon made the scarcely noticed announcement that the United States would start development of the Space Shuttle. From 1976-1978, NASA faced cost and schedule problems on the space

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transportation system and, saddled with low-level funding, had to cut back in other endeavors. Consequently, space science and applications programs suffered and dreams of large civilian space stations orbiting in the 1980s dimmed. Meanwhile, this period saw military programs rapidly expanding with satellites being developed and launched for a variety of functions including reconnaissance (photographic, electronic, early warning, ocean surveillance, and nuclear explosion detection), communications, navigation, meteorology, and geodesy.

More currently, 1981 proved to be a banner year for issues surrounding US activities in outer space. The first two flights of the shuttle reminded the nation not only that it had a space program (no US citizen had gone ^{to} space in six years), but that space could be used for military as well as civilian activities. NASA's eventual fleet of four space shuttles is the point at which the civilian and military space programs clearly intersect. Not only are the shuttles America's major commitment to space exploration and exploitation, but they are the first NASA spacecraft to have a military role.³

Developing policies and goals for DOD's military and NASA's civilian programs, and for interaction between the two, has become critical because of tighter budgets, since many of the efforts seem duplicative. In addition, DOD's space budget authority has grown to exceed NASA's (Appendix, Table A-1). With the advent of the space shuttle era wherein

both agencies will be using the same launch system, clear distinctions between the two programs are blurring, and the possibility of merging them into one agency has arisen.⁴

Other issues about the Government's increasing role in space include whether or not NASA can or should operate systems such as the space shuttle once they are out of the research and development phase,⁵ and whether military activities in space warrant establishment of a separate organization within the Air Force--a space command. At a 7 December 1981 press conference, in fact, Rep. Ken Kramer (R-Colo) announced he had introduced legislation to do just that.⁶ In addition, the roles in space of other federal agencies and the private sector are growing. The Department of Commerce, for example, has responsibility now for operating meteorological satellites, and, in the future, for remote sensing satellites. Not only is a greater segment of private industry using space technology such as communications satellites, but one company (Boeing) is interested in operating space systems such as the shuttle directly.

Concurrently, space is becoming more international in character. China, India, Japan, and the Soviet Union have their own launch capabilities. In addition, the European Space Agency (ESA), a group of 11 European nations, is now testing its Ariane launch vehicle, which is expected

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to compete directly with the space shuttle for launching commercial payloads into space.

In the increasingly complex world of space policy, the nation no longer has one overall goal but rather a multipurpose program, encompassing both manned and unmanned flight, civilian science and applications, and military security. The keys for such a diverse effort to be viable in future years are appropriate national policies and sufficient funding.

In subsequent chapters, this monograph will trace the evolution of the civilian and military programs that have constituted the overall national space program. This, in turn, will reveal the current stage of transition, which calls for changes in national policy, and military and civilian organizational postures. Recommendations will follow for each area.

AUTHOR SCHICHTLE
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ENDNOTES

1. Marcia S. Smith, "Space Policy and Funding: NASA and DOD," Issue Brief Number IB78093, The Library of Congress, Congressional Research Service, 15 December 1981, p. 1.
2. Jerry Grey, Enterprise (New York: William Morrow and Company, Inc., 1979), pp. 55, 70.
3. Trudy E. Bell, "America's Other Space Program," The Science, December 1979, p. 10.
4. Ibid., p. 12.
5. US Congress, House, Report for the Subcommittee on Space Science and Applications, United States Civilian Space Programs 1958-1978, January 1981, pp. 6, 1125-1244.
6. Leonard Larson, "Kramer Calls for Military Force Prepared to Defend US in Space," Denver Post, 7 December 1981, p. 4A, and Leonard Famiglietti, "More Jobs Seen in Space," Air Force Times, 14 December 1981, p. 1 (related articles pp. 16, 19, 21).

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CHAPTER I

POLICY

On 2 November 1981, the Los Angeles Times published an article by Representative Edward P. Boland (D-Mass.), Chairman of the House Appropriations Subcommittee on Housing and Urban Development and Independent Agencies:

If, the truth were known, never was this nation's space program beset by more uncertainty, greater disarray and a cloudier future in all its 30-year history.

. . . it all comes back to a problem of dollars. It is not possible to squeeze a major shuttle development program and new planetary missions and aeronautical research out of a continually contracting budget.

And so NASA is at the crossroads. Decisions must be made, and made soon, on the future role of the US civilian space agency. What will happen to the space shuttle? Will it become a \$15 billion white elephant?

Ironically, the shuttle may gradually evolve primarily into a military vehicle. That would be a particularly difficult pill to swallow because, in trying to hold the shuttle's funding harmless, nearly all NASA's science and applications programs are being sacrificed. That tragic and frustrating scenario appears to be the trend.

In effect, we may be witnessing the gradual "militarization" of NASA. Sadly, we may see NASA become nothing more than an arm of the Department of Defense tasked with running a trucking company. That would abrogate to the Japanese and the Europeans many science applications and communications programs in

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the next decade. When one looks at the trends, it is hard to escape these conclusions.

. . . until a space policy is set out that succeeding Administrations and Congresses will stick with, we are going to continue to pay more for less.¹

Two months later, the Washington Post quoted Mr. George Keyworth, the President's Science Advisor, from his speech before the American Association for the Advancement of Science: "the government must seek out the less productive research areas in science and sharply cut their funds Planetary exploration programs produce less hard science than other parts of the federal space science budget."²

Meanwhile, on the DOD side of the ledger, after reporting on the bill in Congress to rename the Air Force the Aerospace Force and set up a Space Command, the Air Force Times asked the question:

Is it time to take the military space program out of the closet and expand it into a full-blown national effort? Or should we maintain the fiction that our only interest in space is scientific and exploratory and continue to let the military ride the civilian program on a space-available basis?

While the Soviets make no bones about their military involvement in the area, we have clung doggedly to the position that ours is a peaceful, civilian effort "untainted" by military considerations.³

In addition, the Air Force Times reported criticism of DOD by the Government Accounting Office (GAO) in April 1982:

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The Defense Department has a limited view of space and isn't doing all it could to exploit that frontier

The United States should take immediate action to provide a capability to exploit space and protect our interests there

Although DOD said it views space as an adjunct to accomplishing other missions such as providing communications, surveillance, navigation and meteorological support, presidential policy directives call for broader actions

These policies include: (1) maintaining the right of free access to space; (2) exploring and using space to support national well-being, and (3) pursuing space activities for national defense, deterrence of attack and arms control.

Achieving these broad objectives . . . requires the focus on space as a mission area, not a functional one as is the case today.⁴

One way of using space as a mission area was recommended by the conservative Heritage Foundation in March 1982. In its study, "High Frontier," the foundation proposed "a major shift in US defense strategy in which nonnuclear weapons shot from satellites in space . . . would destroy Soviet missiles as they are flying toward the United States."⁵

While the militarization of NASA or the threat of it becoming an arm of DOD is remote, the steady erosion of space science and applications budgets, coupled with the unlikelihood of another Apollo or Shuttle research and development effort, cloud the civilian space agency's future. Barring some catalytic event such as Sputnik that would focus

national attention on another major space endeavor, NASA is destined to inherit only the roles of the nation's researcher for advanced aeronautical and space technology and the "point of contact" for international cooperative efforts in space.

Conversely, DOD's space efforts are expanding and its responsibilities are growing. The objective of DOD is to prevent war, particularly nuclear war, but DOD must be prepared to wage war if necessary, even in space. Not to be prepared for this eventuality would be to deny both the Soviet threat and the lessons learned from the growth of air power. The GAO's criticisms notwithstanding, the Air Force has recognized the importance of space as a mission area for some time, but is delinquent in updating its basic doctrine. It is time to expand the military space program into a full-blown national effort.

International Agreements

Soon after Sputnik 1, many countries realized that legal problems might evolve from new ventures into space. To date, this concern has resulted in four space treaties, ~~Appendix (C.)~~ (see Appendix C.).

Space Treaties and Conventions

The first treaty to be signed was the "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, In-

cluding the Moon and Other Celestial Bodies" (more simply, the Outer Space Treaty or OST). First considered by the UN Committee on the Peaceful Uses of Outer Space in 1966, it entered into force on 10 October 1967. The OST was concerned with only general principles and did not involve details for effectuating the concepts it contained. The three treaties which followed expanded on its premises.

The "Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space" (Astronaut Rescue and Return Agreement) elaborated on Articles V and VIII of the OST. After four years of consideration in the UN, it entered into force on 3 December 1968.

The third space agreement, "Convention on International Liability for Damage Caused by Space Objects," took the longest to ratify. Legal liability for damage was first considered by the UN in 1958 but the convention was not completed until 9 October 1973.

The last international space agreement, "Convention on Registration of Objects Launched Into Outer Space," was based on the voluntary registration system in operation since 1962. This convention established a mandatory system for centralized and public registry of all space objects, and entered into force on 15 September 1976.

Agreements with Military Implications

The OST is currently the principal international agreement that deals with military space-related activities. Article IV prohibits the placement of nuclear weapons or any other weapon of mass destruction in earth orbit, the installation of such weapons on celestial bodies, or the stationing of such weapons in outer space in any manner. It does not prohibit use of ICBMs with nuclear warheads in suborbit or fractional orbit. Although "weapons of mass destruction" is not defined, the generally accepted view is that they include nuclear, chemical, and biological weapons. Article IV also specifies that the moon and other celestial bodies are to be used "exclusively for peaceful purposes." The Soviets have defined this phrase as "non-military," while the United States has interpreted it more expansively as "nonaggressive." Although military personnel may be used for scientific research or any other peaceful purpose, certain specific activities are prohibited on celestial bodies such as the establishment of military bases, installations, or fortifications; the testing of any weapon; and the conduct of military maneuvers.

There are other space agreements with military implications in addition to the OST. Article I of the Limited Test Ban Treaty of 1963 prohibits nuclear weapons tests or any other nuclear explosions in outer space.

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Two provisions of the UN Charter were made especially applicable to space by Article III of the OST. Members of the United Nations may not in their international relations use force against the territorial integrity or political independence of any state (Article 2 (4), UN Charter). However, member states do have the inherent right of individual or collective self-defense if any armed attack occurs (Article 51, UN Charter). The United States has traditionally maintained a broader right (i.e., military, economic, or political) to respond to any threat in self-defense, to act in anticipatory self-defense, or to act in self-defense to avoid accidental injury.

The Antiballistic Missile (ABM) Treaty of 1972 prohibits interference with reconnaissance satellite verification of treaty compliance (Article III) and the development, testing or deployment of space-based ABM systems and their components (Articles IV and V). The latter presumably includes radars for early warning of strategic ballistic missile attack.

Article I of the Environmental Modification Convention prohibits military or other hostile use of environmental modification techniques as the means of destruction, damage or injury to any other state party if such usage has widespread (several hundred square kilometer area), long-lasting (several months or approximately a season), and severe effects (serious or significant disruption or harm to human life, natural and economic resource or other assets). Environmental modification

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techniques are defined as any technique for changing, through deliberate manipulation of natural processes, the dynamics, composition or structure of the earth or outer space.

The Moon Treaty was unanimously endorsed by the UN General Assembly in December 1979 and referred to member states for signature and ratification. To date, the United States has neither ratified nor signed the agreement, nor has the Executive Branch formally submitted the agreement to the Senate for its consent, nor does it appear likely to for some time to come. However, if it were to be ratified, the Moon Treaty would impose the following additional legal obligations:

1. Extend prohibition on use of force or threat of use of force to "any other hostile act or threat of hostile act" in the area of treaty applicability (the Moon, other celestial bodies except the earth, orbits around, and trajectories to or around those celestial bodies).
2. Extend "peaceful purpose" and related OST prohibitions to orbits around the trajectories to or around celestial bodies.
3. Prohibit interference with activities of other states parties in the area of treaty applicability.

Thus, US activities in space are conducted within the context of a body of international as well as domestic law. This limited body of bilateral and multilateral treaties, international conventions, and international customs and practices directly influence space policy and activities.

From a military point of view, the most significant of these is the customary behavior toward space by the United States and Russia, until recently the only nation states capable of exploiting space. With the exception of those provisions in the OST, ABM Treaty, and the Limited Test Ban Treaty restricting specific types of military activities in space (weapons of mass destruction, interference with national technical means of treaty verification, development, and deployment of a space-based ABM, nuclear testing in space), nothing in the body of international space law specifically defines whether or not a particular use of space conforms to the general principles set down in the OST and the UN Charter. Since the OST recognizes the inherent national right of self-defense (as stated in Article 51 of the UN Charter), the United States has supported the concept of the peaceful use of space but has interpreted such use to mean nonaggressive in contrast to nonmilitary.

From a civilian point of view, there is considerable latitude for policy flexibility within this minimal regulatory regime. A basic objective of US civil space policy has been to conduct national programs to

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promote an international climate of legitimacy, acceptance, and minimal interference. The United States has carefully developed and maintained worldwide user communities in areas of launch assistance, remote sensing, weather service, telecommunications, and space sciences.

International Programs

In summarizing international efforts in space with countries other than the Soviet Union through 1978, Marcia S. Smith, a specialist in aerospace and energy systems for the Congressional Research Service, said:

The evidence shows clearly that the United States still has a lot more it could do to make the best use of talents in other countries. How much we can accomplish in this area depends primarily on the strength of NASA's budget in the coming years.⁶

With respect to joint efforts with Russia, success in the past is best summarized by this forecast for the future:

. . . cooperation with the Soviet Union is still welcomed by many US scientists, but their Russian counterparts had better be fully prepared to cooperate or be left out of future US missions. This attitude generally characterizes the current US position regarding space cooperation with the Soviet Union: cooperation is beneficial and desirable, but the exchange must be reciprocal and unfettered by the incomplete information transfer evidenced in the past.⁷

Cooperation

Within the United States, international cooperation in space is principally the responsibility of NASA, through its International Affairs Division, and DOS, through the Technology Policy and Space Affairs Office of the Bureau of Oceans and International Environmental and Scientific Affairs. There are primarily two ways in which international programs materialize: a foreign agency expresses a desire to NASA to participate in a certain program; or a program office or field center within NASA develops a program conducive to international cooperation and suggests it to the Division and vice versa.

Once negotiations have been completed between NASA and the foreign agency involved, agreements can take several forms:

1. An Executive Agreement (or Intergovernmental Agreement), which is consummated by officials of each government signing the agreement. This is used primarily for programs involving large amounts of money, such as Spacelab, and for reimbursable launches.

2. Agency Level Memoranda of Understanding are used for less expensive projects and are signed by the NASA Administrator and his foreign agency counterpart.

3. Letter Agreements are used for programs such as experiments on NASA satellites. These are signed by NASA's International Affairs Division and their foreign counterparts.

4. Lastly, there are informal projects which are conducted without signed agreements and they account for a significant percentage of NASA's cooperative efforts.

Only Executive Agreements have to be processed through DOS, but NASA obtains State Department concurrence on Memoranda of Understanding and informs DOS of its intention to formulate Letter Agreements.

NASA offers two types of arrangements for launching foreign payloads, cooperative agreements and reimbursable agreements. Under the cooperative arrangement, the United States provides the launch vehicle and services free of charge in return for access to resulting scientific information. No exchange of funds takes place between the two countries and each is responsible for its own contribution. Under the reimbursable arrangement, NASA charges the user for launch services and travel expenses for joint working group participants; and, since 1976, NASA has attempted to recover certain indirect costs such as project management, engineering support, depreciation, and research and development.

From 1962 through 1978, there were nearly 40 cooperative launches with a wide variety of stated purposes: ionospheric studies,

atmospheric physics, radio astronomy, solar astronomy and cosmic rays, particles and fields, atmospheric studies, investigation of wind speeds at various altitudes, electric and magnetic fields, galactic X-ray sources, properties and processes in the vicinity of the Sun, experimental communications, interaction of interplanetary medium with the Earth's environment, and ultraviolet explorer. In the ten year period from December 1968 to December 1978, there were approximately 60 reimbursable launches with understandably less descriptive purposes. Nearly 80 percent dealt with communications (military, domestic, experimental) while the others included: interplanetary magnetic fields, solar and cosmic rays, meteorology, and extraterrestrial gamma ray studies. Nearly all of the western European nations participated plus Britain, Canada, Japan, Indonesia, NATO, and the European Space Agency.

Carefully constructed cooperative programs have yielded the benefits of access to foreign scientific and technological expertise, foreign research and development facilities, and foreign funds. This strategy has been successful for the United States in terms of foreign expenditures for the development of spacecraft for joint programs, construction of hardware for US spacecraft, and support of scientific experiments on joint missions. In addition, this strategy has not involved setting aside money specifically for international cooperative projects. Cooperation is carried out through participation in domestic projects competitively selected on their own merits and funded under domestic funding lines.

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

NASA will continue to pursue cooperative ventures in space for at least three other reasons. First, in these tight budget times that all industrialized democracies are facing, no nation can afford to dominate all areas of scientific accomplishment. Collaboration on large-scale, high-cost science and applications programs provides the opportunity to pursue projects that might otherwise be too expensive. A second reason for continuing cooperative space projects is less tangible, but real. Meaningful participation by allied nations in high visibility programs fosters the desired image of openness in US projects which effectively counters Russian attempts to cast suspicion. For instance, early objections to the US remote sensing programs have now received widespread support because of the availability of the program to all foreign nations. Lastly, cooperation is a factor in minimizing competitive pressure. For example, if a friendly nation develops a shuttle-compatible system, it not only supports the US effort but diverts foreign resources from competitive programs.

Competition

The United States is observing aggressive pursuit of the space technology market by Europe and Japan in such areas as launch services, remote sensing and telecommunications satellites. Foreign governments support competition pervasively by funding research and development, by

price subsidization and financing, by development of attractive package deals, and by creation of governmental-backed marketing organizations.

Industry to government relationships in other countries differ greatly from those in the United States. Although the private sector is active, government intervention acknowledges limitations on the ability of the private sector to support research, development, and operational costs for projects of the magnitude required by space. Aggressive up-front money by European and Japanese governments have ensured their effective competition in the world market place. In Japan, the Ministry of Industry and Trade forms partnerships with Japanese industry on high risk, high technology projects and actively promotes international marketing. In France, the aerospace industry is actually 50 percent government owned.

In the area of launch services, the European Space Agency's Ariane launch vehicle is scheduled to be operational by late-1982. If successful, the Ariane would move into a traditional US preserve, reimbursable launch services. Through aggressive marketing, low prices, and attractive financing, the Ariane could operate at full capacity by 1986, and possibly capture up to 30 percent of the world market for reimbursable communications satellite launches.

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

In the area of remote sensing, competitive systems are beginning to proliferate, especially ground station hardware. While France and Japan are motivated by the prospects of commercial sales for their industries, some developing countries, like India and Brazil, are motivated by the political prestige of operating their own systems. Canadian, German, French and Japanese companies have well developed product lines for ground receiving hardware and processing equipment. Furthermore, a number of foreign firms offer data analysis and other value-added services, an area heretofore dominated by the United States.

Foreign international sales efforts often rely on comprehensive government aid packages and concessionary financing. In commercializing its remote sensing satellite system, France has made a 10-year commitment to data continuity and government subsidies. While funding assistance is also active in Canada, Germany, and Japan, it has been the practice of the US Agency for International Development not to fund foreign acquisitions of remote sensing systems.

In the area of telecommunications, the ability of the US industry to continue to provide needed domestic and international services is contingent on meeting rapidly expanding demands. Competition in this multibillion dollar market for telecommunications equipment is coming from European and Japanese firms. In these countries, government-industry teams and direct government-sponsored research and development serve to reduce

perceived program risks and spur domestic industry in effective international competition. Preservation of technological leadership is the key to both meeting the expanding demands and maintaining the competitive edge.

Soviet Space Activities

As evidenced by recent actions, the Russians may choose to violate the provisions of the previously mentioned space treaties without notification or explanation. Clarence Robinson points out in Aviation Week and Space Technology the following Soviet record:

(1) The Soviets have tested an air defense system in an antiballistic missile mode that is a clear violation of the ABM Treaty; (2) During recent war games, the Soviets exercised a 2-5 day reload procedure for the SS-18 heavy ICBM in violation of the SALT accord; (3) Tests of a new submarine-launched ballistic missile used encrypted telemetry that is also a violation of the SALT provisions; (4) A new Soviet air-launched cruise missile was tested from the Backfire bomber with a missile range greater than 600 km, the maximum distance permitted by the unratified SALT 2 agreement; (5) the SS-18 is clearly designed to carry 12-14 reentry vehicles, not the 10 limited by SALT 2.⁸

In addition,

With the deployment of the flat twin movable ABM radar system, the new missile tested against RVs (reentry vehicles) and the battle management radar

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

around Moscow, the Soviets are building toward a capability to break out of the ABM agreement with a clear-cut capability and leave the US behind.⁹

Overt defiance is not the only argument against the suggestion that international treaties can serve as an effective impediment to the introduction of strategic defensive weapons in space. Included within each of the three major treaties that most directly affect military applications in space are provisions for unilateral termination. With respect to the Limited Test Ban Treaty, the ABM Treaty, and the OST, any of the signatories may withdraw after advance notices of three months, six months, and one year, respectively.¹⁰ The United States would therefore have a maximum of one year to recover from a Russian announcement to deploy military weapons in space that fall within the constraints of international agreements. However, more ominous is that the Soviets may not feel obliged by the provisions of military agreements, especially if distinct advantages can be gained from direct violation.

General Jacob E. Smart, USAF (Ret.), has recommended a policy to guide the national effort to overcome the Soviet threat:

Today and henceforth the United States must be prepared to defend itself against aggression in space and from space. We cannot surrender the "high ground" without contest, we must be in space to acquire knowledge of what others are doing there and to prepare to counter that which threatens us.¹¹

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

There are at least three reasons to believe that the Soviet space programs have direct military application. Under the Soviet view of international conflict, space is considered a potential medium for warfare. Their view of war demands that the military potential of this arena not be ignored because that would surrender an advantageous position to the enemy. Space use should thus be viewed in concert with other programs designed to enhance national power in the pursuit of national objectives. And within the Soviet Union bureaucratic hierarchy, there is only one agency that is capable of exploiting national objectives in the space medium--the Strategic Rocket Force (SRF). This situation is the result of at least two decades of Soviet policies that make available to the Russian armed forces the men, material and money required to build a military power capable of competing favorably with the United States. The SRF therefore has a monopoly on the human and technical resources required to design, develop, and employ Soviet hardware in space. From the marriage of Soviet ideology and the military monopoly, it follows that the military industrial establishment can hardly be expected to undertake major space initiatives of a wholly scientific nature.

The second reason for a military concern with Soviet space efforts is that while their programs outstripped those of the United States (~~see~~ Carter section of Chapter I), there has also been a decided chill in cooperative ventures. Following ASTP, the United States and the

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

Soviet Union continued discussions about future space cooperation. A number of projects were considered, including sending American shuttle mission to a Russian Salyut station. In October 1976, the two countries held discussions identifying what each country's space capabilities would be in the 1980s. Unlike ASTP, in which scientific objectives were secondary to docking the two spaceships in orbit, these discussions concluded that prior to selection of hardware for flying cooperative missions, specific scientific objectives should be identified.¹²

In May 1977, NASA and the Soviet Academy of Sciences signed an inter-agency agreement providing for continuing space cooperation. Since this signing, however, little has been accomplished in formalizing any future space cooperation.

The Soviet Union relies heavily on space systems for many of the same purposes that the United States does (weather, navigation, communications, early warning and reconnaissance satellites in both near earth and geosynchronous orbit). In addition to their important reconnaissance role, these systems greatly assist Soviet leaders for near real-time surveillance and for providing over-the-horizon targeting data.

The Soviets also have experimented with offensive strategic systems in space.¹³ Although their "fractional orbital bombardment system (FOBS) has been quiet since 1971," the Soviet Union has actively pursued

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

other space programs that could promote a strategic advantage.¹⁴ They have an operational ASAT system capable of destroying many US satellites. Although these ASATs are presently capable of threatening only near-earth orbit satellites, the US ASAT system is still in development and not expected to be operational before 1985.¹⁵ Not only will the Soviet ASAT system have matured by that time, but they may score an additional propaganda victory by placing an anti-satellite laser in space during this decade.¹⁶

Assessing Soviet intentions based on developmental activities is difficult but necessary if the United States is to avoid a technological surprise. Evidence of Soviet intentions to exploit operationally the strategic advantage of space-based weapons is contained in several seemingly unrelated areas; their experimentation with directed energy weapons, their extensive manned space station efforts, their development of a large space booster and a reusable orbiting vehicle, and their concentration on improving a space power generation ability.

Soviet experimentation with directed energy weapons is an ongoing program. In July 1980 Aviation Week reported, "from a variety of sources the US has discovered a massive Soviet effort to develop and deploy directed-energy weapons--both high-energy lasers and charged particle beams. There is evidence the Soviets already may have issued orders to

design bureaus to begin prototyping the electron-beam device at Saryshagan."¹⁷ In discussing possible laser battle stations, Clarence Robinson reported six months later, "US intelligence estimates have concluded that the USSR is moving at a pace that could permit it to place high-energy lasers in space between 1984 and 1986."¹⁸

Another area of active Soviet military space activity is the development of manned platforms. In 1971 they launched an experimental manned space station called Salyut-1, three years prior to the first US experimental Skylab spacecraft. Since that time, they have had nearly 30 manned orbital missions, one of which set a new 185-day endurance record. "The Russians continue to predict they soon will be ready for permanent occupancy of space and will increase station capacity to ten or twenty cosmonauts."¹⁹ Even more definitively, the

Soviet Union is developing a 220,000-lb. military/scientific space station to be manned permanently in earth orbit by about 12 cosmonauts Military objectives are expected to dominate the multidisciplinary station and could include photo and electronic intelligence and the first large-scale development of space-based, directed-energy weapons.²⁰

In order to launch their large space platforms into orbit, the Russians have been developing a 10 to 14 million pound thrust booster.²¹ Current work on this giant new booster, comparable to the 7.5 million pound Saturn-5 booster used in the US moon shots, could

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

result in a launch attempt as early as next year. If all should go well for the Russians, a large space station launch could be established by 1985.

Similar to the giant booster development, the Soviets are dramatically improving their space electrical-power-generation capabilities, primarily as a result of continued nuclear reactor progress. "Loss of the Cosmos 954 reactor-powered spacecraft over Canada . . . has not slowed the Soviet reactor program."²² Soviet nuclear reactor developments in space could have important consequences for the advancement of space-borne laser devices that require high-energy power sources.

Although caution should be exercised in ascribing goals to the Soviets that are not in their long-range policies, the combination of large booster payloads and 12-man space stations with intrinsic electrical power capabilities, leads to the conclusion that laser battle stations will be a reality. With only four laser battle stations in space, Aviation Week reports the Soviets could "shoot down our entire fleet of high altitude bombers--B-52s, FB-111s and most KC-135 tankers."²³ In addition, Senator Malcolm Wallop suggests that Russian space-based lasers could prevent US flight tests of any missile, or the placing of US payloads in orbit.²⁴ The possibility that the USSR might be able to prevent the United States access to space presents DOD with awesome responsibilities in the years to come.

Prospects for Future Policy

Space has been used by the United States for civilian projects with emphasis on scientific exploration, practical applications, national prestige, and international cooperation. NASA has led these projects with the involvement of 18 separate US government agencies (see Appendix D). By necessity, however, the United States also has a growing space effort in support of national security, and DOD will be the most extensive user of the shuttle--the prime space system for the 1980s and beyond. The key to the future use of space lies, therefore, in the approved policies for the civilian and military communities to pursue. What are the prospects?

Civilian

While the leaders of NASA play a key role in planning for and proposing new civilian uses of space, others also have influential roles, including the President, his staff advisors, OMB, the congressional space committees, and leaders of the scientific community and the aerospace industry. The public has a role as well, for their enthusiasm or apathy determines the nation's interest in any large space effort.

The public image of the civilian space program was bound up with the adventure of man against space and the glamour of lunar landings. The

mass media, not NASA, did an excellent job of publicizing the Apollo programs. The civilian space agency has not done well in bringing home to the public the meaning of science and applications efforts and the potential and actual economic benefits of communications, weather, and earth-resources satellites. With regard to technological spinoffs from space, NASA has tried to show benefits to medicine, industrial manufacturing, biological sciences, and program management--but with little evident success. The reduction of space budgets since the mid-1960s (representing approximately 1.0 percent of the federal budget in 1982, compared to 4.3 percent in 1965) has made the civilian program less controversial, while at the same time the public has become apathetic. For the President and Congress to approve any new, large project such as a space lab, increased public support and understanding would be needed. In light of the present drive to cut government spending, this does not appear likely.

The aerospace industry was a major beneficiary of the expanded space program of the 1960s. In fact, it was essentially a full partner with NASA in the conduct of all major projects. Today, individual firms differ on what they believe should be the emphasis for future civilian space programs. Those with ongoing projects would naturally like to see them continue. New business, however, will go where the big dollars are, and that is in the defense sector.

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

Space scientists were among the most severe critics of space policy in the 1960s with their principal complaint being NASA's emphasis on manned flight. In the late 1970s, their concern centered on reduced budgets because of cost problems on the space shuttle development effort. Although in the past other interests have been more important than science in order to get large space projects through the budget process, the circumstances in which the civilian space agency finds itself now make science support crucial. With fiscal constraints, large military budgets, and public apathy existing in NASA's pathway to future growth, the support of the scientific community will be increasingly important. Ironically, as the shuttle nears operational status, it could be the key to this support with the expectation that scientists may be able to accompany their experiments into space.

On 21, 22, and 23 September 1981, the subcommittee on Space Science and Applications of the House Committee on Science and Technology held hearings on future space programs and policy. The subcommittee heard testimony from 12 witnesses on four themes: "Space as a Frontier, Earth as a Base," "How the Next Generation of Space Might Come to Pass," "Spin-offs: The Economic Successes We Have Already Seen and What They Mean," and "Pragmatic Thinkers: Planning Today for Future Space Programs."²⁵ The hearings were on the subject of future space programs generally, and not on the two policy bills introduced in the House. On 28 July 1981, Representative Gingrich and 13 cosponsors introduced the National Space

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

and Aeronautics Policy Act of 1981 (H.R. 4286). This bill is patterned after Senator Schmitt's bill from the 96th Congress (S.212--World Information System by 1990, Orbital Civilization by 2000, etc.--see Chapter II), but adds a section concerning the government of space territories, including the circumstances under which a space community would be admitted as a state. On 28 May 1981, Representative Brown introduced the National Space Policy Act of 1981 (H.R. 3712), which was virtually identical to the bill he introduced in the 96th Congress calling for rapid development of remote sensing systems and increased international cooperation. All these hearings and bills are a result of Congressional frustration, starting in the 95th Congress, with the lack of specific goals in Carter's Presidential Directives 37 and 42.

Hearings in the second session of the 97th Congress may not have the fervor of those in the past, given the expected publication of President Reagan's space policy in the Summer of 1982. Regardless, the apparent avid interest by Congress in the future of the civilian space program was blunted in the FY 1982 budget process. President Reagan requested a \$600 million reduction from that planned by the Carter Administration. Congress appropriated only \$5.932 billion (Appendix, Table A-2), which effectively cut the Reagan planned budget by an additional \$190 million. Similarly, NASA has requested \$6.613 billion for FY 1983 (\$664 million below the Carter plan) and if Congress should repeat its cutting actions from 1982, it would appear that the elected officials on the hill are

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

reflecting the general mood of the public toward the civilian space program--apathy.

In the 1960s the executive office of the President contained three major units concerned with space policy: the Bureau of the Budget (which became OMB in the Nixon Administration), the PSAC, and the NASC. The latter two were abolished, although the head of OSTP has now assumed the President's scientific advisor role in place of the PSAC. President Carter set up the PRC (Space) within the NSC for rapid referral of policy issues to him--pointing out the obvious mistake of abolishing the NASC. Nonetheless, President Reagan disestablished the PRC (Space) so that today, OMB, which was always more important than the PSAC, the NASC, and the PRC (Space) in shaping recurring space policy, exercises the major influence over the US civilian program. NASA is presently under OMB instructions to reduce its budget requests for FYs 1983-1985, planned under President Carter's already low-level funding plan for the agency, by approximately \$2.36 billion. In equivalent buying power, this would amount to just over one half of what the United States was spending yearly in the mid-1960s.

Presidential support is crucial to the future of the civilian space program. If President Reagan takes a negative position toward future space research and development, there is little NASA can do to push new programs through OMB and Congress. President Eisenhower was generally

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

passive and restrained with regard to providing leadership for a vigorous space effort (except to veto any large manned effort). President Kennedy provided bold leadership that set the course of the space program or nearly a full decade, giving President Johnson little opportunity to demonstrate new initiatives, especially with difficult foreign and domestic problems. President Nixon inherited these problems while riding the glory days of the moon landings, and did not endorse the space shuttle until it was politically advantageous to do so at the beginning of the 1972 election campaign. President Carter wanted no spectacles but kept the shuttle development alive at the expense of science and applications funding. Generalizations on presidential behavior toward the civilian space program can be risky, given the relatively few years and small number of presidents involved. Yet, an expectation of vigorous leadership for the civilian space program from the Reagan White House, barring another Sputnik crisis, seems questionable.

Consistent fiscal funding from Congress for any program is dependent on sound policies and goals in the executive branch, and a concerted advocacy role played by the agency in charge of the program. The fact that NASA leaders in the mid-1960s did not propose post-Apollo goals to the NASC and defend them in the budget process, virtually insured a situation in which there was no clear future for the civilian space program. The proposition that NASA leaders are the primary resource for pressing future goals and missions remains true today.

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

NASA leadership will probably follow the course they have attempted, rather unsuccessfully, for the last 10 years, i.e., a balanced program of manned and unmanned flight, with emphasis on science, applications, and international programs. Unfortunately, NASA and most of its prime contractors are heavily oriented toward large space technology development programs like Apollo and Shuttle. Once the Shuttle development program winds down next year, there will be considerable pressure from the mainstream NASA and industry leadership to commit to another large-scale program. Some of the possibilities include a large manned orbital space station, a large lift vehicle that could place 200,000 pounds of payload into orbit (compared to 65,000 for the shuttle), and a manned space tug, designed to let men fly from the shuttle to high-energy orbits for satellite servicing or recovery. Obviously, pursuit of such a program would be incompatible with the funding projected for NASA over the next few years. In addition, it would raise the scientific community's ire just at the time they were expecting a bigger share of the total NASA budget.

There are at least three other issues facing NASA which affect potential policies to adopt and goals to pursue. The NASAct calls for the United States to be "a" leader in space science and technology, not "the" leader. The Space Act of 1958 also, in the view of most observers, limits NASA to space research which begs the question of whom should operate the shuttle. Does NASA need so many centers to support its reduced space work in the years ahead? A recommendation as to what

should be the course for the civilian program will follow a short look at prospects for future military policy.

Military

There are several determinants in making new space policy for DOD:

1. Bilateral and multilateral treaties and agreements (OST, ABM, etc.).
2. Relevant national policy statements (PD 37 and PD 42).
3. Civil space activities.
4. Soviet space activities and technological projections.
5. Military use of space and service doctrine.

The first four factors have been discussed at some length previously. One, however, Soviet space activities, bears an updating with respect to specific accomplishments in 1981.

The Russians continued their high launch rate in 1981, indicating an expansion of capabilities. They attempted 100 launches, compared to 89

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

each in 1979 and 1980, and placed 124 payloads into orbit--exceeding the previous record of 118 in 1978. Development continued on new boosters, one like the giant US Saturn 5, and large permanently manned space stations and complexes. A significant feature of the Russian program and one which has considerable military potential, in addition to their operational ASAT system, is their manned program. Consisting of a space station and a space station module, this program had a great deal of activity in 1981. Salyut 6, a 42,000 pound space station, completed four years in orbit on 29 September 1981 and remains in orbit today. Two cosmonauts performed a 75-day mission beginning on 12 March 1981, and were visited by two more missions, one with a Mongolian and the other with a Romanian crew member aboard. Another launch routinely provided supplies, repair parts, and propellants to the space station. On 19 June 1981, the Soviets docked Cosmos 1267 to Salyut 6, described as a test of rendezvous, docking and subsequent dynamics of two large space stations. Cosmos 1267-type vehicles will be used in the future as space station modules, each carrying equipment required for a particular mission. These events certainly portend the advent of a new modular space station and move the Russians well along toward the goal of a large permanently-manned space station.

Launches in direct support of Soviet ground, sea, and air forces were also evident in 1981. Seven separate earth resources photography missions were accomplished. Eleven communications satellites were launched, three

of which went into geostationary orbit. Another satellite was launched to provide television broadcast to Far East regions. Meteorological satellite networks were maintained with three launches, and finally, the Soviets expanded earth resources data collection capabilities with oceanographic satellites to collect and relay buoy data from the seas.

The Soviets have often stated their goal of technological superiority. Certain critical military technologies including electronics, propulsion, materials and life sciences received their highest priority in 1981. Over the past 10 years, the Soviet Union is estimated to have taken the lead in the development of directed energy weapons such as high-powered lasers and possibly radio frequency devices.²⁶ Russia is also thought to have enlarged its lead in electrical power sources for such directed energy weapons. The Soviet high energy laser program is not only the world's largest, but is three to five times the US level of effort.²⁷ Their knowledge of radio frequency weapons and their development of very high peak-power microwave generators, give rise to suspicions of possible weapon intent in this area. Since the mid-1960s, the Soviets have been actively pursuing the development of all the high energy laser types considered most promising for future weapons applications, such as the gas dynamic laser, the electric discharge laser, and the chemical laser.

The trends and momentum of the Soviet space and high technology programs for 1981, as for the last two decades, reflect a commitment to develop capabilities that enhance and project military power.

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

With respect to the present and near-future use of space by DOD, not much speculation is required. Dr. Richard DeLauer, USDR&E, spelled out the \$8.5 billion (Appendix, Table A-5) program for the Senate Space Committee on 18 March 1982:

Space activities of the Department of Defense are continuing to expand, maintaining the trend of the past few years. Our military forces are becoming increasingly dependent upon space capabilities for communications, navigation, weather, and surveillance. As a result of space-based capabilities, we find our forces are becoming more effective in achieving their assigned tasks. To insure that our space assets can support our military forces in the event of war, we are improving the survivability of future space systems.²⁸

In the area of military satellite communications (MILSATCOM), the United States presently relies on the Air Force's AFSATCOM system and the Navy's FLTSATCOM system. These SATCOMs are UHF systems with only modest anti-jam capabilities. These series of polar and geostationary orbit satellites are being upgraded by the high-capacity, super-high frequency Defense Satellite Communications System (DSCS). Increased jam resistance is achieved through improved modulation techniques and the use of higher frequencies; survivability against attack is enhanced through proliferation. The DSCS is designed to meet the needs of the Worldwide Military Command and Control System (WMCCS), the National Command Authorities (NCA), the Ground Mobile Forces (GMF), the Diplomatic Telecommunications System (DTS), the Defense Communications System (DCS), and selected allies through the 1980s.

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

To get through the 1990s and beyond, DOD is relying on the successful development of MILSTAR, a highly survivable and enduring SATCOM system designed to provide high-capacity, worldwide, jam-resistant communications for all strategic and tactical forces. With a constellation of eight satellites (five geosynchronous and three polar) in orbit, the MILSTAR will incorporate both electronic and physical survivability features. Space-based laser communications also holds promise for the future. A joint DARPA and Navy submarine laser communications (SLC) program is developing the technology to communicate from space, using blue-green laser light, with submarines at operational depths, creating minimal impact on their natural covertness and flexibility.

In the area of navigation, DOD is continuing development of the NAVSTAR Global Positioning System (GPS), expected to be operational by 1988. In addition to its primary function of improving military forces' weapon delivery and target destruction capabilities on a 24-hour, global basis under all weather and visibility conditions, the GPS will also carry the integrated operational nuclear detection system (IONDS) payloads. IONDS will provide real-time strike and damage assessment information, thereby enhancing strategic force management.

In the area of weather, DOD is continuing to support the Defense Meteorological Satellite Program (DMSP). The DMSP's operational require-

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

ments dictate the use of at least two satellites continuously in orbit, obtaining weather information from all points on the earth a minimum of four times each day. Regional weather data are also transmitted in real time to key locations, supporting Army, Navy, and Air Force tactical operations.

In the area of surveillance, DOD is supporting the Air Force's Defense Support Program (DSP) and the Navy's Integrated Tactical Surveillance System (ITSS). The DSP is one of the key elements of the US defense posture, utilizing satellites at synchronous orbit. In addition to procurement of two more DSP satellites in 1983, the DSP is developing the IONDS for the GPS program. The ITSS program is presently in the concept formulation phase and exploring whether there is a need for development of an active space-based sensor. Passive sensors (e.g., electro optical) do not provide worldwide, all weather, day-night surveillance. At the present time, some type of active sensor is felt to be essential and can potentially satisfy more than one military service.

In the area of advanced technology, DOD has several efforts planned or underway. Programs related to missile surveillance technology are developing sensors and collecting data for improved application of infrared (IR) technology. Under the DSP, IR data on earth backgrounds and rocket engine ^fumes will provide a major contribution to new system design considerations for a space-based missile surveillance system.

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

Technology development continues for components and concepts for a space-based radar, including transceiver modules, large lightweight phased array antenna structures, and onboard signal processing components. Advanced microwave technology on miniature, low cost radar transceiver modules using integrated circuit technology is being pursued. Low cost, low weight and high efficiency of these modules are key factors in feasibility for use in space-borne radars.

In the area of advanced plans, DOD is working with NASA in the definition of requirements for a space station (as yet neither requested by the executive branch, nor approved by Congress). DOD is withholding its support until it has examined the potential utility and cost effectiveness of a space station to satisfy national security needs.

NASA and DOD are also investigating launch vehicle concepts to supplement the space shuttle, which may not be able to meet all future demands for space transportation. One concept under consideration is the SRB-X, which uses one or three solid rocket boosters, plus upper stages, to orbit up to 100,000 pounds.

The Air Force is also initiating an Advanced Military Spaceflight Capability (AMSC) program. According to the Air Force Times, the "Air Force wants to invest \$180 million through FY '88 to analyze and develop the technologies required to put advanced vehicles and systems into space

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

before the year 2000."²⁹ As military data from space become more essential, the requirement for a responsive launch capability has become critical. Under the AMSC program, quick reaction launch, survivable launch, and aerodynamic space vehicles (reusable from conventional airfields) are concepts to be studied.

DOD conducted a major review of the potential of space-based laser weapons and documented its findings in a 15 May 1981 report to Congress. DOD concluded that space-based lasers offer military potential in a number of applications, but their ultimate utility is beyond DOD's ability to predict. Under a program specifically appropriated by Congress, DOD will begin a \$50 million per year (in addition to basic research in lasers) program to aggressively pursue resolution of uncertainties. DARPA and the Air Force are tasked with the job.

Service doctrine, the last determinant of future military space policy, originated in the early months of the Kennedy Administration. On 16 March 1961, Secretary of Defense Robert McNamara promulgated DOD Directive 5160.32, "Development of Space Systems," which gave the Air Force responsibility for developing, producing and deploying military space systems associated with surveillance and warning of enemy nuclear-delivery capability and all launch vehicles, including launch and orbital support operations. DODD 5160.32 was modified on September 8, 1970 to allow for the assignment of program management responsibilities

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

on a case-by-case basis to other services, but requiring Air Force coordination on their execution.³⁰

Over the last 12 years, many observers have felt DODD 5160.32 specified the Air force as the military's executive agent for space. Such is not the case--there is no single DOD point of contact for all military space activities. As a consequence, an equitable mechanism does not exist for consolidating all requirements (very important in optimizing the design of new systems for multiple users) and for funding DOD space programs and services. This fact calls into question the efficiency of the space system development and acquisition process. Lastly, and possibly the most important consequence of not having a single point of contact, are operational considerations. The peacetime use of space systems, the only experience to date, simply does not parallel or enhance those capabilities expected of DOD in time of war.

Over the years the Air Force has attempted to formalize its de facto executive agent role. In the mid-1970s, when neither DODD 5100.1 or JCS Publication #2 (formal mission statements for the Air Force) mentioned space, the USAF published its first attempt at a space doctrine. Generally speaking, military doctrine is considered a body of principles, accepted as authoritative, and used to implement national or DOD policy. Air Force Manual 1-1, dated 15 January 1975, USAF Basic Doctrine, simply reiterated the essence of national space policy:

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

The Space Environment. The underlying goal of the United States national space policy is that the medium of space must be preserved for peaceful use for the benefit of all mankind. Air Force principles relating to space operations are consistent with this national commitment. National policies and international treaties restrict the use of space for employment of weapons of mass destruction. There is, however, a need to insure that no other nation gains a strategic military advantage through the exploitation of the space environment.³¹

Space operations in this old AFM 1-1 were covered in many of the tasks and subtasks of other more classic Air Force missions such as strategic defense, surveillance and reconnaissance, etc.

Two years later the Air Force Chief of Staff stated the USAF role as follows:

The Air Force affirms that among its prime responsibilities are activities in space related to the development of weapons systems, military operations, or the defense of the United States, conducted in accordance with national policy and international law.

The Air Force affirms that its responsibilities in space include the duty to protect the free use of space by providing needed peace defense capabilities.

As DOD executive agent for liaison with NASA, the Air Force affirms its responsibilities for close coordination and cooperation on projects of mutual interest.³²

Following publication of PDs 37 and 42 in 1978, the Air Force republished AFM 1-1, with a slightly different title, and included space

operations as one of its nine basic missions, i.e., strategic aerospace offense, space operations, strategic aerospace defense, airlift, close air support, air interdiction, counterair operations, surveillance and reconnaissance, and special operations.³³ Within the space operations mission, this current AFM 1-1 lists three tasks--space support, enhancement, and defense. There are no subtasks under space defense, but the other two contain four each. Under space support are listed launch and recovery, on-orbit support, satellite surveillance, and satellite control operations. Under space enhancement are listed global surveillance, communications, navigation, and meteorological operations.

These space operations are explained in greater detail in AFM 1-6, Aerospace Doctrine, Military Space Operations, which is still in draft form even though it was scheduled for publication in 1981. Designed to be a basic statement of the current Air Force beliefs concerning space operations doctrine, one of the early draft versions addressed future space activities:

This growing importance of space operations introduces the eventual possibility of offensive space-to-space and space-to-earth warfare. However, the United States intends to deter the introduction of offensive military capabilities into space by whatever means are appropriate.³⁴

In summary, all of the major factors deemed important in developing new space policy for DOD, except one, seem committed to the peaceful use

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

of space. Bilateral and multilateral treaties and agreements, relevant national policy statements, civil space activities, and the US military use of space and service doctrine are all opposed to weapons in space, especially offensive weapons. Only Soviet space activities, along with their corresponding technological projections, are headed in another direction. The United States is not prepared for this eventuality, and the solution to the problem lies in policy and organizational changes for both NASA and DOD.

Recommendations

On the eve of the shuttle becoming operational, the National Space Program's future has never been so uncertain especially the public efforts managed by NASA. On the other hand, this nation's heretofore silent space program managed by DOD is on the ascendancy, not as a result of being better at the Congressional budgeting game, but out of national security necessity. It all boils down to a problem of scarce funds, and it will take a joint effort of the executive and legislative branches of government to establish a national space policy that succeeding administrations and Congresses can understand and live with. Public debate seems essential. To start the process, the Reagan Administration should submit a comprehensive space policy to Congress, along with an update to the NASAct since the institutional viability of the space agency is in question. Such a policy will require disclosure of all but

the most sensitive military space programs. In concert with this "going public" move, DOD should designate the USAF as its executive agent for all space efforts, and the Air Force, in turn, should publish its space doctrine. Lastly, President Reagan should reestablish a policy review mechanism within the Executive Office.

Update NASAct Along With New Policy

What is facing NASA that would require an update to the space act of 1958 along with a comprehensive new policy by the Reagan Administration? In the heyday of the Apollo program, the civilian space agency commanded in excess of four percent of the total federal budget, but today it will garner only one percent, possibly less. Faced with a similar situation in the first year of the Nixon Administration (see ^{Appendix C} Chapter I), NASA leadership took the initiative through the STG to recommend a manned Mars mission, an orbiting lunar station and surface base, and a 50-man earth-orbiting space base. Four years later, after cancellation of the MOL program and several Apollo and Skylab missions, NASA got the space shuttle program under less than satisfactory funding constraints from Congress. This was a far cry from what NASA wanted and was capable of undertaking. In addition, space is no longer just a research and development playground for DOD in competition for the limited space dollars, as it was in 1969. According to the present NASA Administrator, Mr. James Beggs, "the space agency must take on more work for the Penta-

gon if it is going to survive the rough seas of the Ronald Reagan budget years."³⁵

Mr. Beggs was referring to NASA's planned use of the shuttle in support of DOD. According to the GAO, "of the 234 flights tentatively scheduled through 1994, at least 114, or 48 percent, will be flown exclusively for the military."³⁶ The GAO also concluded that NASA earmarked for the Pentagon almost 25 percent of the \$3.47 billion it will spend on the shuttle in FY 1983.

These plans call to mind several questions with respect to the law of the land. President Eisenhower's version of the NASAct, as well as that passed by Congress, envisioned separate military and civilian programs, with mechanisms set up to ensure no costly duplication. Is this not a militarization of the civil space agency or is there little consequence to the possible merger of NASA and DOD space activities? In the past, NASA has been limited to the research and development role, and when this phase was completed on applications programs, operational control was given to other agencies. Section 102(c)(3) of the NASAct of 1958 states that the aeronautical and space activities of the United States shall be conducted so as to contribute materially to the objective of "development and operation of vehicles capable of carrying instruments, equipment, supplies and living organisms through space." Section 103 defines "aeronautical and space activities" as "the development, construction,

testing and operation for research purposes of aeronautical and space vehicles." Thus, NASA's charter seems clear with respect to launching and operating research payloads, and developing the means to conduct space flight. However, once the shuttle becomes operational, and is used for scientific, applications, and military purposes, what restrictions should apply to NASA authority to operate this system? It would take a revision to the NASAct to explicate the NASA authority to operate the shuttle). Further, it is entirely possible that DOD would be more efficient in operating the shuttle than NASA, if evaluated closely.

Mr. Beggs also said that "NASA's expertise is essential if the United States is to maintain superiority over the Soviet Union."³⁷ He was referring to additional NASA plans to increase research center contracts with the military. NASA centers have had excess research capability for some time. For example, just under 30 percent of the business done by the Lewis Research Center is on energy for DOE, and more is also done at the JPL and the Dryden Flight Research Center. The NASAct established NASA for a large space effort with many research centers transferred directly from the military. With this big overhead and no follow-on space endeavor approved (such as the planned nine billion dollar space lab), might it not be time to transfer these facilities back to DOD? The enabling legislation which created NASA also set forth some general objectives, i.e., "preservation of the United States as a leader in aeronautical and space science and technology"

When informed of the NASA plans to increase support of DOD, Senator William Proxmire (D-W^{is}) said, "This is bad news for those who are concerned over cutbacks in NASA's space science activities."³⁸ Thus, the same argument, as old as the space age itself, is raised again. It is just as true now as it was in the beginning, however; when tight budgets exist, science and applications programs are the first to slip or get cancelled. Couple this fact with the views of Dr. Keyworth, the Presidential Science Advisor, who is on record favoring some other types of research with possibly higher payoffs than space science, the conclusion can only be that the space agency has rough sledding ahead.

If there is any argument for keeping NASA viable financially, in the face of the OMB budget axe, it is the image it fosters in international cooperative programs and the lead it takes in maintaining the competitive edge over foreign interests. Much more can be done in this area, and any comprehensive space policy considered by the Reagan Administration should include all efforts with potential for handsome dividends, even if there are high up-front costs.

Designate DOD Executive Agent

In the recent past, several changes have been made that crystallize the management process of space activities within DOD. The Defense Space Operations Steering Committee was formed in the Office of the Secretary

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

of Defense. The Air Force established a Space Operations Steering Committee; formed a new Directorate of Space within the Deputy Chief of Staff, Plans and Operations at Headquarters Air Force; and designated a Deputy Commander for Space Operations within the Space Division of the Air Force Systems Command.

Space has certainly become big business within DOD, when compared to any other mission or function and by any standard of measurement. The space appropriation for FY 1982 grew by over 30 percent from FY 1981, and the request for FY 1983 promises another leap of nearly 20 percent--far outstripping the whole of NASA's space and aeronautics budget. Even excluding the intelligence community and NASA, there is a multiplicity of departments and agencies directly involved in DOD space activities. With the breadth and depth of DOD space business, it is little wonder that it takes special steering committees, ad hoc groups, and over 25 different documents to disseminate policy and guidance. Involved are Presidential Directives, Public Laws, DOD Directives, JCS Publications, SECDEF and DEPSECDEF Memoranda, Undersecretary and Assistant Secretary of Defense Memoranda, Decision Coordinating Papers, and JCS Memoranda of Policy. Cancelling the 1970 version of DODD 5160.32, Development of Space Systems, and republishing another directive appointing the Air Force as the DOD Executive Agent for Space Programs would not obviate the need for all these guidance documents, but it would certainly codify current practice and relieve the need for special committees. In addition, once

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

approved, this document would establish clearly the responsibilities within DOD for advocacy, acquisition, plans, programs, and operations (including launch and on-orbit control) of all space systems.

Publish Air Force Doctrine

Simultaneous with becoming the DOD Executive Agent for Space, the Air Force should publish AFM 1-6, Aerospace Doctrine, Military Space Operations. As a body of principles governing military activities in space for the foreseeable future, it should be a natural flowdown from stated national space policies. In addition, it should contain all but the most sensitive military space plans, i.e., remain unclassified; and signify the defense establishment's desire to "come out of the closet."

As space budgets continue to grow and more of the tax dollar goes to DOD than NASA, the public and Congress will demand more open disclosure. The nation's reliance on space for its security is entirely defensible, especially in light of the fragility of international treaties, and the Soviet technological trends as well as present threat. Furthermore, the GAO has criticized DOD for not doing all it should in space while the Heritage Foundation recommended putting non-nuclear weapons into orbit. In relation to the latter, the Office of the Judge Advocate General prepared a summary and list of permissible military space activities as part of the 1978 DOD study, "The Utility of Military Crews in Space."

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

Listed as permissible were such items as testing, development or placement in space of ASAT systems; suborbital and fractional orbital flights of nuclear weapons systems; testing, orbiting or stationing of traditional conventional weapons in outer space; and military measures necessary for individual or collective self-defense to the threat or use of force.

Establish Policy Review Mechanism

The use of the NASC during its 16 years of existence varied from extensive by Kennedy and Johnson to minimal by Eisenhower and Nixon (see ~~Chapter I~~). After four years of no routine mechanism for the review of space policy, PD 37 set up the PRC (Space) within the NSC in 1978. In 1981, President Reagan disestablished the PRC (Space). The only recourse for DOD or NASA (whose Administrator does not enjoy cabinet level rank) to obtain Presidential attention on space policy issues would be through OSTP and the President's council. This summer, coincidental with publication of President Reagan's space policy, some review mechanism should be reestablished similar to the old space council or the PRC (Space) to ease this cumbersome avenue to the President.

The main criticism over the last four years of President Carter's National and Civilian Space Policies (~~Chapter I and Appendix B~~) has been the lack of specified goals. The President's partner in establishing and

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

carrying out space policy, the Congress, has shown its frustration with the introduction of many space acts of its own. Now Congress appears to be getting better organized with the formation of the Congressional Space Caucus (CSC) to promote US military and civilian space efforts.³⁹ Led by Representative Daniel Akaka (D-Hawaii), the CSC has 43 members and is growing in both houses of Congress.

In addition to standing the test of public debate, any new National Space Policy, in order to be accepted and therefore successful, must be comprehensive. Keeping in mind firm goals and the impact of limited funding, it should address: outside forces (the Soviet threat, international competition and cooperation); commercial and industrial applications programs (earth observation, material processing, etc.); exploration, science, and advanced technology (planetary probes, astronomy, life sciences, space-based power systems, etc.); future roles of man in space (space stations or colonies); civilian assets (space shuttle and its operation, other launch systems, spacelab); and national security (reconnaissance, space support-enhancement-defense programs, space warfare, survivability, command and control).

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AUTHOR SCHICHTLE
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CHAPTER II

ORGANIZATION

Organizational issues of considerable consequence face both NASA and DOD in the years ahead, with the former's being driven by the prognostication of limited funding and the latter's by increased mission responsibilities in space. As pointed out in Chapter ~~I~~, Congress established NASA as an agency with high status and significant powers so that it could provide vigorous direction for a strong civilian program. That was done to rectify the situation that had developed in aeronautical research policy in which a combination of interests from other agencies dominated NACA, NASA's predecessor and politically weak government organization. Without maintenance of a larger budget level, increased activity in providing aerospace research and launch services, and increased cost-sharing with other nations and agencies, NASA might not be able to retain its present manpower and institutional capability. Conversely, DOD must take positive steps now to prepare for an eventual Space Command. The USAF, as DOD's executive agent for space, will not only have to combine the diverse operations that presently exist, but rethink its research, development, and acquisition policies and procedures.

The focus of this chapter will be on these and other issues which impact the present organizational structure of both DOD and NASA. The shortcomings of each agency will be shown followed by recommendations for the future.

Space Transportation System

Before investigating institutional issues at NASA and DOD, I will preview the Space Transportation System because its proposed operation so dominates the future of both agencies.

Planned Shuttle Operations

While not denying the problem of fiscal stringency, NASA believes that improved funding levels may well come in the years ahead as the space shuttle becomes operational and proves its worth in supporting full science and applications programs. Since before the program started in 1972, NASA has argued that the shuttle will substantially reduce launching fees, and make repairs possible both on the ground (by satellite retrieval) and in orbit. NASA recently announced plans to nearly triple the price (from \$42 million to \$116 million) it charges to carry satellites and other cargo into earth orbit aboard the shuttle in 1985 and after.¹ Further, since the shuttle's bay provides a gentler ride than the conventional launch vehicle, science and applications

satellites can be built more cheaply because their parts can be built to less stringent requirements.

After one more launch, the shuttle's flight test development program will be completed. Present plans call for entering the operational phase late this year (1982), the capability for which the scientific, military, and commercial users have been anxiously awaiting. The shuttle manifest is based on a series of assumptions which have not been verified yet. One of the critical assumptions is turnaround time, now roughly estimated to be 280 hours between flights. This assumption influences the number of shuttle vehicles required to meet the expected traffic demand. The present procurement plan calls for four shuttles to satisfy both military and civilian needs out of both east and west coast launching sites. With the military expected to dominate shuttle usage (nearly 50 percent) over the next 10 years, it begs the question of DOD's involvement in the STS program.

DOD Involvement

The advent of the shuttle has stimulated three areas of DOD involvement--STS development, transition, and spacecraft development.

The Air Force acts as the lead agency within DOD for the development and operation of the shuttle, and interacts daily with NASA to insure

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

that military requirements are incorporated with minimal cost and design impact. Military requirements have dictated modifications to existing NASA and DOD facilities and equipment, as well as development and acquisition of unique DOD facilities and equipment.

At NASA's Kennedy Space Center (KSC) in Florida and Johnson Space Center (JSC) in Houston, the Air Force is implementing procedures and installing equipment to insure that shuttle launches, crew training, equipment simulations and flight control satisfy DOD requirements. It is also modifying expandable launch vehicle facilities at Cape Canaveral Air Force Station for off-line STS payload preparation, final assembly, and checkout.

Two projects are underway to build new STS facilities. The first consists of the design and construction of the West Coast shuttle launch site at Vandenberg AFB, California. This complex will support NASA and other civilian space programs as well as DOD. The second project consists of the development of the Consolidated Space Operations Center (CSOC) planned for Colorado Springs, Colorado. As the central facility for DOD shuttle flight planning and control, it will have the additional capability to provide back-up control for civilian shuttle operations and DOD satellite operations in the event of failure or saturation of existing dedicated control facilities. Vandenberg operations are scheduled to begin in late 1984 and the CSOC will be operational in

1988. In addition to these activities, the Air Force is developing the Inertial Upper Stage (IUS), designed as a solid propellant upper stage to be carried into low earth orbit by the shuttle where it would then boost spacecraft into geostationary orbits. Other types of upper stages are also being investigated with NASA.

Another aspect of DOD involvement in the STS program is the transition activity required to convert from expendable launch vehicles (ELVs) to the reusable shuttle. The STS will require totally different concepts in launch operations, logistics, and preparations from those previously associated with ELVs. To ease the impact of this changeover, the Air Force conversion to the shuttle is phased with each spacecraft program (DMSP, DSCS, etc.) having a different date for integration, which is a costly and extensive endeavor. The transition involves many complex activities: design changes to optimize spacecraft to take advantage of improved shuttle capabilities; tests, simulations, and support and integration activities to insure each spacecraft is compatible with the shuttle; and phaseout of old equipment, facilities, and vehicles in an orderly, cost effective manner.

Lastly, the Air Force is consolidating the Titan III family of ELVs into a single configuration, the Titan 34D, which will serve all Titan class users. The Titan 34D will be used to backup critical DOD shuttle missions through at least the mid-1980s, and possibly indefinitely thereafter, if national security requirements dictate.

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

Turning to spacecraft development, the STS will enhance the performance of the military space mission by providing opportunities to improve system survivability, reliability, and capability. The increased throw weight of the shuttle will open up a variety of survivability alternatives. In addition to the economic feasibility of placing backup or decoy spacecraft in orbit, it will allow for the use of propellants for maneuverability, redundant subsystems, hardening, and other defensive systems.

DOD satellite reliability will be greatly improved through increased launch vehicle success, on-orbit rendezvous, inspection and repair of spacecraft, and return of spacecraft or subsystem modules for testing and analysis.

Space system capabilities will improve by virtue of increased size and weight, and since booster payload capacity will not be such a constraining factor, design of technological improvements will be easier. The ability to dock and loiter while on-orbit will facilitate manufacturing, assembly, and deployment of large space structures. Equally important is the ability to conduct experiments with man in the loop. Overall, sensor resolution, reception, transmission, and power capacity should vastly improve.

DOD use of the shuttle will provide for extensions and improvements of existing capabilities. With respect to communications, the spacecraft will become larger and more powerful for global support of strategic and tactical forces and for satellite-to-satellite communications. Meteorological satellites will be able to provide better weather information to commanders worldwide, and will be capable of extensive on-board processing to quickly refine the data into a more usable and available form. Navigation satellites, based upon improvements to the Global Positioning System, will allow pinpoint weapons delivery. With more effective weapons distribution, there is a potential for reduced total weapons requirements. Surveillance spacecraft will make use of space-based radars tens of meters in diameter, mosaic sensors in geostationary orbits and in deep space, high altitude large optics, and integrated operational nuclear detonation detection systems.

New space systems will allow satellites to control satellites and permit autonomous operations of spacecraft without constant updating of their positions from earth stations. They will also include such concepts as directed energy weapons for defense of both space-based and earth-based assets. Consequently, it will not be long before the Space Defense task under the Space Operations Mission in AFM 1-1 (see Chapter III) will contain missions such as satellite defense, ballistic missile defense, and anti-satellite operations. The inherent capabilities of these new space systems, coupled with the routine access to space made

possible by military use of the STS, spell the eventuality of "offense in space." The only question remaining is if the United States will beat the Soviets in acquiring these capabilities.

NASA Issues

In the last chapter, the question was raised of the civilian agency's status in running the shuttle operationally. The foregoing discussion of the Air Force's total involvement in the STS, along with its inherent ability to totally run the entire program, not only provides the President and Congress an alternative to updating the space act, but presents a foremost challenge to NASA leadership. The current NASA Administrator, Mr. Beggs, is counting on keeping shuttle operations in-house and the massive military support that entails, in order to maintain NASA as a strong and independent agency through the troubling budget years ahead. Toward this end, the civilian space agency split its shuttle development and operational activities, and acquired Major General James Abrahamson, on loan from the Air Force, to be the Associate Administrator for the STS program. General Abrahamson, having managed the F-16 fighter program for four years and its complicated, multinational deployment and operations, is a natural for setting up shuttle operations. However, he has a formidable task ahead, given the expertise of NASA as an organization. Designing airplanes and running airlines call for different skills. Shuttle operations management being

like running an airline (flights are now scheduled as often as once a month), and NASA's being geared primarily for major design efforts, it is not clear that the space agency should be undergoing this metamorphosis to run the "shuttle airline."

By the same token, it is equally not clear that the Air Force should take over shuttle operations, just because it has the capability to do so. Without commensurate funding from Congress, there would be an obvious drain on other Air Force operational missions, and there would be the often heard "image problem" of the military's takeover of the civilian space program. Another alternative is the proposal for a private or semiprivate corporation to do the job modeled after COMSAT, Synthetic Fuels Corporation, or the AEC Laboratories. Under this scheme, these quasi-government corporations would have self-funding responsibilities, and would have to contract with private companies to operate the facilities commercially.

There are other institutional issues facing NASA that fall into the following categories: roles and missions, manpower, and organization.

Roles and Missions

In the years ahead NASA could play different roles and advocate different missions from those of the past. It could revert to the NACA

pattern of performing only basic research while giving up developmental work to the military and other agencies engaged in space activities (see Appendix D). This mission could be sustained with less than one half of one percent of the national budget going to NASA, and the Air Force acquiring all manned space flight activities. This option would permit scientists to perform research on space without worrying about competition for funds from manned flight, although the budget for space science might be stringent.

This course of action has several drawbacks: it would weaken the civilian foundation of the nation's space program, it would leave NASA very small in comparison to its bureaucratic competitors, it would possibly not allow NASA to draw top talent, it would probably lessen the opportunity for serious new ventures in space leaving that to the initiative of other nations, and finally, it would severely damage NASA's international cooperative ventures.

Another option proposed by some scientists in the early-1970s is for NASA to maintain a large-scale research and development program in science and applications, but still stay out of the manned flight business. This option might be viable if the space agency were to get full support from the entire scientific community, the aerospace industry, public interest and consumer groups, and other government agencies engaged in space activities, especially the military. Such

support might be enough to overcome the budget-cutting pressure of OMB, and protect a projected budget for this option of approximately one percent of the national budget. An offshoot of this option would be for NASA to lose its independence and become an agency under the umbrella of a larger department, i.e., DOC. It could then operate similar to DARPA in DOD, with the parent department able to fight the budget bureaucracy and, if it were DOC, to maximize the nation's international competitive interests.

NASA, however, is not likely to pursue either course. First, NASA considers the manned space-flight program as an essential element of both the civilian space effort and the nation's overall space capability. Second, the space committees of Congress, certain segments of industry, and parts of the scientific community have a strong stake in NASA's continuing as a vital and independent agency.

Manpower

NASA is no longer a young agency. Like most large organizations, it has acquired a definite character over the years, shaped heavily by its history. That history has been dominated by large technology development programs--Mercury, Gemini, Apollo, and Shuttle. As the development of the Shuttle is completed next year, questions will arise about the future of NASA's manpower and organization, as well as its roles and missions.

NASA employs exceptionally well-educated, highly motivated personnel, but, for the most part, they are technical specialists who interface with other technical specialists. Low and mid-level managers, while adept at managing the high degree of complexity involved in reaching technological goals, are generally not good at dealing with the ambiguities involved in choosing those goals politically. In addition, the average age of NASA's professional work force has been advancing steadily, reflecting the static size and low turnover rate of the agency since the end of the Apollo program (Appendix, Table A-3).

The civilian space agency has relied a great deal on the aerospace industry in its large programs (Appendix, Figure A-2). There is a commercial work force, roughly four times the size of NASA (10 times bigger during Apollo), with close professional and economic ties to NASA and its programs. With the high degree of cooperation that exists, many of the manpower issues facing the space agency also apply to industry.

NASA management, since the departure of the politically adept Mr. Webb in 1968 (see Chapter I), has tended to come from the relatively narrow NASA/aerospace/science community. Its focus has therefore tended to be essentially internal, and its concerns technical and developmental rather conceptual and operational. Many senior managers are now approaching retirement, and replacements are needed who can help Mr. Beggs conceive a national program, with priorities and goals commensurate

with realistic funding. In conjunction with appropriate goal setting, an examination of NASA's total work force is needed with emphasis on development of the proper mix of operational, technical, and scientific skills.

Organization

There are three dimensions to NASA organization. One is its focus on large-scale technology development involving management coordination of geographically widespread government and industry efforts, as opposed to evolving and managing a more equally balanced mix of scientific and applications programs. A second is the concentration on technology development rather than on-going operations. The third is the maintenance of a number of NASA centers around the country, each with its own mission, expertise, and political constituency.

A change from the past focus on large-scale technology would have important implications with respect to manpower policies, management orientation, and the aerospace industry's role in space programs, but would probably have little impact on the NASA organization chart.

A change from the past concentration on technology rather than operations does raise important organizational issues. Early in the shuttle program, the worry was that once the development phase ended,

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
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NASA would not devote adequate priority to the smooth and efficient operation of the shuttle nor be responsive to users' needs. From the previous discussion in regards to General Abrahamson's task, it now appears NASA is addressing this problem. What remains a bigger question, however, is whether shuttle launch operations can co-exist organizationally with another high technology effort plus a balanced program of science and applications.

The last organizational issue is maintenance of so many centers around the country. A larger-than-necessary fraction of the NASA budget is required just for housekeeping at these facilities. This institutional base could support a major civilian space program in excess of \$12 billion per year, compared in terms of buying power to the heydays of Apollo. It was mentioned earlier that three centers are doing some energy research but, by and large, none of NASA's centers is easily convertible to other forms of advanced research. A new look at several of the centers is needed before they have outlived their competence and relevance.

DOD ISSUES

Shortly before his retirement in 1979, the commander of ADCOM, in a letter to the Air Force Chief of Staff, expressed his belief that "unless

we make an explicit organizational decision which assigns to a single organization the Air Force responsibilities in space operations once and for all, we will be faced with serious, negative, long-term impacts on resource management and planning."² The following summer, the Air Force Scientific Advisory Board (SAB) examined national space activities and the Air Force organization for space operations, and concluded: "given current capabilities and potentials of space systems, the AF organization for operational exploitation of space is inadequate" and "There is insufficient emphasis on an integrated force structure in which space systems are included as essential elements."³

Operational Control

As a consequence of the current dispersal of responsibilities, there is no single channel of operations control from the National Command Authority (NCA) to the operators of space assets. Doctrinally, operational direction should flow from the NCA through the Joint Staff to Unified and Specified (U&S) commanders who in turn control operations of MAJCOM assets, in peacetime as well as war. (See Appendix E).

In peacetime the assignment of responsibilities is dispersed across several organizations. The AF Communications Command (AFCC) provides communications and electronic support for communications satellites. The tactical Air Command (TAC) provides the F-15 aircraft for the

air-launched ASAT weapon. The Aerospace Defense Center, a direct reporting unit to the Air Force Chief of Staff, manages the Space Defense Operations Center. The Military Airlift Command is responsible for the DMSP program, but shares operational control with the Strategic Air Command (SAC). SAC, in addition, operates the Global Positioning System (GPS), provides host responsibilities at Vandenberg AFB for NASA and the Air Force Systems Command (AFSC), and manages the missile warning and space surveillance network. AFSC responsibilities will be discussed later. The Army (communications along with some continental United States point defense responsibilities not depicted), the Navy (communications and some space surveillance), and NASA (TT&C-telemetry, tracking, and control) also have a piece of the action. Thus, bypassing the JCS and inputting directly or indirectly to the NCA in peacetime are: six Air Force Commands, NASA, civil systems (communications), and National Systems.

The wartime lines of authority are more direct with SAC (MAJCOM and a Specified Command) taking over full control of the DMSP and retaining its GPS responsibilities, and the Aerospace Defense Command (ADCOM), while not a MAJCOM, would take over all other functions under its Specified Command charter for operational control of the space defense mission. However, there are still four inputs directly to the NCA, and the JCS must sort out inputs from two major Specified Commands. Clearly, no one is totally in charge of this nation's space assets below the level of the NCA.

The peacetime functions of AFSC were saved for discussion last because they are unique and represent a "womb to tomb" involvement in space activities (see Appendix F-- Space Systems Functional Flow Diagram). AFSC's vast stable of laboratories and research centers work closely with DCA, DARPA, the other services, and other agencies in basic and advanced technology efforts. Since there is no centralized operational control, the "requirements pull" for new space systems is fragmented, which drives AFSC's Deputy Chief of staff for Plans and Programs to work closely with other commands, and the new space operations directorate within HQ USAF/XO. AFSC's Space Division in Los Angeles is an organization totally dedicated to space activities. Its System Program Offices (SPOs) manage the research, development, and acquisition of launch vehicles and satellites, and the engineering integration for them. Due to cost, the trend is toward more joint activity with all programs being national in character or serving multiple services. Its Deputy Commander for Space Operations (DCSO) handles the myriad of tasks associated with launch and orbital support. With the introduction of NASA into launch support, the DCSO provides the common interface requirement for DOD with payload integration and security policies and procedures, mission planning and execution, and the eventual control of the CSOC. The DCSO's satellite control facility is the only organization with a worldwide TT&C network (with the exception of NASA's, used in manned space flight operations), and by agreement supports ADCOM in accomplishing its space defense operations role.

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/22/82 OPERATOR: Laura

Finally, the DCSO controls operations at the space centers on both coasts and, until the CSOC is a reality, manages the Manned Space Flight Support Group (MSFSG) at the JSC. Thus, even though AFSC is an "R&D" command with no wartime role, it has a history of over 20 years in space and its activities run the gamut of present operations. In fact, AFSC's Space Division is listed in official Air Force Doctrine (AFM 1-1) as having responsibilities in three mission areas (the only organization below the MAJCOM level so listed): Space Operations, Strategic Aerospace Defense, and Surveillance and Reconnaissance.⁴

As a result of the wide distribution of responsibility for space systems and space operations, planning and programming are performed in offices at Headquarters USAF, SAC, TAC, ADCOM, ADC, and AFSC. Most of the activity at OSD is limited to R&D planning by the staff and DARPA, while operations planning in the JCS is limited principally to reconnaissance and warning.

For the effective use of space assets, be it for any of the assigned missions-support, enhancement, defense (and eventually offense), a single source of operations control must be used, i.e., the NCA backed by the planning of Joint Staff to the Unified and Specified Commanders. Doctrinally, this is the only proved method for the effective operational deployment and employment of the armed forces.

Other than planning, there are many problems as a result of the malassignment of responsibilities and the lack of centralized operational control. With respect to advocacy, no single using command is defending either new requirements in the PPBS process, or the "ilities" in the development process, which are always the first to suffer when the budget gets tight. With the trend toward not only multi-command, but multi-service spacecraft, who is ultimately responsible? With routine access to space by virtue of the shuttle, should multimission payloads be discontinued? Which command should be preparing the space workforce for the future?

These and many other problems were investigated by the Space Mission Organization Planning Study (SMOPS), directed by the Secretary of the Air Force and published in February 1979. Five alternative organizational approaches were outlined, but none was recommended. They included: maintenance of the status quo, assignment of the responsibilities to either SAC or AFSC, evolution of an eventual organization, and creation of a new space command.

Space Command

Many newspaper and magazine articles have addressed a new organization for space in general, and a space command in particular. A bill was recently introduced in the House (H.R. 5130) which directs the

Secretary of the Air Force to report to Congress on the feasibility and desirability of establishing a separate command for space (see Kramer bill, Introduction). Readers desiring a thorough treatment of the problems only briefly described above, as well as some salient analyses of the SMOPS study, should refer to Miller 1975, Sanborn 1976, Gyauch 1979, Beamer and Rosolanka 1980, and Dekok & Angell, Diederich, Cook, Van Inwegen, and Wisely 1981.⁵

Although some authors have gone so far as to recommend a separate service, on a par with the Air Force, Army, and Navy, the majority have centered on the need for a space command within the Air Force, designated as a four-star MAJCOM with a Specified Command charter. The civilian leadership of the Air Force appears to be headed that way as Under Secretary of the Air Force, Edward C. Aldridge, Jr., said recently, "I believe the right answer may be some form of a space command for the operation of our satellites and launch services. The AF is moving in that direction now."⁶ The former Deputy Chief of Staff for Systems at Headquarters AFSC (this position has responsibility for acquisition management of all new weapons systems, including space systems) and now Associate Administrator of NASA for the STS, Major General James Abrahamson, said, "I am convinced there will be a 'space command' at some time. The question is not if but when. What comes next is the overall planning."⁷

RECOMMENDATIONS

It seems clear that organizational issues of considerable magnitude face both NASA and DOD in the near term, with the space shuttle dominating the plans of each agency. Which way should NASA proceed in face of the limited funds projected for the years ahead? How can operating the "space shuttle airline," after the organizational adjustments have been made and the charter to do it approved, coexist with another developmental effort and a viable program of science and applications efforts? DOD's problem with dispersed responsibilities for space operations is well documented, and leadership in the Air Force is moving toward establishing a space command. The only question is timing and the planning necessary to make it happen.

NASA--Retain Capability, Reduce Scope

If NASA leadership could have its way, the agency would proceed on a concept of a balanced program of manned and unmanned flight, with emphasis on science, applications, and international programs. This course of action would have the advantages of keeping the civilian element of the national program strong and of providing for the formulation of ambitious plans for manned and unmanned exploration and space operations. Some possibilities were discussed in Chapter ^I ~~II~~ such as an orbital space station and a large lift vehicle (required because

the space station cannot be built using only the shuttle). The latter is of interest to the Air Force because of the requirement for a mixed fleet of launch vehicles, but space station activity by the military is awaiting potential utility and cost-effectiveness examinations. The fact that DOD was approached by NASA confirms that another large technology development effort is going to be pursued by the civilian space agency. As has been evidenced over the last five years, pursuit of this course along with a meaningful amount of science and applications efforts, is not compatible to a funding level of one percent of the national budget. Couple this fact with the previously discussed problems of: (a) the shuttle operations; (b) the difficulty of converting excess space research talent at many of NASA's field centers to energy, transportation, or other types of advanced research; (c) the likelihood that Congress will continue to insist on the separation of NASA and DOD programs, which suggests there can never be joint development activities; (d) the probable insistence that NASA continue to exist as a viable and separate government agency, and they all seem to imply drastic cutbacks are in order for the civilian space agency.

When faced with similar funding constraints in the past, although not as severe as those being imposed now, efforts to reduce the scope of activities (NACA-like operation or the relinquishment of manned flight) never got past the discussion phase. NASA simply cut back its science and applications programs to keep the shuttle development alive. By

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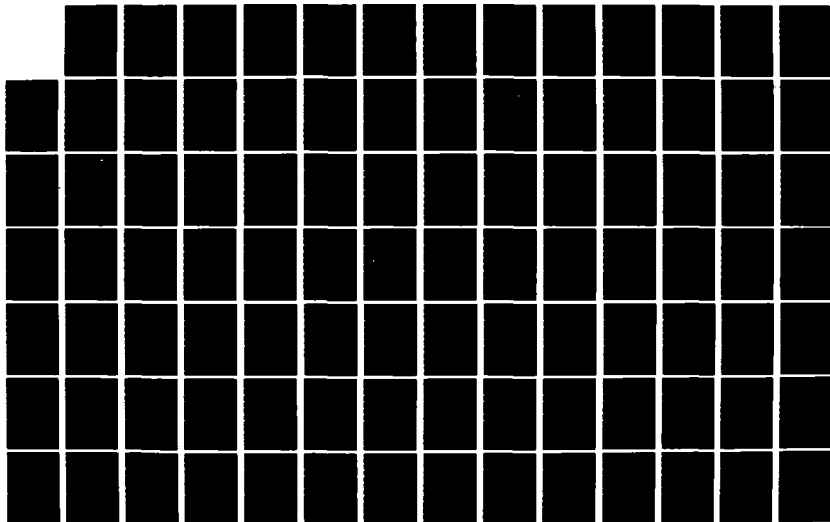
POLICY AND ORGANIZATION: THE NEXT STEP IN THE NATIONAL
SPACE PROGRAM(U) NATIONAL DEFENSE UNIV WASHINGTON DC
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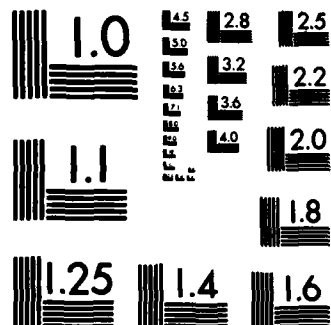
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substituting shuttle operations for any near-term space technology endeavor (obviously this is not a one-for-one tradeoff), NASA could keep science and applications going, at the expense of organizational and manpower impacts. Other "what-ifs" such as this would be equally unacceptable because, in reducing scope, they also take away capabilities considered essential to NASA's basic missions.

One capability that is not yet mission essential to NASA's future is space shuttle operations, and it should be given up while, at the same time, not relinquishing the manned space flight effort. Between now and the time that Initial Operational Capability (IOC) is reached, NASA should phase-in DOC to take over shuttle operations at KSC. DOC, in turn, could elect to run the operation, set up a quasi-government organization, or contract it out to private industry. A fifth orbiter should be procured so that DOC could count on at least two shuttles at all times for commercial use. The third orbiter would be shared between NASA and DOC, with NASA having priority for its manned research missions. The fourth and fifth orbiters would be used by the military. Under this scheme, all five orbiters would continue to be used interchangeably by DOC and DOD, with payloads being mixed or unique to either agency. The missions considered to be essential to national security would be under total control of the Air Force.

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

If the United States is to take a major step beyond the shuttle lift capability, NASA will need to do some serious design and development work over the next decade. Such a vehicle is required for the military's AMSC program and for futuristic civilian programs (manned planetary flights, space stations, or large solar power satellites-plans which should be put on the back burner for now). NASA has the talent and experience (witness the Saturn 5 rocket) for this effort, and candidates include an unmanned version of the shuttle or a new vehicle using high energy propulsion techniques. Investigation has started on the "Big Dumb Booster," or SRB-X (see Chapter ^I XI), and on the "In-line" concept that uses a module with one or two main engines placed under the shuttle external tank and a large cargo placed atop the tank. This effort would then free the Air Force to concentrate on a reusable aerodynamic space vehicle.

NASA's work on heavy lift vehicles should be kept low-key and scheduled over the remainder of the 1980s to keep within funding limitations. A high-level steady-state condition should be sought with respect to the heretofore suppressed science and applications programs using ELVs and the shuttle.

The last recommendation with regard to the civilian space program addresses the manpower overhead problem at NASA's research centers. Even if a large shuttle-like development effort were a possibility, this vast resource of space research talent could not be totally utilized.

Further, efforts in the past to gainfully employ these scientists in advanced research for other agencies, i.e., energy and transportation, have been less than satisfactory. These space experts should be working on advanced space projects, and go to the military, if necessary. Efforts to increase support through "military contracts" is not satisfactory as it does not get the same results and allegiance as if belonging to the organization. Assuming the Air Force becomes DOD's executive agent for space, a study effort should be initiated to compare the functions of AFSC's laboratories and research centers with those of NASA (e.g., Ames, Dryden, Langley, Lewis, and Wallops flight centers, plus the National Space Technology and Jet Propulsion Laboratories). Where it makes economical sense to do so, wholesale functions should be transferred to the Air Force. These changes would have be handled sensitively and with the proviso that should there be another Sputnik-like event, i.e., a 20-man Soviet space station, these functions, along with their personnel and facilities, would revert back to NASA.

These recommendations, taken in the aggregate, solve NASA's real as well as perceived (e.g., militarization) problems via reducing the scope of activities, while simultaneously retaining the capabilities expected by the NASAct of 1958.

Air Force - Plan for a Space Command

As indicated earlier, Air Force leadership is already leaning in the direction of a Space Command, and the only remaining step is planning for implementation. As of this writing, rumors are rampant in the Pentagon that the CSAF, General Lew Allen, Jr., will announce these plans before his retirement on 30 June 1982. Since this work will not be published for many months, readers will have the luxury of 20-20 hindsight on the accuracy of the recommendation which follows.

The alternatives considered by the SMOPS study notwithstanding, ADCOM has to be the new space command rather than establishing an entirely new one. It presently has a four-star commanding general and, in peacetime, manages the SPADOC through ADC, and tracks everything in space. In wartime, under its Specified Command charter, it reports directly to the JCS and assumes the space-based strategic defense operations role, wherein it controls everything except SAC's DMSP and GPS satellites with the help of AFSC's Satellite Control Facility.

If ADCOM were chosen, the first item of business would be to return its MAJCOM. Organizing, training, and equipping for space operations are MAJCOM functions which need the greatest degree of centralization, advocacy, and budget support separated from the development community.

The second item of business would be to choose an Initial Operational Capability (IOC) date for space operations in ADCOM. For lack of better criteria, I would pick the start date to coincide with CSOC operations. The requirement for CSOC can be found in national policy (PD-37), and with ADCOM providing the necessary advocacy, CSOC could be ready by 1986. In the meantime, a series of carefully timed, well planned, and coordinated interim steps would have to be worked out. For example, the DCSO could initially be "dual-hatted," reporting to both SD/CC and ADCOM/CC. Management of the launch and orbital support functions, as well as the space portion of the Eastern and Western Space and Missile Centers would have to be thoroughly scrubbed and agreed on. At least this step would bring the Air Force Satellite Control Facility, the Satellite Test Center, SPADOC, and Manned Space Flight Support Group initially under the control of ADCOM.

The Air Staff would have to determine if existing U&S commands should retain operational control of space assets directly supporting their missions, but multidisciplinary systems (e.g., DSCS, GPS, DMSP, etc.) could be transitioned to ADCOM fairly quickly. Lastly, the transfer of atmospheric defense, strategic offense or communications, and ballistic missile warning missions would have to be addressed.

Consolidation of space organization, training, equipment, and operations into ADCOM would promote more efficient use of resources and would certainly provide greater responsiveness to the NCA.

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
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AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
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CONCLUSIONS

In October 1982, the space age will be a quarter of a century old. As each year has passed, the magnitude and character of space activities have grown and changed throughout the world. No longer are only the United States and Russia involved, but other nations, international organizations, and even private companies are space users, with many in direct competition with American interests. A reassessment of what the national space policy should be to best take advantage of this climate is needed and is presently underway by the Reagan Administration.

When this task was approached prior to the mid-1970s, the factors that most influenced space policy were international cooperation, technological prowess, scientific discovery, commercial applications, and national pride and prestige, which were molded chiefly by NASA. Generally, these factors determined the goals that were set in space exploration, science, and applications programs, along with the role of manned flight in each. The magnitude of the funding to meet these goals, as well as the overall thrust of the nation's space policy, were determined by the influence NASA had with the President, his staff agencies, and Congress, coupled with support from the aerospace industry, the scientific community, and the public.

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

This modus operandi was fully envisioned by Congress when NASA was established in 1958 with broad powers and direction to lead the national space program. However, Congress also recognized the eventual role space would play in national security, and bestowed upon DOD the responsibility for managing this nation's "other" space program. While enjoying a budget only one fourth the size of NASA's during the mid-1960s, DOD's program started slowly and supported the civilian space agency. A decade later, however, military programs had rapidly expanded with satellites being developed and launched for a variety of functions including reconnaissance (photographic, electronic, early warning, ocean surveillance, and nuclear explosion detection), communications, navigation, meteorology, and geodesy. As the decade of the 1970s came to an end, and NASA was experiencing cost problems with the shuttle development that necessitated cancelling new efforts and stretching out on-going programs, DOD not only had more activity in space but was outspending the civilian agency. By 1982, for the first time in 22 years, the DOD space appropriation exceeded the whole of NASA's space and aeronautics appropriation by \$430 million. In 1983, this difference should swell to nearly \$2.0 billion, or nearly 25 percent larger.

The first public inkling that national security ranked equally with (if indeed it does not now dominate) the other factors of technological prowess, scientific discovery, etc., that most influence space policy, came in June 1978. It was then that President Carter published his

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

national space policy, which was severely criticized by the civilian community for over-emphasizing the military role. Within four months, a civilian space policy was released which, in turn, was criticized for not having established firm goals.

Thus we have the situation that presently exists. In response to the Soviet threat and for the support, enhancement, and defense of our military forces, the DOD space program is on the ascendancy, with the probability looming high for space weapons and warfare in the not too distant future. The defense establishment is not without problems, however. It does not have an executive agent for space which causes problems with the flowdown of national policy and necessitates the establishment of special steering committees. Organizationally, service doctrines are lagging, and the operational control of our multiple space assets is fragmented among the services and within the Air Force, such that they are not responsive to the Joint Chiefs or the national command authority.

The civilian space program has even bigger problems, foremost of which is funding. For a decade now, NASA has lived with low and level funding, equivalent in buying power to roughly half of what it was yearly in the 1960s. At the same time, NASA has cut its number of employees by only one third, and has continued to maintain 11 centers around the country. Its corresponding contractor support in private industry has

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

reduced employees from a peak of over 400,000 to roughly 100,000 today. Prospects for increased funding look bleak judging from where NASA must garner support: the President, his staff agencies (OMB and OSTP), and Congress have effectively cut the Carter projected budgets through 1985, which were already low; the aerospace industry and the general public are apathetic; and the scientific community will be unsupportive if NASA embarks on another high-technology effort following shuttle development.

NASA hopes to survive by increased support of the military, i.e., research center subcontracts and DOD traffic on the operational shuttle. This policy has raised cries from some parties as the militarization of NASA, while others say the civilian agency should merge with DOD.

Other issues exist as well. Does NASA have the necessary charter to operate the shuttle? If so, what effect will it have on the skill mix of NASA employees? Further, if operating the shuttle is coupled with another development effort like a space station, what will happen to the primary missions of space science and applications, which have been cut back for the last five years? How will NASA continue to gainfully employ the personnel at all its research centers?

These problems call for a new and comprehensive National Space Policy that succeeding administrations and Congresses can understand and live with. This implies both a joint effort of the executive and Legislative

branches of government and public debate. The new policy should address:
(a) outside forces--the Soviet threat, international competition and cooperation; (b) commercial and industrial applications--earth observation and material processing programs, for example; (c) exploration, science, and advanced technology--planetary probes, astronomy, and possible space-based power systems; (d) future roles of man in space--space stations or colonies; (e) civilian space assets--the shuttle and its operation, new launch systems, and a space lab; and (f) all national security programs with the exception of the most sensitive military and intelligence efforts. Once accomplished, the new policy must remain current and dynamic; therefore, a review mechanism has to be reestablished similar to the old National Aeronautics and Space Council.

Projected funding for NASA at one percent or less of the national budget presents severe problems in setting goals for each of the areas of the new policy. NASA simply cannot maintain meaningful science and applications programs while simultaneously initiating another large technology development effort and shuttle operations. Consequently, DOC should manage the operation of five shuttle orbiters, with two dedicated to the Air Force and one placed on call for NASA's manned research activities. The civilian space agency's next high technological effort should be a low key investigation of increasing the shuttle's lift capacity, thus making future large space structures a possibility. As a final move, NASA must scale down its operations at several research

AUTHOR SCHICHTLE
DOCUMENT: 1995A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

centers, possibly even relinquishing some facilities and personnel to the Air Force Systems Command. If these actions are not taken, then an update of the Space Act of 1958 is needed, along with increased funding over that projected in order for NASA to retain its capabilities and missions.

The actions required by DOD are straight forward. In concert with going public because of the funding magnitude, DOD must designate the USAF as its executive agent for all space efforts, and the Air Force, in turn, should publish its space doctrine. Lastly, plans should be laid now to make ADCOM the Air Force's operational space command.

APPENDIX A

BUDGET TABLES AND FIGURES

TABLE A-1. SPACE ACTIVITIES OF THE US GOVERNMENT

24-YR BUDGET SUMMARY -- BUDGET AUTHORITY

(In Millions of Dollars)

FY	NASA		Defense	Energy	Comm	Int	Agric	NSF	Total Space
	Total	Space							
1959	330.9	260.9	489.5	34.3					784.7
1960	523.6	461.5	560.9	43.3				0.1	1,065.8
1961	964.0	926.0	813.9	67.7				0.6	1,808.2
1962	1,824.9	1,796.8	1,298.2	147.8	50.7			1.3	3,294.6
1963	3,673.0	3,626.0	1,549.9	213.9	43.2			1.5	5,434.5
1964	5,099.7	5,016.3	1,599.3	210.0	2.8			3.0	6,831.4
1965	5,249.7	5,137.6	1,573.9	228.6	12.2			3.2	6,955.5
1966	5,174.9	5,064.5	1,688.8	186.8	26.5			3.2	6,969.8
1967	4,965.6	4,830.2	1,663.6	183.6	29.3			2.8	6,709.5
1968	4,587.3	4,430.0	1,921.8	145.1	28.1	0.2	0.5	3.2	6,289.4
1969	3,990.9	3,822.0	2,013.0	118.0	20.0	0.2	0.7	1.9	5,975.8
1970	3,745.8	3,547.0	1,678.4	102.8	8.0	1.1	0.8	2.4	5,340.5
1971	3,311.2	3,101.3	1,512.3	94.8	27.4	1.9	0.8	2.4	4,740.9
1972	3,306.6	3,071.0	1,407.0	55.2	31.3	5.8	1.6	2.8	4,574.7
1973	3,406.2	3,093.2	1,623.0	54.2	39.7	10.3	1.9	2.6	4,824.8
1974	3,036.9	2,758.5	1,766.0	41.7	60.2	9.0	3.1	1.8	4,640.3
1975	3,229.1	2,915.3	1,892.4	29.6	64.4	8.5	2.3	2.0	4,914.3
1976	3,550.3	3,225.4	1,983.3	23.3	71.5	10.4	3.6	2.4	5,319.9
1976T	931.8	849.2	460.4	4.6	22.2	2.6	0.9	0.6	1,340.5
1977	3,817.8	3,440.2	2,411.9	21.7	90.8	9.5	6.3	2.4	5,982.8
1978	4,060.1	3,622.9	2,728.8	34.4	102.8	9.7	7.7	2.4	6,508.7
1979	4,595.5	4,030.4	3,211.3	58.6	98.4	9.9	8.2	2.4	7,419.2
1980	5,240.2	4,680.4	3,848.4	39.6	92.6	11.7	13.7	2.4	8,688.8
1981est	5,519.1	4,997.2	4,789.4	42.0	91.9	12.1	15.5	2.4	9,950.5
1982est	6,118.3	5,617.3	5,916.3	38.0	126.3	12.6	17.2	2.0	11,729.7

Note: Excludes Amounts for Air Transportation.

Source: Office of Management and Budget (December 1981).

TABLE A-2

NASA BUDGET 1959-1979

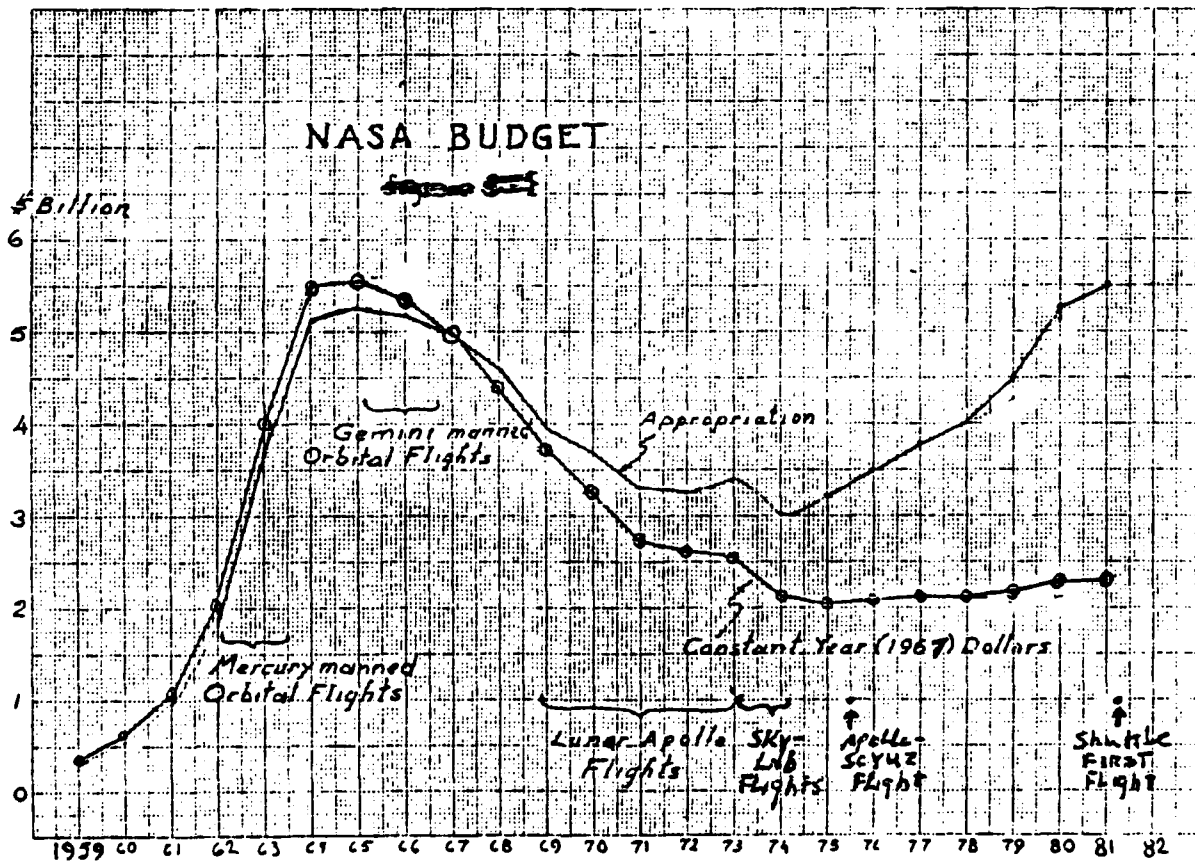
FISCAL YEAR	APPROPRIATION	1967 DOLLARS	GNP DELATOR FACTOR
1959	184.3	214.9	0.8575
1960	523.6	598.1	0.8754
1961	964.0	1,086.2	0.8855
1962	1,825.3	2,032.6	0.8980
1963	3,674.1	4,024.2	0.9130
1964	5,100.0	5,505.8	0.9263
1965	5,250.0	5,565.6	0.9433
1966	5,175.0	5,341.1	0.9689
1967	4,968.0	4,968.0	1.000
1968	4,588.9	4,429.4	1.036
1969	3,995.3	3,682.3	1.085
1970	3,749.2	3,274.4	1.145
1971	3,312.6	2,751.3	1.204
1972	3,310.1	2,629.2	1.259
1973	3,407.6	2,593.3	1.314
1974	3,039.7	2,142.1	1.419
1975	3,231.2	2,052.8	1.574
1976	3,551.8	2,099.1	1.692
Transition Quarter	932.2	550.9	----
1977	3,819.1	2,130.0	1.793
1978	4,063.7	2,112.1	1.924
1979	4,558.8	2,208.7	2.064
1980	5,243.4	2,348.1	2.233
1981	5,522.7	2,266.2(Estimate)	2.437 ¹
1982	5,932.0	-----	-----
1983	6,612.9 ²	-----	-----

Source: NASA Budget Office

¹Deflator factor for 1981 is not based on a full year's data and is subject to revision, therefore, 1967 dollars Figure is an estimate.

²NASA Request (March 1982)

FIGURE A-1



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FIGURE A-2

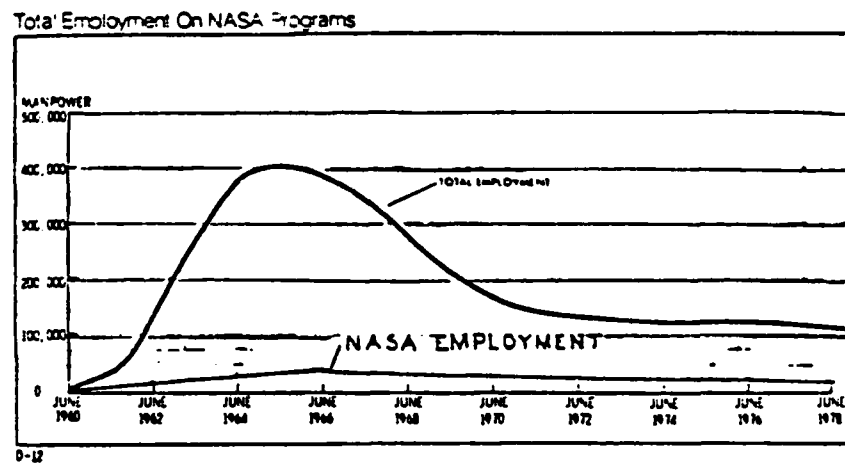


TABLE A-3

Personnel Summary

INSTALLATION	Onboard At End of Fiscal Year ^a										
	FY 1967	FY 1968	FY 1967	FY 1966	FY 1965	FY 1964	FY 1963	FY 1962	FY 1961	FY 1960	FY 1959
NASA Headquarters	2,293	2,310	2,336	2,135	2,135	2,158	2,001	1,477	735	587	492
Ames Research Center	2,117	2,197	2,264	2,310	2,270	2,204	2,116	1,658	1,471	1,421	1,464
Electronics Res. Center	951	950	791	555	250	33b/	25b/	---	---	---	---
Dryden Flt. Research Ctr	601	622	642	662	669	619	616	538	467	408	340
Goddard Sp. Flt. Cn.	4,295	4,073	3,997	3,958	3,774	3,675	3,487	2,755	1,599	1,255	398
Kennedy Space Center	3,058	3,044	2,867	2,669	2,464	1,625	1,181	339	---	---	---
Langley Research Cn.	4,087	4,219	4,405	4,485	4,371	4,330	4,220	3,894	3,338	3,203	3,624
Leuna Research Center	4,339	4,583	4,956	8,047	4,897	4,859	4,697	3,800	2,773	2,722	3,809
Johnson Space Center	4,751	4,956	5,407	4,487	4,859	4,277	3,345	1,786	794	In GSFC	---
Marshall Sp. Flt. Center	6,639	6,935	7,602	7,740	7,719	7,679	7,322	6,843	5,948	370	---
Pacific Launch Ops.	---	---	---	d/	21	22	17	---	---	---	---
Space Nuclear Sys. Ofc.	104	108	113	115	116	112	96	39	4	---	---
Western Support Ofc.	---	e/	119	294	377	376	308	136	60	37	---
NASA Pasadena Ofc.	80	79	91	85	376	a/	---	---	---	---	---
Wallops Station	554	565	578	563	554	530	493	421	322	229	171
NASA TOTAL	23,929	24,641	25,860	25,708	24,849	23,499	22,934	23,686	17,471	10,232	9,235

a/ Prior years figures included in WSO. * Includes Temporary Personnel
b/ Figures for North Eastern Office.
c/ Effective in 1968 WSO was disestablished and elements merged with NaPO
d/ Effective in 1966 PLOO activity was merged with KSC.

INSTALLATION	FY 1978	FY 1977	FY 1976	FY 1975	FY 1974	FY 1973	FY 1972	FY 1971	FY 1970
NASA Headquarters	1,606	1,619	1,708	1,673	1,734	1,747	1,755	1,894	2,187
Ames Research Center	1,691	1,645	1,724	1,754	1,776	1,740	1,844	1,968	2,013
Dryden Flight Center	514	546	566	564	531	509	539	579	583
Goddard Sp. Fl. Cn.	3,641	3,664	3,808	3,871	3,936	3,852	4,178	4,459	4,487
Kennedy Space Center	2,234	2,270	2,404	2,377	2,408	2,516	2,568	2,704	2,895
Langley Research Center	3,167	3,207	3,407	3,472	3,504	3,389	3,592	3,830	3,970
Leuna Research Center	2,964	3,061	3,168	3,181	3,172	3,368	3,866	4,083	4,740
Johnson Space Center	3,617	3,648	3,796	3,877	3,886	3,896	3,935	4,208	4,539
Marshall Sp. Fl. Center	3,808	4,014	4,336	4,337	4,576	5,287	5,353	6,060	6,325
Space Nuclear Sys. Ofc.	---	---	---	---	---	---	45	89	103
NASA Pasadena Office (NaPO)	---	---	---	35	39	39	40	44	72
Wallops Flight Center	429	426	437	441	447	434	465	497	522
National Space Tech. Lab.	108	94	72	76	---	---	---	---	---
NASA TOTAL	23,779a/	24,188	25,426	25,638	26,007	26,177	28,382	30,506	32,548b/

* Includes Temporary Personnel

a/ Excludes 85% employees in the youth programs.
b/ Includes 192 of ERC which closed 6/30/78.

103
✱

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TABLE A-4
DOD SHUTTLE FUNDING--FY80 PRESIDENT'S
BUDGET FIGURES¹

FY71 & Prior	\$4.3 million
72	3.0
73	3.7
74	3.5
75	10.0
76	18.5
77 + TQ	8.2
78	206.3
79	390.7
80 ²	444.8
81	383.7
82	256.0
83	160.1
<u>84</u>	<u>85.0</u>
Total	\$1977.8

Source: Congressional Research Service (November 1981)

¹Data supplied by the Air Force, March 1980. Table includes funding for Inertial Upper Stage, Preparation of Vandenberg Air Force Base for shuttle operations, and operations capability development.

²Figures up to and including FY80 are actual expenditures, FY81-84 are estimates of funding to completion.

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TABLE A-5

DOD SPACE-RELATED FUNDING

(In Millions of Dollars)

<u>Program</u>	<u>FY80</u> <u>Approp.</u>	<u>FY 81</u> <u>Approp.</u>	<u>FY 82</u> <u>Approp.</u>	<u>FY 83</u> <u>Request¹</u>
Missions Oriented				
Navigation	185.6	215.4	224.5	291.3
Communications	506.2	625.3	979.7	1,352.2
Warning	207.3	277.3	563.2	714.1
Mapping/Charting/ Geodesy	10.3	11.2	29.2	53.1
Weather	67.9	90.9	114.3	235.9
Vehicle Development	661.0	696.5	863.8	1,110.4
Space Ground Support	242.3	307.4	433.4	557.6
Supporting R&D	427.7	554.0	755.2	972.5
General Support	<u>1,540.1</u>	<u>1,891.2</u>	<u>2,399.0</u>	<u>3,164.6</u>
Total	<u>3,848.4</u>	<u>4,669.2</u>	<u>6,362.3</u>	<u>8,451.7</u>

Source: Congressional Research Service (March 1982)

¹Testimony, Senate Subcommittee Science, Technology, and Space, Dr. R. DeLauer, USDR&E, 18 March 1982.

APPENDIX B ~~SECRET~~

TEXTS OF PRESIDENT CARTER'S SPACE DIRECTIVES

(Office of the White House Press Secretary—June 19, 1978)

THE WHITE HOUSE

The President directed under a Presidential Review Memorandum that the NSC Policy Review Committee (PRC) thoroughly review existing policy and formulate overall principles which should guide our space activities. The major concerns that prompted this review arose from growing interaction among our various space activities.

This review examined and the resultant Presidential Directive establishes:

- A government policy oversight system to review and revise space policy as needed;

- Ground rules for the balance and interaction among our space programs to insure achievement of the interrelated national security, economic, political, and arms limitation goals of the U.S.;
- and

- Modifications to existing policies, the appropriate extent of the overlapping technology, and product dissemination by the sectors.

This Presidential Directive establishes an NSC Policy Review Committee to provide a forum to all Federal agencies for their policy views, to advise on proposed changes to national space policy, to resolve issues referred to the Committee, and to provide for rapid referral of issues to the President for decision as necessary. This Committee will be chaired by the Director of the Office of Science and Technology Policy, Frank Press. Recognizing that the civilian space program is at the threshold of change, the President has asked the PRC to assess the needs and aspirations of the nation's civil space program. The United States has built a broad national base in space and aeronautics. At issue is how best to capitalize on prior investments and set the needed direction and purpose for continued vitality in the future.

Under the Presidential Review Memorandum the emphasis was to resolve potential conflicts among the various space program sectors and to recommend coherent space principles and national space policy. In focusing upon these issues, the Policy Review Committee concluded that our current direction set forth in the Space Act of 1958 is well founded and that the preponderance of existing problems was related to interactions and resultant stresses among the various space programs. For this reason, the classified portion of the recently signed Presidential Directive concentrates on overlap questions. It does not deal in detail with the long-term objectives of our defense, commercial,

and civil programs. Determining our civil space policy, outlined above, will be the next step.

As a result of this in-depth review, the President's Directive established national policies to guide the conduct of United States activities in and related to space programs. The objectives are (1) to advance the interests of the United States through the exploration and use of space and (2) to cooperate with other nations in maintaining the freedom of space for all activities which enhance the security and welfare of mankind. The space principles set forth in this Directive are:

The United States will pursue space activities to increase scientific knowledge, develop useful commercial and government applications of space technology, and maintain United States leadership in space technology.

The United States is committed to the exploration and use of outer space by all nations for peaceful purposes and for the benefit of all mankind.

The United States is committed to the exploration and use of outer space in support of its national well-being.

The United States rejects any claims to sovereignty over outer space or over celestial bodies, or any portion thereof, and rejects any limitations on the fundamental right to acquire data from space.

The United States holds that the space systems of any nation are national property and have the right of passage through and operations in space without interference. Purposeful interference with space systems shall be viewed as an infringement upon sovereign rights.

The United States will pursue activities in space in support of its right of self-defense and thereby strengthen national security, the deterrence of attack, and arms control agreements.

The United States will conduct international cooperative space activities that are beneficial to the United States scientifically, politically, economically, and/or militarily.

The United States will develop and operate on a global basis active and passive remote sensing operations in support of national objectives.

The United States will maintain current responsibility and management relationships among the various space programs, and, as such, close coordination and information exchange will be maintained among the space sectors to avoid unnecessary duplication and to allow maximum cross-utilization of all capabilities.

Our civil space programs will be conducted to increase the body of scientific knowledge about the earth and the universe; to develop and operate civil applications of space technology; to maintain United States leadership in space science, applications, and technology; and to further United States domestic and foreign policy objectives within the following guidelines:

The United States will encourage domestic commercial exploitation of space capabilities and systems for economic benefit and to promote the technological position of the United States; however, all United States earth-oriented remote sensing satellites will require United States government authorization and supervision or regulation.

Advances in earth imaging from space will be permitted under controls and when such needs are justified and assessed in relation to civil benefits, national security, and foreign policy. Controls, as appropriate, or other forms of remote earth sensing will be established.

Data and results from the civil space programs will be provided the widest practical dissemination to improve the condition of human beings on earth and to provide improved space services for the United States and other nations of the world.

The United States will develop, manage, and operate a fully operational Space Transportation System (STS) through NASA, in cooperation with the Department of Defense. The STS will service all authorized space users—domestic and foreign, commercial and governmental—and will provide launch priority and necessary security to national security missions while recognizing the essentially open character of the civil space program.

Our national security related space programs will conduct those activities in space which are necessary to our support of such functions as command and control, communications, navigation, environmental monitoring, warning and surveillance, and space defense as well as to support the formulation and execution of national policies; and to support the planning for and conduct of military operations. These programs will be conducted within the following guidelines:

Security, including dissemination of data, shall be conducted in accordance with Executive Orders and applicable directives for protection of national security information. Space-related products and technology shall be afforded lower or no classification where possible to permit wider use of our total national space capability.

The Secretary of Defense will establish a program for identifying and integrating, as appropriate, civil and commercial resources into military operations during national emergencies declared by the President.

Survivability of space systems will be pursued commensurate with the planned need in crisis and war and the availability of other assets to perform the mission. Identified deficiencies will be eliminated and an aggressive, long-term program will be applied to provide more assured survivability through evolutionary changes to space systems.

The United States finds itself under increasing pressure to field an anti-satellite capability of its own in response to Soviet activities in this area. By exercising mutual restraint, the United States and the Soviet Union have an opportunity at this early juncture to stop an unhealthy arms competition in space before the competition develops a momentum of its own. The two countries have commenced bilateral discussions on limiting certain activities directed against space objects, which we anticipate will be consistent with the overall U.S. goal of maintaining any nation's right of passage through and operations in space without interference.

While the United States seeks verifiable, comprehensive limits on anti-satellite capabilities and use, in the absence of such an agreement, the United States will vigorously pursue development

of its own capabilities. The U.S. space defense program shall include, an integrated attack warning, notification, verification, and contingency reaction capability which can effectively detect and react to threats to U.S. space systems.

(Office of the White House Press Secretary—October 11, 1978)

THE WHITE HOUSE

U.S. CIVIL SPACE POLICY

The President announced today a space policy that will set the direction of U.S. efforts in space over the next decade. The policy is the result of a four-month interagency review requested by the President in June 1978. American civil space policy will be centered around three tenets:

First: Our space policy will reflect a balanced strategy of applications, science and technology development containing essential key elements that will:

- Emphasize space applications that will bring important benefits to our understanding of earth resources, climate, weather, pollution and agriculture, and provide for the private sector to take an increasing responsibility in remote sensing and other applications.

- Emphasize space science and exploration in a manner that retains the challenge and excitement and permits the nation to retain the vitality of its space technology base, yet provides short-term flexibility to impose fiscal constraints when conditions warrant.

- Take advantage of the flexibility of the space shuttle to reduce the cost of operating in space over the next two decades to meet national needs.

- Increase benefits for resources expended through better integration and technology transfer among the national space programs and through more joint projects when appropriate, thereby increasing the return on the \$100 billion investment in space to the benefit of the American people.

- Assure American scientific and technological leadership in space for the security and welfare of the nation and continue R&D necessary to provide the basis for later programmatic decisions.

- Demonstrate advanced technological capabilities in open and imaginative ways having benefit for developing as well as developed countries.

- Foster space cooperation with nations by conducting joint programs.

- Confirm our support of the continued development of a legal regime for space that will assure its safe and peaceful use for the benefit of mankind.

Second: More and more, space is becoming a place to work—an extension of our environment. In the future, activities will be pursued in

space when it appears that national objectives can most efficiently be met through space activities.

Third: It is neither feasible nor necessary at this time to commit the United States to a high-challenge space engineering initiative comparable to Apollo. As the resources and manpower requirements for shuttle development phase down, we will have the flexibility to give greater attention to new space applications and exploration, continue programs at present levels or contract them. To meet the objectives specified above, an adequate Federal budget commitment will be made.

Space applications

As a part of his overall review and in accordance with his desire to increase emphasis on uses of space for a wide variety of practical and economic benefits the President made the following decisions:

Remote Sensing Systems.—Since 1972 the United States has conducted experimental civil remote sensing through LANDSAT satellites. There are many successful applications and users, including Federal departments, other nations, a number of states, and a growing number of commercial organizations. The United States will continue to provide data from the developmental LANDSAT program for all classes of users. Operational uses of data from the experimental system will continue to be made by public, private, and international users. Specific details and configurations of the LANDSAT system and its management and organizational factors will evolve over the next several years to arrive at the appropriate technology mix, test organizational arrangements, and develop the potential to involve the private sector.

Integrated Remote Sensing System.—A comprehensive plan covering expected technical, programmatic, private sector, and institutional arrangements for remote sensing will be explored. NASA will chair an interagency task force to examine options for integrating current and future systems into an integrated national system. Emphasis will be placed on defining and meeting user requirements. This task force will complete its review prior to the FY 1981 budget cycle.

Weather Satellites.—Separate operational requirements for meteorological data over the past two decades have led to separate Defense and Commerce's National Oceanic and Atmospheric Administration (NOAA) weather satellites. The Defense community, NASA, and NOAA will conduct a review of meteorological satellite programs to determine the degree to which these programs might be consolidated in the 1980s and the extent to which separate programs supporting specialized defense needs should be maintained. The possibility of integrated systems for ocean observations from space will also be examined.

The Private Sector.—Along with other appropriate agencies, NASA and Commerce will prepare a plan of action on how to encourage private investment and direct participation in civil remote sensing systems. NASA and Commerce will be the contacts for the private sector on this matter and will analyze proposals received before submitting to the Policy Review Committee (Space) for consideration and action.

Communications Satellite R&D.—United States leadership in communications satellite systems will be supported by NASA. Selected

technological opportunities to provide better frequency and orbit utilization and other longer-term opportunities will be pursued.

Communications Satellite Services.—Some areas of communications services—such as educational and health services and basic communications services for remote areas—involve low-volume and intermittent use and have evidenced little interest from commercial satellite operators. The Department of Commerce's National Telecommunications and Information Administration (NTIA) will assist in market aggregation, technology transfer, and possible development of domestic and international public satellite services. This direction is intended to stimulate the aggregation of the public service market drawing on the technology that is already in existence. The Agency for International Development and Interior will work with NTIA in translating domestic experience in public service programs into potential programs for lesser-developed countries and the remote territories.

Future Applications and Economic Activity.—It is too early to make a commitment to the development of a satellite solar power station or space manufacturing facility due to the uncertainty of the technology and economic cost-benefits and environmental concerns. There are, however, very useful intermediate steps that will allow the development and testing of key technologies and experience in space industrial operations to be gained. The United States will pursue an evolutionary program that is directed toward assessing new options which will be reviewed periodically by the Policy Review Committee (Space). The evolutionary program will stress science and basic technology—integrated with a complementary ground R&D program—and will continue to evaluate the relative costs and benefits of proposed activities.

Space science and exploration

The President reviewed the space science and planetary exploration program and determined that the United States' priorities at any given time will depend on the promise of the science, the availability of the particular technology, and the budgetary situation. The United States will maintain a position of leadership in space science and planetary exploration and will:

Continue a vigorous program of planetary exploration to understand the origin and evolution of the solar system. The goal in the years ahead is to continue the reconnaissance of the outer planets and to conduct more detailed exploration of Saturn, its moons, and its rings; to continue comparative studies of the neighboring planets, Venus and Mars; and to conduct reconnaissance of comets and asteroids.

Utilize the space telescope and free-flying satellites to usher in a new era of astronomy, as we explore interstellar molecules, quasars, pulsars, and black holes to expand our understanding of the universe.

Develop a better understanding of the sun and its interaction with the terrestrial environment through space systems—such as the Solar Maximum Mission and the Solar Polar Mission—that will journey towards the sun and earth-orbiting satellites that will measure the variation in solar output and determine the resultant response of the earth's atmosphere.

Utilize the space shuttle and spacelab, alone and in cooperation with other nations, to conduct basic research that complements earth-based life science investigations and human physiology research.

Our policy in international space cooperation will include two basic elements: (1) to pursue the best science available regardless of national origin and expand our international planning and coordinating effort; and (2) to seek cooperative support for experiments-spacecraft which have been chosen on sound scientific criteria.

Increased benefit for resources expended

As a result of the President's review, decisions were made that will increase the benefit of the United States for resources expended.

Strategy to Utilize the Shuttle.—The Administration will make incremental improvements in the shuttle transportation system as they become necessary. Decisions on extending the shuttle's stay time in orbit and future upper stage capabilities (e.g., the reusable space tug and orbital transfer vehicle) will be examined in the context of our emerging space policy goals. An interagency task force will make recommendations on what future capabilities are needed. This task force will submit the findings to the Policy Review Committee (Space) prior to FY 1981 budget cycle.

Technology Sharing.—The Policy Review Committee (Space) will take steps to enhance technology transfer between the space sectors. The objective will be to maximize efficient utilization of the sectors while maintaining necessary security and current management relationships.

Background

Early in his Administration, the President directed a National Security Council review of space policy. The emphasis was on coherent space principles and national space policy and did not deal in detail with the long-term objectives of our defense, commercial, and civil programs. The review, completed in May 1978, resulted in a Presidential Directive that set the basic framework for our civil space policy completed last week. The President's May 1978 directive established a Policy Review Committee (Space) to provide a forum for all Federal agencies in which to advise on proposed changes to national space policy and to provide for rapid referral of issues to the President for decision. This Committee is chaired by the Director of the Office of Science and Technology Policy, Frank Press. In June 1978 the President directed the Policy Review Committee (Space) to assess the future needs of the nation's civil space program, and their report formed the basis for the policy decisions outlined here. The following agencies and departments participated: The National Aeronautics and Space Administration, Commerce, Interior, Agriculture, Energy, State, National Science Foundation, Agency for International Development, Defense, Director of Central Intelligence, Joint Chiefs of Staff, and Arms Control and Disarmament Agency, as well as the Domestic Policy Staff, the National Security Council Staff, and the Office of Management and Budget.

APPENDIX ~~XXXXXX~~ C

INTERNATIONAL SPACE TREATIES

1. TREATY ON PRINCIPLES GOVERNING THE ACTIVITIES OF STATES IN THE EXPLORATION AND USE OF OUTER SPACE, INCLUDING THE MOON AND OTHER CELESTIAL BODIES

The States Parties to this Treaty,

Inspired by the great prospect opening up before mankind as a result of man's entry into outer space,

Recognizing the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes,

Believing that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development,

Desiring to contribute to broad international co-operation in the scientific as well as the legal aspects of the exploration and use of outer space for peaceful purposes,

Believing that such co-operation will contribute to the development of mutual understanding and to the strengthening of friendly relations between States and peoples,

Recalling resolution 1962 (XVIII), entitled "Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space," which was adopted unanimously by the United Nations General Assembly on 13 December 1963,

Recalling resolution 1884 (XVIII), calling upon States to refrain from placing in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction or from installing such weapons on celestial bodies, which was adopted unanimously by the United Nations General Assembly on 17 October 1963,

Taking account of United Nations General Assembly resolution 110 (II) of 3 November 1947, which condemned propaganda designed or likely to provoke or encourage any threat to the peace, breach of the peace or act of aggression, and considering that the aforementioned resolution is applicable to outer space,

Convinced that a Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, will further the Purposes and Principles of the Charter of the United Nations,

Have agreed on the following:

ARTICLE I

The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.

Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.

There shall be freedom of scientific investigation in outer space, including the moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation.

ARTICLE II

Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.

ARTICLE III

States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international co-operation and understanding.

ARTICLE IV

States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner.

The moon and other celestial bodies be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military maneuvers on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the moon and other celestial bodies shall also not be prohibited.

ARTICLE V

States Parties to the Treaty shall regard astronauts as envoys of mankind in outer space and shall render to them all possible assistance in the event of accident, distress, or emergency landing on the territory of another State Party or on the high seas. When astronauts make such a landing, they shall be safely and promptly returned to the State of registry of their space vehicle.

In carrying on activities in outer space and on celestial bodies, the astronauts of one State Party shall render all possible assistance to the astronauts of other States Parties.

States Parties to the Treaty shall immediately inform the other States Parties to the Treaty or the Secretary-General of the United Nations of any phenomena they discover in outer space, including the moon and other celestial bodies, which could constitute a danger to the life or health of astronauts.

ARTICLE VI

States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization.

ARTICLE VII

Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the moon and other celestial bodies.

ARTICLE VIII

A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body. Ownership of

objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth. Such objects or component parts found beyond the limits of the State Party to the Treaty on whose registry they are carried shall be returned to that State Party, which shall upon request, furnish identifying data prior to their return.

ARTICLE IX

In the exploration and use of outer space, including the moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space, including the moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the moon and other celestial bodies, may request consultation concerning the activity or experiment.

ARTICLE X

In order to promote international co-operation in the exploration and use of outer space, including the moon and other celestial bodies, the conformity with the purposes of this Treaty, the States Parties to the Treaty shall consider on a basis of equality any requests by other States Parties to the Treaty to be afforded an opportunity to observe the flight of space objects launched by those States.

The nature of such an opportunity for observation and the conditions under which it could be afforded shall be determined by agreement between the States concerned.

ARTICLE XI

In order to promote international co-operation in the peaceful exploration and use of outer space, States Parties to the Treaty conducting activities in outer space, including the moon and other celestial bodies, agree to inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of the nature, conduct, locations and results of such activities. On receiving the said information, the Secretary-General of the United Nations should be prepared to disseminate it immediately and effectively.

ARTICLE XII

All stations, installations, equipment and space vehicles on the moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity. Such representatives shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited.

ARTICLE XIII

The provisions of this Treaty shall apply to the activities of States Parties to the Treaty in the exploration and use of outer space, including the moon and other celestial bodies, whether such activities are carried on by a single State Party to the Treaty or jointly with other States, including cases where they are carried on within the framework of international inter-governmental organizations.

Any practical questions arising in connection with activities carried on by international inter-governmental organizations in the exploration and use of outer space, including the moon and other celestial bodies, shall be resolved by the States Parties to the Treaty either with the appropriate international organization or with one or more States members of that international organization, which are Parties to this Treaty.

ARTICLE XIV

1. This Treaty shall be open to all States for signature. Any State which does not sign this Treaty before its entry into force in accordance with paragraph 3 of this article may accede to it at any time.

2. This Treaty shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the United States of America, the United Kingdom of Great Britain and Northern Ireland and the Union of Soviet Socialist Republics, which are hereby designated the Depositary Governments.

3. This Treaty shall enter into force upon the deposit of instruments of ratification by five Governments including the Governments designated as Depositary Governments under this Treaty.

SIGNATORIES TO TREATY ON PRINCIPLES GOVERNING THE ACTIVITIES OF STATES IN THE EXPLORATION AND USE OF OUTER SPACE, INCLUDING THE MOON AND OTHER CELESTIAL BODIES

Ninety signatures plus the Ukrainian S.S.R. and Byelorussian S.S.R.; 57 Ratifications plus the Ukrainian S.S.R. and Byelorussian S.S.R.; 14 Accessions.

Signatures:

Afghanistan	Germany, Federal	Niger ¹
Argentina ¹	Republic of ¹	Norway ¹
Australia ¹	Ghana	Pakistan ¹
Austria ¹	Greece ¹	Panama
Belgium ¹	Guyana	Peru ¹
Bolivia	Haiti	Philippines
Botswana	Honduras	Poland ¹
Brazil ¹	Hungary ¹	Romania ¹
Bulgaria ¹	Iceland ¹	Rwanda
Burma ¹	India	San Marino ¹
Burundi	Indonesia	Sierra Leone ¹
Cameroon	Iran	Somalia
Canada ¹	Iraq ¹	South Africa ¹
Central African	Ireland ¹	Soviet Union ¹
Republic	Israel ¹	Sri Lanka
Chile	Italy ¹	Sweden ¹
China, Republic of ¹	Jamaica ¹	Switzerland ¹
Colombia	Japan ¹	Thailand ¹
Cyprus ¹	Jordan	Togo
Czechoslovakia ¹	Korea ¹	Trinidad and Tobago
Denmark ¹	Laos ¹	Tunisia ¹
Dominican Republic ¹	Lebanon ¹	Turkey ¹
Ecuador ¹	Lesotho	United Kingdom ¹
Egypt ¹	Luxembourg	United States ¹
El Salvador ¹	Malaysia	Upper Volta ¹
Ethiopia	Mexico ¹	Uruguay ¹
Finland ¹	Mongolia ¹	Vatican City
France ¹	Nepal ¹	Venezuela ¹
Gambia	Netherlands ¹	Vietnam
German Democratic	New Zealand ¹	Yugoslavia
Republic ¹	Nicaragua	Zaire

¹ Ratification.

Accessions:

Barbados	Morocco	Spain
Kuwait	Nigeria	Syria
Libya	Saudi Arabia	Uganda
Malagasy Republic	Seychelles	Zambia
Mali	Singapore	

2. AGREEMENT ON THE RESCUE OF ASTRONAUTS, THE RETURN OF ASTRONAUTS AND THE RETURN OF OBJECTS LAUNCHED INTO OUTER SPACE

The Contracting Parties,

Noting the great importance of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, which calls for the rendering of all possible assistance to astronauts in the event of accident, distress or emergency landing, the prompt and safe return of astronauts, and the return of objects launched into outer space,

Desiring to develop and give further concrete expression to these duties, Wishing to promote international co-operation in the peaceful exploration and use of outer space,

Prompted by sentiments of humanity,

Have agreed on the following:

ARTICLE 1

Each Contracting Party which receives information or discovers that the personnel of a spacecraft have suffered accident or are experiencing conditions of distress or have made an emergency or unintended landing in territory under its jurisdiction or on the high seas or in any other place not under the jurisdiction of any State shall immediately:

(a) Notify the launching authority or, if it cannot identify and immediately communicate with the launching authority, immediately make a public announcement by all appropriate means of communication at its disposal;

(b) Notify the Secretary-General of the United Nations, who should disseminate the information without delay by all appropriate means of communication at his disposal.

ARTICLE 2

If, owing to accident, distress, emergency or unintended landing, the personnel of a spacecraft land in territory under the jurisdiction of a Contracting Party, it shall immediately take all possible steps to rescue them and render them all necessary assistance. It shall inform the launching authority and also the Secretary-General of the United Nations of the steps it is taking and of their progress. If assistance by the launching authority would help to effect a prompt rescue or would contribute substantially to the effectiveness of search and rescue operations, the launching authority shall co-operate with the Contracting Party with a view to the effective conduct of search and rescue operations. Such operations shall be subject to the direction and control of the Contracting Party, which shall act in close and continuing consultation with the launching authority.

ARTICLE 3

If information is received or it is discovered that the personnel of a spacecraft have alighted on the high seas or in any other place not under the jurisdiction of any State, those Contracting Parties which are in a position to do so shall, if necessary, extend assistance in search and rescue operations for such personnel to assure their speedy rescue. They shall inform the launching authority and the Secretary-General of the United Nations of the steps they are taking and of their progress.

ARTICLE 4

If, owing to accident, distress, emergency or unintended landing, the personnel of a spacecraft land in territory under the jurisdiction of a Contracting Party or have been found on the high seas or in any other place not under the jurisdiction of any State, they shall be safely and promptly returned to representatives of the launching authority.

ARTICLE 5

1. Each Contracting Party which receives information or discovers that a space object or its component parts has returned to Earth in territory under its jurisdiction or on the high seas or in any other place not under the jurisdiction of any State, shall notify the launching authority and the Secretary-General of the United Nations.

2. Each Contracting Party having jurisdiction over the territory on which a space object or its component parts has been discovered shall, upon the request of the launching authority and with assistance from that authority if requested, take such steps as it finds practicable to recover the object or component parts.

3. Upon request of the launching authority, objects launched into outer space or their component parts found beyond the territorial limits of the launching authority shall be returned to or held at the disposal of representatives of the launching authority, which shall, upon request, furnish identifying data prior to their return.

4. Notwithstanding paragraphs 2 and 3 of this article, a Contracting Party which has reason to believe that a space object or its component parts discovered in territory under its jurisdiction, or recovered by it elsewhere, is of a hazardous or deleterious nature may so notify the launching authority, which shall immediately take effective steps, under the direction and control of the said Contracting Party, to eliminate possible danger of harm.

5. Expenses incurred in fulfilling obligations to recover and return a space object or its component parts under paragraphs 2 and 3 of this article shall be borne by the launching authority.

ARTICLE 6

For the purposes of this Agreement, the term, "launching authority" shall refer to the State responsible for launching, or, where an international inter-governmental organization is responsible for launching, that organization, provided that that organization declares its acceptance of the rights and obligations provided for in this Agreement and a majority of the States members of that organization are Contracting Parties to this Agreement and to the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

ARTICLE 7

1. This Agreement shall be open to all States for signature. Any State which does not sign this Agreement before its entry into force in accordance with paragraph 3 of this article may accede to it at any time.

2. This Agreement shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the United States of America, the United Kingdom of Great Britain and Northern Ireland and the Union of Soviet Socialist Republics, which are hereby designated the Depositary Governments.

3. This Agreement shall enter into force upon the deposit of instruments of ratification by five Governments including the Governments designated as Depositary Governments under this Agreement.

4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Agreement, it shall enter into force on the date of the deposit of their instruments of ratification or accession.

5. The Depositary Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification or accession to this Agreement, the date of its entry into force and other notices.

6. This Agreement shall be registered by the Depositary Governments pursuant to Article 102 of the Charter of the United Nations.

ARTICLE 8

Any State Party to the Agreement may propose amendments to this Agreement. Amendments shall enter into force for each State Party to the Agreement accepting the amendments upon their acceptance by a majority of the States Parties to the Agreement and thereafter for each remaining State Party to the Agreement on the date of acceptance by it.

ARTICLE 9

Any State Party to the Agreement may give notice of its withdrawal from the Agreement one year after its entry into force by written notification to the Depositary Governments. Such withdrawal shall take effect one year from the date of receipt of this notification.

ARTICLE 10

This Agreement, of which the English, Russian, French, Spanish and Chinese texts are equally authentic, shall be deposited in the archives of the Depositary Governments. Duly certified copies of this Agreement shall be transmitted by the Depositary Governments to the Governments of the signatory and acceding States.

SIGNATORIES TO AGREEMENT ON THE RESCUE OF ASTRONAUTS, THE RETURN OF ASTRONAUTS AND THE RETURN OF OBJECTS LAUNCHED INTO OUTER SPACE

Seventy-nine signatures plus the Ukrainian S.S.R. and Byelorussian S.S.R.; 50 Ratifications plus the Ukrainian S.S.R. and Byelorussian S.S.R.; 16 Accessions.

Signatures:

Argentina ¹	Greece ¹	Nicaragua
Australia	Guyana ¹	Niger ¹
Austria ¹	Haiti	Nigeria ¹
Belgium ¹	Hungary ¹	Norway ¹
Bolivia	Iceland ¹	Philippines
Bulgaria ¹	Iran ¹	Poland ¹
Burma	Ireland ¹	Portugal ¹
Cameroon ¹	Israel ¹	Romania ¹
Canada ¹	Italy ¹	Rwanda
Chile	Jamaica	San Marino ¹
China, Republic of ¹	Jordan	Senegal
Colombia	Korea ¹	Sierra Leone
Costa Rica	Laos ¹	Somalia
Cyprus ¹	Lebanon ¹	South Africa ¹
Czechoslovakia ¹	Lesotho	Soviet Union ¹
Denmark ¹	Luxembourg	Switzerland ¹
Dominican Republic	Malagasy Republic ¹	Syria ¹
Ecuador ¹	Malaysia	Tunisia ¹
Egypt ¹	Maldives ¹	Turkey
El Salvador ¹	Malta	United Kingdom ¹
Finland ¹	Mexico ¹	United States ¹
Gambia	Monaco	Uruguay ¹
German Democratic Republic ¹	Mongolia ¹	Venezuela
Germany, Federal Republic of ¹	Morocco ¹	Vietnam
Ghana	Nepal ¹	Yemen Arab Republic
¹ Ratified.	Netherlands	Yugoslavia ¹
	New Zealand ¹	Zaire

Accessions:

Barbados	Kuwait	Swaziland
Botswana	Mauritius	Sweden
Brazil	Pakistan	Thailand
France	Peru	Zambia
Gabon	Seychelles	
Iraq	Singapore	

3. CONVENTION ON INTERNATIONAL LIABILITY FOR DAMAGE CAUSED BY SPACE OBJECTS

The States Parties to this Convention,
 Recognizing the common interest of all mankind in furthering the exploration and use of outer space for peaceful purposes,
 Recalling the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies,
 Taking into consideration that, notwithstanding the precautionary measures to be taken by States and international intergovernmental organizations involved in the launching of space objects, damage may on occasion be caused by such objects,
 Recognizing the need to elaborate effective international rules and procedures concerning liability for damage caused by space objects and to ensure, in particular, the prompt payment under the terms of this Convention of a full and equitable measure of compensation to victims of such damage,

Believing that the establishment of such rules and procedures will contribute to the strengthening of international cooperation in the field of the exploration and use of outer space for peaceful purposes,
Have agreed on the following:

ARTICLE I

For the purposes of this Convention:

- (a) The term "damage" means loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations;
- (b) The term "launching" includes attempted launching;
- (c) The term "launching State" means:
 - (i) A State which launches or procures the launching of a space object;
 - (ii) A State from whose territory or facility a space object is launched;
- (d) The term "space object" includes component parts of a space object as well as its launch vehicle and parts thereof.

ARTICLE II

A launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the earth or to aircraft in flight.

ARTICLE III

In the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State, the latter shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible.

ARTICLE IV

1. In the event of damage being caused elsewhere than on the surface of the earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State and of damage thereby being caused to a third State or to its natural or juridical persons, the first two States shall be jointly and severally liable to the third State, to the extent indicated by the following:

(a) If the damage has been caused to the third State on the surface of the earth or to aircraft in flight, their liability to the third State shall be absolute;

(b) If the damage has been caused to a space object of the third State or to persons or property on board that space object elsewhere than on the surface of the earth, their liability to the third State shall be based on the fault of either of the first two States or on the fault of persons for whom either is responsible.

2. In all cases of joint and several liability referred to in paragraph 1 of this article, the burden of compensation for the damage shall be apportioned between the first two States in accordance with the extent to which they were at fault; if the extent of the fault of each of these States cannot be established, the burden of compensation shall be apportioned equally between them. Such apportionment shall be without prejudice to the right of the third State to seek the entire compensation due under this Convention from any or all of the launching States which are jointly and severally liable.

ARTICLE V

1. Whenever two or more States jointly launch a space object, they shall be jointly and severally liable for any damage caused.

2. A launching State which has paid compensation for damage shall have the right to present a claim for indemnification to other participants in the joint launching. The participants in a joint launching may conclude agreements regarding the apportioning among themselves of the financial obligation in respect of which they are jointly and severally liable. Such agreements shall be without prejudice to the right of a State sustaining damage to seek the entire compensation due under this Convention from any or all of the launching States which are jointly and severally liable.

3. A State from whose territory or facility a space object is launched shall be regarded as a participant in a joint launching.

ARTICLE VI

1. Subject to the provisions of paragraph 2 of this article, exoneration from absolute liability shall be granted to the extent that a launching State establishes that the damage has resulted either wholly or partially from gross negligence or from an act or omission done with intent to cause damage on the part of a claimant State or of natural or juridical persons it represents.

2. No exoneration whatever shall be granted in cases where the damage has resulted from activities conducted by a launching State which are not in conformity with international law including, in particular, the Charter of the United Nations and the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

ARTICLE VII

The provisions of this Convention shall not apply to damage caused by a space object of a launching State to:

(a) Nationals of that launching State;

(b) Foreign nationals during such time as they are participating in the operation of that space object from the time of its launching or at any stage thereafter until its descent, or during such time as they are in the immediate vicinity of a planned launching or recovery area as the result of an invitation by that launching State.

ARTICLE VIII

1. A State which suffers damage, or whose natural or juridical persons suffer damage, may present to a launching State a claim for compensation for such damage.

2. If the State of nationality has not presented a claim, another State may, in respect of damage sustained in its territory by any natural or juridical person, present a claim to a launching State.

3. If neither the State of nationality nor the State in whose territory the damage was sustained has presented a claim or notified its intention of presenting a claim, another State may, in respect of damage sustained by its permanent residents, present a claim to a launching State.

ARTICLE IX

A claim for compensation for damage shall be presented to a launching State through diplomatic channels. If a State does not maintain diplomatic relations with the launching State concerned, it may request another State to present its claim to that launching State or otherwise represent its interests under this Convention. It may also present its claim through the Secretary-General of the United Nations, provided the claimant State and the launching State are both Members of the United Nations.

ARTICLE X

1. A claim for compensation for damage may be presented to a launching State not later than one year following the date of the occurrence of the damage or the identification of the launching State which is liable.

2. If, however, a State does not know of the occurrence of the damage or has not been able to identify the launching State which is liable, it may present a claim within one year following the date on which it learned of the aforementioned facts; however, this period shall in no event exceed one year following the date on which the State could reasonably be expected to have learned of the facts through exercise of due diligence.

3. The time-limits specified in paragraphs 1 and 2 of this article shall apply even if the full extent of the damage may not be known. In this event, however, the claimant State shall be entitled to revise the claim and submit additional documentation after the expiration of such time-limits until one year after the full extent of the damage is known.

ARTICLE XI

1. Presentation of a claim to a launching State for compensation for damage under this Convention shall not require the prior exhaustion of any local remedies which may be available to a claimant State or to natural or juridical persons it represents.

2. Nothing in this Convention shall prevent a State, or natural or juridical persons it might represent, from pursuing a claim in the courts or administrative tribunals or agencies of a launching State. A State shall not, however, be entitled to present a claim under this Convention in respect of the same damage for which a claim is being pursued in the courts or administrative tribunals or agencies of a launching State or under another international agreement which is binding on the States concerned.

ARTICLE XII

The compensation which the launching State shall be liable to pay for damage under this Convention shall be determined in accordance with international law and the principles of justice and equity, in order to provide such reparation in respect of the damage as will restore the person, natural or juridical, State or international organization on whose behalf the claim is presented to the condition which would have existed if the damage had not occurred.

ARTICLE XIII

Unless the claimant State and the State from which compensation is due under this Convention agree on another form of compensation, the compensation shall be paid in the currency of the claimant State or, if that State so requests, in the currency of the State from which compensation is due.

ARTICLE XIV

If no settlement of a claim is arrived at through diplomatic negotiations as provided for in Article IX, within one year from the date on which the claimant State notifies the launching State that it has submitted the documentation of its claims, the parties concerned shall establish a Claims Commission at the request of either party.

ARTICLE XV

1. The Claims Commission shall be composed of three members: one appointed by the claimant State, one appointed by the launching State and the third member, the Chairman, to be chosen by both parties jointly. Each party shall make its appointment within two months of the request for the establishment of the Claims Commission.

2. If no agreement is reached on the choice of the Chairman within four months of the request for the establishment of the Commission, either party may request the Secretary-General of the United Nations to appoint the Chairman within a further period of two months.

ARTICLE XVI

1. If one of the parties does not make its appointment within the stipulated period, the Chairman shall, at the request of the other party, constitute a single-member Claims Commission.

2. Any vacancy which may arise in the Commission for whatever reason shall be filled by the same procedure adopted for the original appointment.

3. The Commission shall determine its own procedure.

4. The Commission shall determine the place or places where it shall sit and all other administrative matters.

5. Except in the case of decisions and awards by a single-member Commission, all decisions and awards of the Commission shall be by majority vote.

ARTICLE XVII

No increase in the membership of the Claims Commission shall take place by reason of two or more claimant States or launching States being joined in any one proceeding before the Commission. The claimant States so joined shall collectively appoint one member of the Commission in the same manner and subject

122

to the same conditions as would be the case for a single claimant State. When two or more launching States are so joined, they shall collectively appoint one member of the Commission in the same way. If the claimant States or the launching States do not make the appointment within the stipulated period, the Chairman shall constitute a single-member Commission.

ARTICLE XVIII

The Claims Commission shall decide the merits of the claim for compensation and determine the amount of compensation payable, if any.

ARTICLE XIX

1. The Claims Commission shall act in accordance with the provisions of article XII.

2. The decision of the Commission shall be final and binding if the parties have so agreed; otherwise the Commission shall render a final and recommendatory award, which the parties shall consider in good faith. The Commission shall state the reasons for its decision or award.

3. The Commission shall give its decision or award as promptly as possible and no later than one year from the date of its establishment, unless an extension of this period is found necessary by the Commission.

4. The Commission shall make its decision or award public. It shall deliver a certified copy of its decision or award to each of the parties and to the Secretary-General of the United Nations.

ARTICLE XX

The expenses in regard to the Claims Commission shall be borne equally by the parties, unless otherwise decided by the Commission.

ARTICLE XXI

If the damage caused by a space object presents a large-scale danger to human life or seriously interferes with the living conditions of the population or the functioning of vital centers, the States Parties, and in particular the launching State, shall examine the possibility of rendering appropriate and rapid assistance to the State which has suffered the damage, when it so requests. However, nothing in this article shall affect the rights or obligations of the States Parties under this Convention.

ARTICLE XXII

1. In this Convention, with the exception of articles XXIV to XXVII, references to States shall be deemed to apply to any international intergovernmental organization which conducts space activities if the organization declares its acceptance of the rights and obligations provided for in this Convention and if a majority of the States members of the organization are States Parties to this Convention and to the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

2. States members of any such organization which are States Parties to this Convention shall take all appropriate steps to ensure that the organization makes a declaration in accordance with the preceding paragraph.

3. If an international intergovernmental organization is liable for damage by virtue of the provisions of this Convention, that organization and those of its members which are States Parties to this Convention shall be jointly and severally liable; provided, however, that:

(a) Any claim for compensation in respect to such damage shall be first presented to the organization;

(b) Only where the organization has not paid, within a period of six months, any sum agreed or determined to be due as compensation for such damage, may the claimant State invoke the liability of the members which are States Parties to this Convention for the payment of that sum.

4. Any claim, pursuant to the provisions of this Convention, for compensation in respect of damage caused to an organization which has made a declaration in accordance with paragraph 1 of this article shall be presented by a State member of the organization which is a State Party to this Convention.

ARTICLE XXIII

1. The provisions of this Convention shall not affect other international agreements in force insofar as relations between the States Parties to such agreements are concerned.

2. No provision of this Convention shall prevent States from concluding international agreements reaffirming, supplementing or extending its provisions.

ARTICLE XXIV

1. This Convention shall be open to all States for signatures. Any State which does not sign this Convention before its entry into force in accordance with paragraph 3 of this article may accede to it at any time.

2. This Convention shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Governments of the United States of America, the United Kingdom of Great Britain and Northern Ireland and the Union of Soviet Socialist Republics, which are hereby designated the Depositary Governments.

3. This Convention shall enter into force on the deposit of the fifth instrument of ratification.

4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of this Convention, it shall enter into force on the date of the deposit of their instruments of ratification or accession.

5. The Depositary Governments shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification or accession to this Convention, the date of its entry into force and other notices.

6. This Convention shall be registered by the Depositary Governments pursuant to Article 102 of the Charter of the United Nations.

ARTICLE XXV

Any State Party to this Convention may propose amendments to this Convention. Amendments shall enter into force for each State Party to the Convention accepting the amendments upon their acceptance by a majority of the States Parties to the Convention and thereafter for each remaining State Party to the Convention on the date of acceptance by it.

ARTICLE XXVI

Ten years after the entry into force of this Convention, the question of the review of this Convention shall be included in the provisional agenda of the United Nations General Assembly in order to consider, in the light of past application of the Convention, whether it requires revision. However, at any time after the Convention has been in force for five years, and at the request of one-third of the States Parties to the Convention, and with the concurrence of the majority of the States Parties, a conference of the States Parties shall be convened to review this Convention.

ARTICLE XXVII

Any State Party to this Convention may give notice of its withdrawal from the Convention one year after its entry into force by written notification to the Depositary Governments. Such withdrawal shall take effect one year from the date of receipt of this notification.

ARTICLE XXVIII

This Convention, of which the English, Russian, French, Spanish and Chinese texts are equally authentic, shall be deposited in the archives of the Depositary Governments. Duly certified copies of this Convention shall be transmitted by the Depositary Governments to the Governments of the signatory and acceding States.

IN WITNESS WHEREOF the undersigned, duly authorized, have signed this Convention.

DONE in triplicate, at the cities of Washington, London and Moscow, this twenty-ninth day of March, one thousand nine hundred and seventy-two.

**SIGNATORIES TO CONVENTION ON INTERNATIONAL LIABILITY FOR DAMAGE CAUSED BY
SPACE OBJECTS**

Seventy-one signatures plus the Ukrainian S.S.R. and Byelorussian S.S.R.; 34
Ratifications plus the Ukrainian S.S.R.; 17 Accessions.

Signatures:

Algeria ¹	Ghana	Niger ¹
Argentina	Greece ¹	Norway
Austria	Guatemala	Oman
Belgium	Haiti	Pakistan ¹
Botswana ¹	Honduras	Panama
Brazil ¹	Hungary ¹	Peru
Bulgaria ¹	Iceland	Philippines
Burundi	Iran ¹	Poland ¹
Central African Republic	Ireland ¹	Romania
China (Republic of) ¹	Italy	Rwanda
Colombia	Jordan	Senegal ¹
Costa Rica	Khmer Republic (Cambodia)	Sierra Leone
Cyprus ¹	Korea (Republic of)	Singapore ¹
Czechoslovakia ¹	Kuwait ¹	South Africa
Dahomey ¹ (now Benin)	Laos ¹	Soviet Union ¹
Denmark ¹	Lebanon	Spain
Dominican Republic ¹	Luxembourg	Switzerland ¹
Ecuador ¹	Mali ¹	Tanzania
Egypt	Mexico ¹	Togo ¹
El Salvador	Mongolia ¹	Tunisia ¹
Finland ¹	Morocco	United Kingdom ¹
Gambia	Nepal	United States ¹
German Democratic Republic ¹	New Zealand ¹	Venezuela ¹
	Nicaragua	Zaire

¹ Ratification.

Accessions:

Australia	Iraq	Sweden
Canada	Israel	Uruguay
Chile	Kenya	Yugoslavia
Fiji	Malta	Zambia
France	Saudi Arabia	
Germany, Federal	Seychelles	
Republic of	Sri Lanka	

4. CONVENTION ON REGISTRATION OF OBJECTS LAUNCHED INTO OUTER SPACE

The States Parties to this Convention,

Recognizing the common interest of all mankind in furthering the exploration and use of outer space for peaceful purposes,

Recalling that the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies of 27 January 1967 affirms that States shall bear international responsibility for their national activities in outer space and refers to the State on whose registry an object launched into outer space is carried,

Recalling also that the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space of 22 April 1968 provides that a launching authority shall, upon request, furnish identifying data prior to the return of an object it has launched into outer space found beyond the territorial limits of the launching authority,

Recalling further that the Convention on International Liability for Damage Caused by Space Objects of 29 March 1972 establishes international rules and procedures concerning the liability of launching States for damage caused by their space objects,

Desiring, in the light of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, to make provision for the national registration by launching States of space objects launched into outer space,

Desiring further that a central register of objects launched into outer space be established and maintained, on a mandatory basis, by the Secretary-General of the United Nations,

Desiring also to provide for States Parties additional means and procedures to assist in the identification of space objects,

Believing that a mandatory system of registering objects launched into outer space would, in particular, assist in their identification and would contribute to the application and development of international law governing the exploration and use of outer space,

Have agreed on the following:

ARTICLE I

For the purposes of this Convention:

- (a) The term "launching State" means:
 - (i) A State which launches or procures the launching of a space object;
 - (ii) A State from whose territory or facility a space object is launched;
- (b) The term "space object" includes component parts of a space object as well as its launch vehicle and parts thereof;
- (c) The term "State of registry" means a launching State on whose registry a space object is carried in accordance with article II.

ARTICLE II

1. When a space object is launched into orbit or beyond, the launching State shall register the space object by means of an entry in an appropriate registry which it shall maintain. Each launching State shall inform the Secretary General of the United Nations of the establishment of such a registry.

2. Where there are two or more launching States in respect of any such space object, they shall jointly determine which one of them shall register the object in accordance with paragraph 1 of this article, bearing in mind the provisions of article VIII of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, and without prejudice to appropriate agreements concluded or to be concluded among the launching States on jurisdiction and control over the space object and over any personnel thereof.

3. The contents of each registry and the conditions under which it is maintained shall be determined by the State of registry concerned.

ARTICLE III

- 1. The Secretary General of the United Nations shall maintain a Register in which the information furnished in accordance with article IV shall be recorded.
- 2. There shall be full and open access to the information in this Register.

ARTICLE IV

1. Each State of registry shall furnish to the Secretary General of the United Nations, as soon as practicable, the following information concerning each space object carried on its registry:

- (a) Name of launching State or States;
- (b) An appropriate designator of the space object or its registration number;
- (c) Date and territory or location of launch;
- (d) Basic orbital parameters, including:
 - (i) Nodal period,
 - (ii) Inclination,
 - (iii) Apogee,
 - (iv) Perigee;
- (e) General function of the space object.

2. Each State of registry may, from time to time, provide the Secretary-General of the United Nations with additional information concerning a space object carried on its registry.

3. Each State of registry shall notify the Secretary-General of the United Nations, to the greatest extent feasible and as soon as practicable, of space objects concerning which it has previously transmitted information, and which have been but no longer are in earth orbit.

ARTICLE V

Whenever a space object launched into earth orbit or beyond is marked with the designator or registration number referred to in article IV, paragraph 1(b), or both, the State of registry shall notify the Secretary-General of this fact when submitting the information regarding the space object in accordance with article IV. In such case, the Secretary-General of the United Nations shall record this notification in the Register.

ARTICLE VI

Where the application of the provisions of this Convention has not enabled a State Party to identify a space object which has caused damage to it or to any of its natural or judicial persons, or which may be of a hazardous or deleterious nature, other States Parties, including in particular States possessing space monitoring and tracking facilities shall respond to the greatest extent feasible to a request by that State Party, or transmitted through the Secretary-General on its behalf, for assistance under equitable and reasonable conditions in the identification of the object. A State Party making such a request shall, to the greatest extent feasible, submit information as to the time, nature and circumstances of the events giving rise to the request. Arrangements under which such assistance shall be rendered shall be the subject of agreement between the parties concerned.

ARTICLE VII

1. In this Convention, with the exception of articles VIII to XII inclusive, references to States shall be deemed to apply to any international intergovernmental organization which conducts space activities if the organization declares its acceptance of the rights and obligations provided for in this Convention and if a majority of the States members of the organization are States Parties to this Convention and to the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.

2. States members of any such organization which are States Parties to this Convention shall take all appropriate steps to ensure that the organization makes a declaration in accordance with paragraph 1 of this article.

ARTICLE VIII

1. This Convention shall be open for signature by all States at United Nations Headquarters in New York. Any State which does not sign this Convention before its entry into force in accordance with paragraph 3 of this article may accede to it at any time.

2. This Convention shall be subject to ratification by signatory States. Instruments of ratification and instruments of accession shall be deposited with the Secretary-General of the United States.

3. This Convention shall enter into force among the States which have deposited instruments of ratification on the deposit of the fifth such instrument with the Secretary-General of the United Nations.

4. For States whose instruments of ratification or accession are deposited subsequent to the entry into force of the Convention, it shall enter into force on the date of the deposit of their instruments of ratification or accession.

5. The Secretary-General shall promptly inform all signatory and acceding States of the date of each signature, the date of deposit of each instrument of ratification or accession to this Convention, the date of its entry into force and other notices.

ARTICLE IX

Any State Party to this Convention may propose amendments to the Convention. Amendments shall enter into force for each State Party to the Convention accepting the amendments upon their acceptance by a majority of the States Parties to the Convention and thereafter for each remaining State Party to the Convention on the date of acceptance by it.

ARTICLE X

Ten years after the entry into force of this Convention, the question of the review of the Convention shall be included in the provisional agenda of the

United Nations General Assembly in order to consider, in the light of past application of the Convention, whether it requires revision. However, at any time after the Convention has been in force for five years, at the request of one third of the States Parties to the Convention and with the concurrence of the majority of the States Parties, a conference of the States Parties shall be convened to review this Convention. Such review shall take into account in particular any relevant technological developments, including those relating to the identification of space objects.

ARTICLE XI

Any State Party to this Convention may give notice of its withdrawal from the Convention one year after its entry into force by written notification to the Secretary-General of the United Nations. Such withdrawal shall take effect one year from the date of receipt of this notification.

ARTICLE XII

The original of this Convention, of which the Arabic, Chinese, English, French, Russian and Spanish texts are equally authentic, shall be deposited with the Secretary-General of the United Nations, who shall send certified copies thereof to all signatory and acceding States.

IN WITNESS WHEREOF the undersigned, being duly authorized thereto by their respective Governments, have signed this Convention, opened for signature at New York on January 24, 1975.

SIGNATORIES TO CONVENTION ON REGISTRATION OF OBJECTS LAUNCHED INTO OUTER SPACE

Twenty-five signatures plus the Ukrainian S.S.R. and Byelorussian S.S.R.; 16 Ratifications plus the Ukrainian S.S.R. and Byelorussian S.S.R.; 7 accessions.

Signatures:

Argentina
Austria
Belgium¹
Bulgaria¹
Burundi
Canada¹
Czechoslovakia¹
Denmark¹
France¹

¹ Ratification.

German Democratic
Republic¹
Germany, Federal
Republic of
Hungary¹
Iran
Mexico¹
Mongolia
Nicaragua

Niger¹
Pakistan
Poland¹
Singapore
Soviet Union¹
Sweden¹
Switzerland¹
United Kingdom¹
United States¹

Accessions:

Cuba
Cyprus
Peru

Seychelles
Spain
Uruguay

Yugoslavia

APPENDIX D
FEDERAL AGENCIES WITH
CIVILIAN SPACE ACTIVITIES

- A. Arms Control and Disarmament Agency
- B. Department of Agriculture
- C. Department of Commerce
 - 1. National Oceanic and Atmospheric Administration
 - 2. National Bureau of Standards
 - 3. National Telecommunications and Information Administration
 - 4. Maritime Administration
 - 5. Bureau of the Census
- D. Department of Energy
- E. Department of Health, Education and Welfare
- F. Department of Interior
- G. Department of State
- H. Department of Transportation
 - 1. Coast Guard
 - 2. Federal Aviation Administration
- I. Environmental Protection Agency
- J. Federal Communications Agency
- K. International Communications Agency
- L. National Science Foundation
- M. Smithsonian Institution

SPACE ORGANIZATIONAL FIGURES

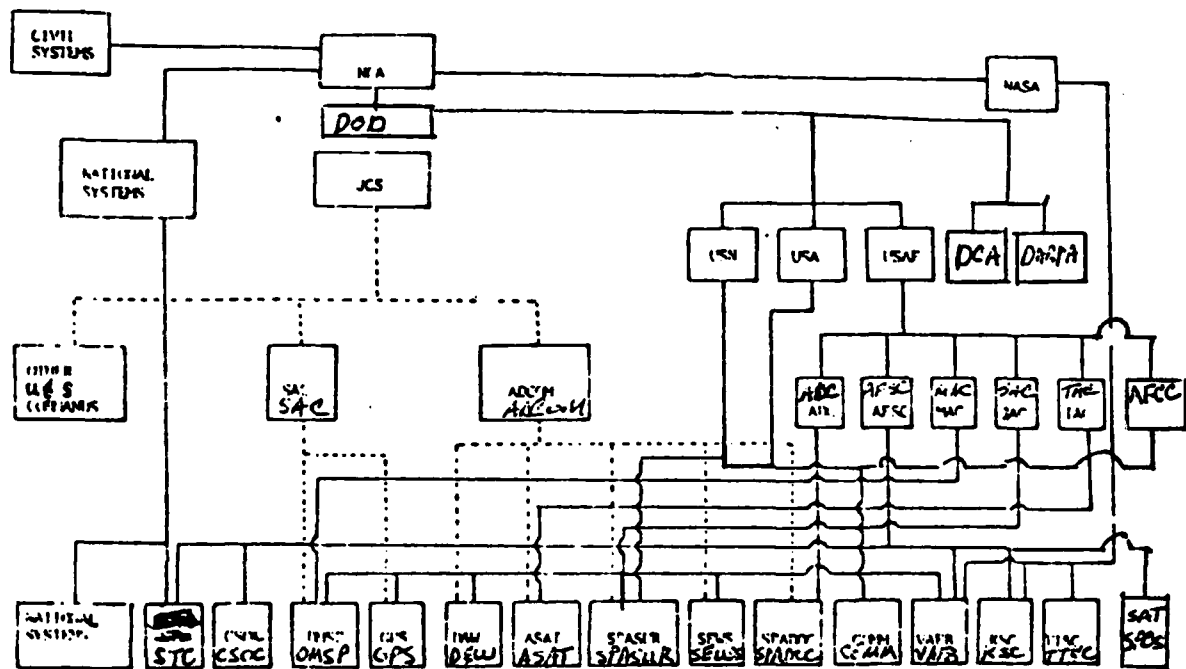
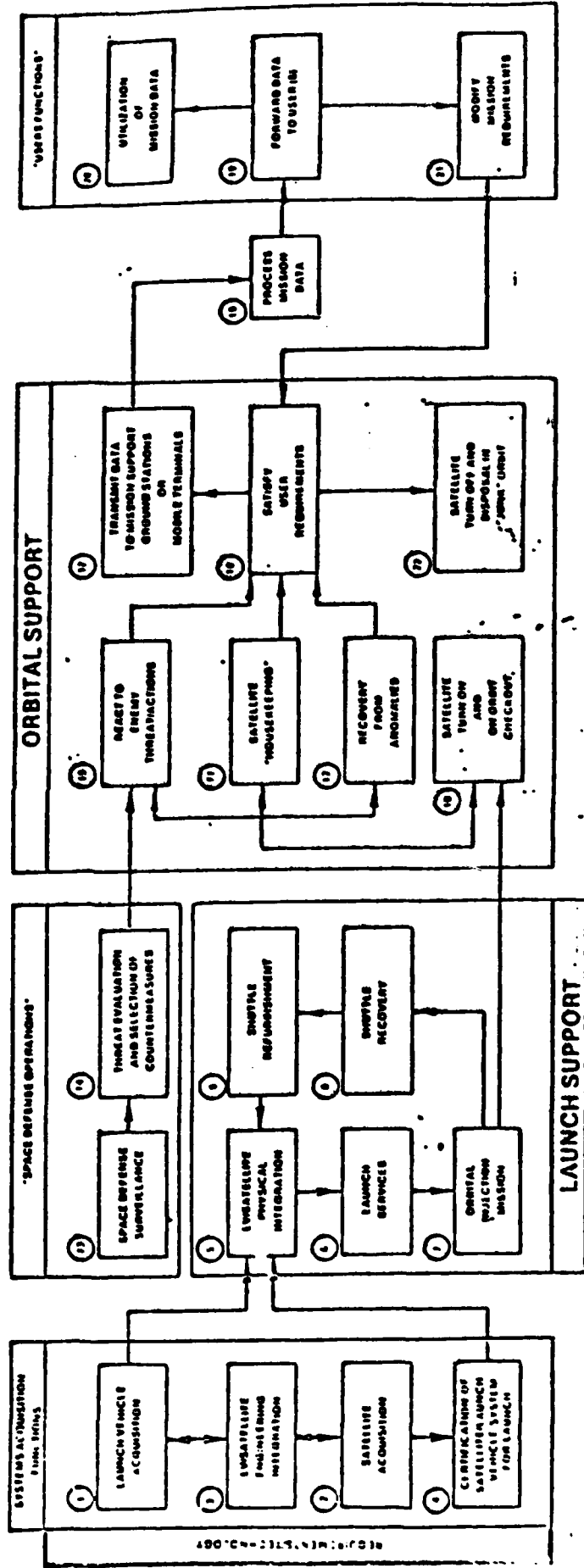


Figure E-1. Peacetime Organizational structure

APPENDIX F

SPACE SYSTEMS FUNCTIONAL FLOW DIAGRAM



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APPENDIX G

HISTORICAL BACKGROUND

In December 1981, the Government Printing Office released the President's report of aeronautics and space activities for calendar year 1980.¹ This 103-page, nearly half-inch thick document chronicles the seemingly vast accomplishments of seven government departments (Defense, Commerce, Energy, Interior, Agriculture, Transportation, and State), plus the Federal Communications Commission (FCC), Environmental Protection Agency (EPA), National Science Foundation (NSF), Smithsonian Institution, International Communication Agency, and NASA. By addressing some 45 space efforts, satellite programs, various studies and research, etc., the impression is that the national space program, with over two decades of activity under its belt, is on firm ground and pursuing concrete goals for the future.

In truth, questions and issues abound. President Carter published military and civilian space policy statements (June 1978 and October 1978, respectively) that were subsequently criticized because specific goals and programs were not identified. Congress showed its frustration. Four bills were introduced in the 96th Congress offering alternatives to the President's policies, and hearings were held in both the Senate and House. Legislation was reintroduced in the 97th

Congress. What will the new administration's policies be (results of President Reagan's intergovernment working group are due out in the Summer 1982), and will they meet the same fate as President Carter's? Is the US public interested in a commitment to exploring and exploiting space? Is the National Aeronautical and Space Act (NASAct) of 1958 adequate as a policy vehicle for the 1980s and beyond? As the space shuttle nears operational status, should civil and military activities be merged, with the possible abolishment of NASA? Within DOD, why has the Air Force not been designated the executive agent for all space efforts, vice only the space transportation system? Within the national security establishment, why has official space doctrine, as the implementation of national policy, not been published? As the DOD budget and military dependency on space systems increase, what is the perceived threat versus international agreements?

Answers to these questions and substantive comments on the issues, to be meaningful for the future, have to come from past experiences and the knowledge gained from them. Therefore, the next section traces the complicated and confusing evolution of the US space program through five past administrations. Readers familiar with this history may want to skip directly to the following section, Stage of Transition, which describes the current situation in the Reagan Administration. In light of past policies, the present unsettled State of Affairs, and the bleak prospects for future space funding, the last section of Chapter I, Decision Point, calls for a new space policy and organizational changes.

this appendix,

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Evolution

The Eisenhower Constraints

To state with certainty the beginning of the space age would be difficult, but ask a significant number of people and a majority would surely reply "Sputnik," meaning, of course, Sputnik 1 launched by the Soviet Union on 4 October 1957. The USSR quickly followed the space first with two more launches: the 1,120-pound Sputnik 2 on 3 November with a live dog onboard, and the 2,925¹/₂ round Sputnik 3 on 15 May 1958, described as a complete laboratory. Unaccustomed at being second-best at anything, the US public was shocked and questioned not only the status of the nation's space technology, but also its political process that allowed these surprises and what they meant in terms of military security.

The relative capabilities of the United States and the Soviet Union at this time were predetermined over a decade earlier by differing military emphases. Following World War II, the United States was complacent, resting on its overwhelming dominance in manned bombers and advanced nuclear-bomb technology. With the sole exceptions of Dr. von Braun's team of ex-German missile experts established by the Army at White Sands, New Mexico, to rebuild and test-fire some captured V-2 missiles, and the establishment of the low priority Navy-Viking high-altitude research rocket program, there was not much else in the

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late forties that could be called a serious American space effort.² The American military had decided to concentrate on the existing manned-aircraft fleet capability to deliver its nuclear might, and not actively pursue the development of an intercontinental ballistic missile (ICBM).

The Soviets took a different path following World War II, however, having essentially no air power and lagging miserably behind the United States in nuclear-warhead technology. Instead of trying to match the advanced bomber fleet of the Americans, they decided to develop the enormous rocket boosters required to carry their heavy nuclear bombs over intercontinental ranges. By the early fifties, utilizing two ballistic missile facilities and knowledge gained from captured German scientists, the Russians were reported developing a rocket engine with a thrust of 260,000 pounds. Between mid-1953 and late-1956, the Soviets effectively set the stage for the infamous Missile Gap. By their test of the hydrogen bomb on 12 August 1953, the Russians informed an astonished world they had mastered this facet of high technology. In the summer of 1955 they were routinely testing an intermediate range ballistic missile (IRBM) capable of hitting targets 1,000 miles away in Western Europe, and by the fall of 1956, they began testing a longer-range ICBM.

The beginning of the US reappraisal of the ICBM's potential as a long range strategic weapon came in May of 1951 (the USAF had let a modestly funded ICBM study contract to Convair, now a division of the General

Dynamics Corporation, in January 1951).³ It was the result of laboratory tests, by the Atomic Energy Commission (AEC), which indicated the basic feasibility of constructing an H-bomb. Before the ICBM could be a viable strategic weapon, however, major problems had to be addressed such as more accurate guidance systems, more powerful rocket engines, and smaller warheads with techniques to enable them to withstand the turbulent, searing heat of atmospheric reentry at hypersonic speeds. The AEC continued its efforts for over two years before announcing the thermonuclear breakthrough in the summer of 1953.⁴ Laboratory experiments indicated that the size and weight of the H-bomb could be reduced drastically, thus permitting a much smaller ICBM.

The coincidence of this breakthrough with the Russian H-bomb test caused a frantic scurry of activity in the United States. All three military services vied for the leadership role in development of the ICBM, and the Pentagon established the Strategic Missiles Evaluation Committee (more popularly known as the Teapot Committee), composed of distinguished scientists, to investigate the future of ICBMs given this technological advancement.

Meeting for the first time in November 1953, the Teapot Committee submitted its report in February 1954. It urged a massive effort that would secure an effective ICBM as soon as possible, because the nation was in mortal danger and only a quantum jump could prevent disaster in the 1959-60 time period.⁵

AUTHOR SCHICHTLE
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By virtue of the von Braun team, the Army was well ahead of the other services in missile development. In fact, by August 1953 they had fired the Redstone, the first US liquid-propellant long-range (200 miles) missile.⁶ The Navy had been working with the Army on an advanced Redstone called Jupiter, but dropped out later in favor of developing the easier-to-handle solid-propellant rockets for submarine applications. Despite this, the USAF became the lead military service and within three months of the Teapot Committee report had given its highest priority to the general dynamics study effort which later became the Atlas ICBM program.

Even with the scientific community's warning and the USAF's eagerness, support of the Eisenhower Administration would not come for over two years. In the Summer of 1955, a US intelligence radar near the Black Sea began to track the Russian IRBM launches. The Soviet missile progress was so disturbing that the National Security Council (NSC) recommended that the USAF Atlas development effort be given the highest priority in the nation. In its deliberations, the NSC felt the Soviets were pulling abreast of the United States in long-range jet bombers, and that it was likely a Russian ICBM could be developed as much as two years earlier than the USAF's. If true, the military foreign policy of Massive Retaliation would be stripped of its deterrent value and, even more ominous, the nation would lie exposed to the possibility of a "thermonuclear Pearl Harbor."⁷

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In September 1955, President Eisenhower agreed with the NSC and gave the development of the Atlas ICBM the nation's highest priority. Since much work remained on the Atlas, the Administration hedged its bets by also authorizing development of the Titan ICBM (by the Martin Marietta Corporation) which could carry a larger payload over greater distances. The administration's authorizations did not stop there. In a bold effort to counter the approaching Missile Gap, on 15 November 1955 two IRBM developments were approved with a priority equal to the Atlas and Titan programs, but with the proviso that they not interfere in any way. To hold the fort until the ICBMs could be deployed, the IRBMs could be quickly placed in Western Europe where their 1,500-mile range would be sufficient to reach parts of the Soviet Union. Douglas Aircraft was selected to develop the Thor while the Army Ballistic Missile Agency (ABMA), under Dr. von Braun, was authorized to design and build an improved Redstone IRBM, called Jupiter. Some statistics will illustrate the magnitude of the Air Force's total missile program.⁸ Within three years, it was approaching an annual cost of two billion dollars, and was utilizing the services of almost 14,000 scientists and technical experts from universities and industry, as well as 1,500 USAF administrative officers. Also participating were an additional 76,000 people representing 22 industries, including 25 major prime contractors and 200 major subcontractors.

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While 1955 was the year that saw the race to close the Missile Gap officially start, it also heralded the beginning of another race with Russia in connection with the International Geophysical Year (IGY). The designated period from 1 July 1957 through 31 December 1958 was established for the IGY by an international organization of scientists as a period for intensive study of the earth and its environment. One of the experiments included in the broad spectrum of IGY activities planned by the scientists was to be the launching of artificial satellites. By the early 1950s, based on the Navy's successful upper-atmosphere research program using the post-WWII developed Viking "sounding rockets," scientists knew the orbiting of small, instrumented satellites was no longer a question of feasibility, but how to get Government support for the necessary launchers and facilities.⁹ The National Academy of Science (NAS) and the NSF began their role of lobbying the Eisenhower Administration early in 1955. President Eisenhower's personal interest was achieved, and in an effort to announce America's plans for the IGY before Russia released its own plan, Press Secretary James Hagerty released the following statement on 29 July 1955:

On behalf of the President, I am now announcing that the President has approved plans by this country for going ahead with the launching of small Earth-circling satellites as part of the United States participation in the International Geophysical Year This program will for the first time in history enable scientists throughout the world to make sustained observations in the regions beyond the earth's atmosphere.

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The President expressed personal gratification that the American program will provide scientists of all nations this important and unique opportunity for the advancement of science.¹⁰

The USSR made a similar announcement the following day and a Russian physicist declared that their launches would be much larger than anything the United States would attempt.

The US Government had three choices for satellite launchers in the Fall of 1955: the USAF's Atlas ICBM, the ABMA's Jupiter-C IRBM, or an entirely new launch vehicle based on the Viking sounding rocket technology. It was at this point that President Eisenhower's philosophy of wanting to present an image to the world of the United States fostering the peaceful uses of space was born. Although the Soviets made no distinction between military and IGY launch systems, and despite Dr. von Braun's belief that the Jupiter could be readied for a satellite launch by as early as September 1956, the administration chose the high risk third option as most appropriate for the civilian character of the IGY's scientific efforts. Thus, with the formation of a team from the nearly completed Viking program, Project Vanguard was initiated and the race for space was on. Scientific jurisdiction was to come under the NAS with funding from the NSF and, further, instructions were received that Vanguard could not interfere with any defense related programs.

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For the next two years, the Vanguard project made faltering progress, plagued, as it was, by the tension of the space race, seemingly endless trials to achieve a viable launcher, and inexperienced contractors. Following the humiliation of Sputniks 1 and 2 and loss of the race, it was clear that at least part of the explanation was President Eisenhower's insistence that any US satellite launched in support of the IGY be identified as a non-military program. In October 1957, following Sputnik 1, the President insisted that Vanguard be used to launch the first US satellite, and he gave that project highest priority. Continuing reliability and quality problems, coupled with the Soviet's successful 3 November launch of Sputnik 2, led to the President's authorization five days later for launch of a satellite using the existing Jupiter military rocket, plus a solid-propellant fourth stage which gave the carrier the new name Juno.¹¹ This was indeed a fortuitous decision, for on 6 December 1957 the first Vanguard launch was an embarrassing failure when the vehicle lifted about four feet from the pad and then fell back in flames. Besides being witnessed by the largest group of reporters and observers ever assembled for a launch, the crowning blow came from the Russians when they offered to aid the United States through their United Nations plan to provide technical assistance to backward nations! Some semblance of technological equality was restored when, courtesy of the Army's ABMA and the Juno rocket, the 17.6 pound Explorer 1 satellite was launched on 31 January 1958. America had not only reached orbit but discovered the Van Allen radiation belts,

AUTHOR SCHICHTLE
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undoubtedly the single most important scientific achievement of the IGY. Vanguard finally made its first successful orbital flight on 17 March 1958 carrying a 4.4 pound satellite leading to the discovery that the earth is slightly pear-shaped. This was not the beginning of an immediate success story for Vanguard, however; the next four launch attempts ended in failures, and it would not be until nearly a year later (17 February 1959) that a 22-pound satellite orbited again.

The problems associated with Vanguard were a manifestation of the Eisenhower Administration's policies toward science and research in general. One noted author, Donald Cox, points out that the culs of "Complacency, Bureaucracy, and Omnipotence" were at work.¹² Another, Jerry Grey, said that Vanguard was plagued by the necessity to operate an ultra-advanced-technology program on a minimal "shoestring" basis.¹³ Indeed, with respect to nondefense expenditures, the administration was inclined to hold the line, especially in research and development. Science agencies, both military and civilian, generally felt their budgets were too low to keep pace with the fast changes in technology. The President personally viewed the IGY satellite launches as a limited project in international scientific cooperation and any follow-on space projects as unnecessary. His convictions were not altered by Sputnik 1 or the announcement three days later by the Soviet Union that it had tested a new H-bomb at high altitude (shock ways were felt in Japan). At an 9 October 1957 press conference, President Eisenhower sought to play

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down the importance of the Russian accomplishments by saying they did not increase his apprehensions "by one iota."¹⁴

The President's existing policies and remarks during October failed to quiet the press, the Congress, and the public. The news media questioned the policy of putting domestic budgetary and political considerations ahead of national security. Senator Stuart Symington called for a full investigation and Senator Lyndon Johnson (D-TX), chairman of the Preparedness Investigating Subcommittee of the Senate Armed Services Committee, announced plans for a prompt investigation of why the Russians had beaten the United States in launching a satellite. These series of hearings during October 1957 confirmed the nation's lagging status in both satellite and missile programs, and laid the groundwork for the eventual major role that Congress would play in the national space program.¹⁵ The launching of Sputnik 2 within a month of Russia's first space spectacular, along with the fact that it was six times as heavy and of much more sophistication, caused the public's apprehension about the nation's lagging scientific and military prowess to change into anxiety. These events effectively combined to force the President's hand.

Two days following Sputnik 2, President Eisenhower picked Dr. James R. Killian, President of the Massachusetts Institute of Technology, to be his Science Advisor. Announced in a speech on 7 November 1957, the new

position would grant important institutional access to the White House by the scientific community. However, it would be 4 February 1958 before Dr. Killian acquired the task of setting up the mechanism for managing a national space program.¹⁶ The latter months of 1957 and the early part of 1958 were a period of confusion and competition throughout the executive branch. Both the military services and the civilian science agencies actively vied for management of the space role. Possibilities centered on the following:

1. A single agency for all government programs managed by the military, either at the Secretary of Defense level or by one of the armed services, most likely the Air Force.
2. A new Cabinet-level Department of Science and Technology which, among its other responsibilities, would have charge of the civilian space effort.
3. Adding space to the responsibilities of the Atomic Energy Commission.
4. Expanding the responsibilities of the National Advisory Committee on Aeronautics (NACA) to include a substantial component of space activities.

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5. Creating a new civilian agency with a responsibility for government space activities, except those primarily associated with defense applications (which would be managed by DOD).¹⁷

As these possibilities became clearer over the winter months through the lobbying efforts of various executive agencies, so were the strong preferences of the Eisenhower Administration. They were for (a) a civilian agency to handle all aspects of research and development with scientists playing an important role in guiding the space effort; (b) an agency subject to the direct control of the President, as opposed to the NSF or AEC which had strong aspects of independence; and (c) a new agency built upon the basis of an existing agency.

Shortly after Sputnik 2, almost coincident with the approval to the Army to launch the Juno rocket, President Eisenhower gave responsibility for the US space program to DOD, owner and manager of all the nation's existing space capability. In February 1958, Congress authorized DOD to establish the Advanced Research Projects Agency (ARPA). Within a month, that agency's interim plan for space exploration was approved by the President. Thus in a genuine sense, the first US space agency was a military organization, ARPA. This role for the military was to be short-lived, however, because the image it portrayed was in direct conflict with the 8 October 1957 American request to the United Nations

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General Assembly that "outer space be brought under international control and be used only for scientific and peaceful purposes."¹⁸

Bills in Congress proliferated as champions of various agencies sought to secure new scientific and space-related functions for favored agencies. Included were bills to turn space over to the AEC, the NSF, as well as totally new agencies, one to be called the Commission on Outer Space. Another new entity was proposed in two bills to be called the Department of Science, and umbrella for science, parts of which would cover space. Even more comprehensive were bills proposing a new Department of Science and Technology which would subsume existing agencies such as the NSF, the AEC, the NACA, and the Bureau of Standards.¹⁹ For the hearings on these bills, and eventually the administration's proposal, the Congress was well-prepared. In addition to the hearings in the Fall of 1957 were hearings by both the Senate and House Appropriations Committees, the House Armed Services Committee, and the Special Subcommittee on Outer Space Propulsion of the Joint Committee on Atomic Energy. In February 1958, the Senate established a Special Committee on Space and Astronautics, chaired by Majority Leader Lyndon Johnson, and in March the House created the Select Committee on Astronautics and Space exploration, chaired by Majority Leader John McCorwick (D-MA). It should be noted that these committees were subsequently changed to standing committees to oversee the space budget. They were titled Aeronautical and Space Sciences (Senate) and Science and

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

Astronautics (House). These stayed in existence until Congress reorganized its committee structure in 1976-77; the Senate committee was eliminated altogether and its space budget cognizance transferred to a subcommittee of the Commerce Committee; but the House committee, which continually expanded its scope over the years, became the powerful Committee on Science and Technology.²⁰ For the sake of simplicity, Senate or House "space committee" will be used in the remainder of this work.

During this period of intense congressional activity, the Administration was working hard on its own legislative proposal. In early February 1958, President Eisenhower asked Dr. Killian to formulate a plan leading to an adequate civil space agency. Working in conjunction with experts in administrative organization, such as Mr. William Finn of the Bureau of the Budget, it soon became clear that Dr. Killian favored turning the space responsibilities over to NACA which most closely paralleled the agency envisioned by the President. NACA had proposed adding Astronautics to its title (becoming NACAA) and picking-up the space role, in January 1958. The Science Policy Research Division of the Congressional Research Service quotes Arthur L. Levine's account of the NACA plan.²¹

The leaders of NACA were among those diligently and rapidly working on the preparation of a proposal for the assignment of the space role. Their first step followed the traditional lines of NACA procedure

AUTHOR SCHICHTLE

DOCUMENT: 1828A ARCHIVE:

PRINTED: 6/23/82 OPERATOR: Laura

as they established a special committee on space technology, headed by H. Guyford Stever, Associate Dean of Engineering at MIT. This was on 21 November 1957. Less than two months later, the Main Committee of NACA adopted a resolution recommending that the national space program could be most effectively implemented by a cooperative effort of the Department of Defense, the NACA, the National Academy of Sciences, and the National Science Foundation, together with universities, research institutions and industrial firms. Under the NACA plan, the military would be in charge of development, construction and launching of space vehicles, while the NACA would have responsibility for research on satellites and scientific experiments in space.

This was a simple solution for the NACA since it merely elaborated on its over 40 years of experience and existing procedures. Leadership would continue by an Executive Board or "Committee" and activities would be limited primarily to research with other responsibilities divided among various government agencies, especially the military.

While acknowledging the skills and facilities of the NACA in aeronautics were without equal, Dr. Killian and the Administration had problems with the "NACAA" plan. During its history the NACA had shown itself to be rather refractory to political leadership, much like the AEC and the NSF, i.e., its independent committee structure did not tie directly to the President. In addition, NACA tradition had established its character as academically or research-oriented, a trait considered too narrow for a major new space agency.

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

The Administration's solution to these problems became evident when President Eisenhower sent a Special Message to Congress on Space Science and Exploration wherein he outlined his proposal to establish NASA. The aforementioned bills before Congress and hearings that had been underway for months became academic when the administration's legislative proposal was actually introduced on 14 April 1958. Rather than a simple enlargement of the old aeronautical research group, the administration proposed establishing an entirely new organization, with NACA as its nucleus, to be endowed with powerful operating authority. The new agency would have a single executive responsible to the President, but aided by a 17-man statutory advisory board. In addition, it would have the authority to contract for systems development and procurement of hardware, to eventually launch satellites and other space vehicles, and to immediately acquire other existing government agencies that could aid the space program. Reflecting the President's views on the civilian nature of future space endeavors, the legislative proposal left the NASA-DOD relationship vague with no formal coordination dictated. In fact, the Administration never envisioned a joint civil-military space program. The President's Scientific Advisory Committee (PSAC), set-up in late 1957 and headed by Dr. Killian, advised to do so would violate President Eisenhower's personal philosophy and jeopardize the US initiative to reserve space for scientific and peaceful purposes.

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

Just as the Administration had problems with the "NACAA plan," Congress had similar misgivings about the Presidents' NASA proposal. For a period of over two months, each House of Congress wrestled with its version of the NASAct. A conference committee met for nearly a month to resolve the differences which centered on "organizational structure, status of NASA in the Executive Branch, and the NASA-military relationship."²²

The House's concern with government and DOD membership on the 17-man Advisory Space Board was rather quickly disposed of by the conference committee. They struck the provision for the board from the bill and simply stated the new administrator of NASA would be a civilian with wide operational powers.

The Senate had recommended establishing a seven-member Space Policy Board, operating from the Executive Office of the President, to include the NASA Director, the Chairman of the AEC, the Secretaries of Defense and State, plus three others appointed by the President. The conference committee amended the recommendation to include the President as the eighth member and chairman. Its name became the National Aeronautics and Space Council (NASC) from which Congress expected that major space policy would emanate.

AUTHOR SCHICHTLE

DOCUMENT: 1828A ARCHIVE:

PRINTED: 6/23/82 OPERATOR: Laura

Sensing the nation's need for a totally responsive, comprehensive approach to space, both the Senate and House committees experienced difficulty with the informal NASA-military relationship proposed in the administration bill. No doubt the Russian launch of the one and one-half-ton Sputnik 3 on 15 May 1958 was an influence as evidenced by the language of House Resolution 1770, dated nine days later, which stated:

. . . this country is not unmindful of what these Soviet achievements (in space) mean in terms of military defense. . . . Ballistic missiles already travel for a considerable part of their path through near outer space and can arrive virtually without warning to deliver their devastating thermonuclear warheads. The United States must have strong capability in the use of outer space, both as a deterrent to the use of military vehicles against this country and as an aid in developing antimissile techniques. Satellite (operations) will have important implications for guarding the peace. On one hand they are adjuncts to weapon systems related to the deterrent power, and on the other they represent important techniques for inspection and policing, in accordance with any disarmament scheme which may be negotiated in the years to come.²³

Clearly Congress envisioned a role for the military in space. The Senate committee carefully defined the jurisdictions of NASA and DOD, then placed coordination authority in its proposed Space Policy Board. The House committee version simply established a military liaison committee consisting of personnel from DOD. The conference committee chose the House concept. Called the Civilian-Military Liaison Committee, it would have broad powers to coordinate NASA and DOD activities and consist of equal membership from each agency.

The conference committee's version of the NASAct was accepted without debate or amendment by both houses on 16 July 1958. Thirteen days later, President Eisenhower signed the NASAct of 1958 (Public Law 85-568) establishing NASA and abolishing NACA as of 1 October 1958. Section 102(b) of the NASAct dictated the dual space program responsibilities which exist today.

The Congress declares that the general welfare and security of the United States require that adequate provision be made for aeronautical and space activities. The Congress further declares that such activities shall be the responsibility of, and shall be directed by, a civilian agency exercising control over aeronautical and space activities sponsored by the United States, except that activities peculiar to or primarily associated with the development of weapons systems, military operations, or the defense of the United States (including research and development necessary to make effective provision for the defense of the United States) shall be the responsibility of, and shall be directed by, the Department of Defense. . . .

Thus, an administration for space was established, including a mechanism for adjudicating possible conflicts between NASA and DOD via the Civilian-Military Liaison Committee, and a method for the formation of total space policy via the National Aeronautics and Space Council with the President as Chairman.

Thomas K. Glennan came to NASA from the presidency of Cleveland's Case Institute of Technology. After confirmation by the full Senate, Mr. Glennan was sworn in 19 August 1958 as the first Administrator of NASA.

AUTHOR SCHICHTLE

DOCUMENT: 1828A ARCHIVE:

PRINTED: 6/23/82 OPERATOR: Laura

The tenure of Mr. Glennan, through the remainder of the Eisenhower presidency, was ^{hectic} ~~hietic~~ as he attempted to amalgamate the diverse programs, personnel and facilities transferred into NASA. From the former NACA, NASA inherited 8,000 employees and five research centers: the Langley Laboratory (now Langley Research Center) at Langley Air Force Base, Virginia, which studied aircraft and missile structures; the Ames Aeronautical Laboratory (now Ames Research Center) at Moffett Naval Air Station, California, which studied the problems of high-speed flight; the Lewis Flight Propulsion Laboratory (now Lewis Research Center) at Cleveland, Ohio, which worked on engines for airplanes and spaceships; the High-Speed Flight Station (now Dryden Flight Research Center) at Edwards Air Force Base, California, where experiments with manned rockets were underway; and the Pilotless Aircraft Research Station (now Wallops Flight Center) at Wallops Island, Virginia, which tested rocket-powered vehicles.²⁴ In November 1958, NASA acquired the Naval Research Laboratory and Project Vanguard, and approved their move to the Goddard Space Flight Center, to be built on government land near Greenbelt, Maryland. In December 1958, two Army programs were transferred to NASA: the ABMA's launch vehicle program, under Dr. von Braun, at the Redstone Arsenal (now Marshall Space Flight Center) in Huntsville, Alabama, and the Explorer satellite program at the Jet Propulsion Laboratory in Pasadena, California.

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

With this rich inheritance of scientists and facilities, NASA's space research was able to begin at once. As part of its broad development program aimed at furthering the unmanned exploration of space, NASA sent three rockets loaded with instruments deep into space, put three new satellites into orbit, and conducted advanced tests on rockets and satellites. Despite these feats, the nation's hoped for leap-frogging of the Soviet space accomplishments was not Mr. Glennan's legacy to his successor in the Kennedy Administration. In fact, NASA's launch record during the 29 months under Glennan's leadership shows only eight successes in 25 attempts.

While NASA may have been less than spectacular in space, it certainly became a capable and functioning government agency. With the help of his deputy and long-time leader in NACA, Dr. Hugh Dryden, as well as a prestigious management consulting firm, Mr. Glennan succeeded in pulling NASA together during a period of organizational evolution, a period of reassignment of personnel, a period of realignment of subgroups, and a period of structuring both internal and external relationships. Reliability programs, long range planning, and executive training became established functions. Finally, the nation's industrial and university sectors were successfully coupled with NASA's goals and requirements.

With NASA's absorption of the major Army and Navy space capabilities, the Air Force and the ARPA moved ahead with the DOD space program. On 11

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

October 1958, an Air Force Thor-Able launch vehicle lifted the Pioneer I space probe nearly 71,000 miles toward the moon in the deepest penetration of space achieved by man up to that time. Two months later, on 18 December, an Air Force Atlas B put the ARPA's SCORE, the first communications satellite, into orbit. For thirteen days it broadcasted President Eisenhower's Christmas and New Year's greetings to the world. By the end of the Eisenhower Administration, the Air Force accomplished several other space firsts thanks to its reacquainted stable of efficient, reliable space launch vehicles, and its two billion dollars per year IRBM and ICBM programs. Out of more than 40 successful launches came the first satellite placed in polar orbit, the first photographs of the earth taken from space, the first meteorological satellite, and the first ocean and midair capsule recoveries.²⁵ Nearly all of these efforts, however, were programs in which NASA held the lead role. In the majority of cases, with the exception of reconnaissance, the military requirement for a space program could not be pushed through or justified. As a result, NASA's unmanned, purely scientific missions proliferated while the Air Force played mostly a support role.

In summary, the national space program started midway through President Eisenhower's second term, but was clearly constrained. Neither the jolt of the Sputniks nor subsequent Soviet space achievements (in 1959, Lunik 2 landed on and took pictures of the backside of the moon, and in 1960, Russia orbited and recovered space capsules carrying live

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

dogs, as well as a 14,300-pound operational satellite) convinced the administration that a major national space undertaking was called for. President Eisenhower preferred that NASA, while endowed with considerable powers by Congress, dedicate itself primarily to scientific activities, and proceed at a measured pace. Since the Russian accomplishments, each more spectacular than its predecessor, did not pose a threat to national security in the Administration's view, a "space race" solely for the sake of prestige was not deemed necessary. The NASAct's inclusion of the concept of a single civilian-military space program, with the NASC as the mechanism to achieve an integrated policy, was never endorsed by President Eisenhower. Instead, the President preferred to consult with his Scientific Advisor and the PSAC which consistently disapproved early DOD and NASA plans for advanced manned space flight programs, including a proposal for an American expedition to the moon, because of insufficient scientific or military justification for such undertakings. Therefore, the nation's first space policy (a framework for which many exciting possibilities existed under the new Space Act), as practiced by the Eisenhower Administration, can be characterized as conservative, cautious, and constrained. Those who were to take charge of the developmet of space policy in the next administration would have a different view.

Kennedy's Moon Race

While the enactment of the NASA Act of 1958 moved the nation toward a space policy, the development of a full-fledged policy did not come to fruition until several months after President Kennedy assumed office. The key elements of the Space Act--a primarily civilian program; coordination of civilian and military space efforts; a multipurpose space program, including but not limited to science and applications; a strong commitment to international cooperation--saw their initial, forceful implementation under President Kennedy's leadership. Even though instrumental in assuring these elements (with the exception of the concept of an integrated civilian-military program) were inserted into the act, President Eisenhower did comparatively little to establish them as fixed features of space policy.

Space activity under President Eisenhower was akin to a series of separate and unrelated efforts. NASA conducted interesting experiments in weather and communication satellites and in space science, along with a limited manned project called Mercury. Meanwhile, the Air Force was conducting programs in reconnaissance satellites, communications, and rocket research. Therefore, each had specialized programs producing specific capabilities in a narrow range, but no overall capability was being developed to operate in space for either civilian or military

purposes. In 1960, there were two manifestations of this problem: President Eisenhower asked Congress to abolish the NASC, and NASA and DOD established the Aeronautics and Astronautics Coordinating Board (AACB). The President never accepted the idea of a single civil-military space program, and he felt the statutory concept of the NASC enforcing the program from a national policy viewpoint was not only "confusing, but unattainable."²⁶ This attempt to abolish the council was successfully blocked by Lyndon Johnson who argued that the action might restrict the freedom and options available to the next President. Establishment of the AACB by interagency agreement was driven by the ineffectiveness of the Civilian/Military Liaison Committee and the need for lower level coordination between NASA and DOD. In fact, the liaison committee would finally be abolished in 1965, while the AACB still functions today.

The poor launch record of NASA and the impact of Soviet space achievements entered into the 1960 presidential campaign. Combined with the concern over the military position of the United States in missile power, America's chances for leading in the space race made for a significant campaign issue on technology. Controversy over whether there were missile gaps or space gaps marked the campaign. While Kennedy warned of peril to the national defense unless policies were changed, Nixon argued that the gaps were more imaginary than real.

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

President-elect Kennedy decided in January 1961 that Vice-President Johnson would have special responsibilities for coordinating and overseeing US space efforts. His first task was to recommend a new NASA administrator to replace Mr. Glennan whose resignation was effective at the close of the Eisenhower Administration. Johnson wasted little time in selecting Mr. James E. Webb over several outstanding "technical" nominees. By formal education a teacher and lawyer whose forte was administration and whose natural element was high technology and aerospace in particular, Mr. Webb had served as director of the Bureau of Budget from 1946 to 1949 and then moved to Undersecretary of State for three more years. Within ten days of being nominated by President Kennedy on 30 January 1961, the Space Committee had enthusiastically endorsed and the full Senate had confirmed Mr. Webb. Destined to preside over NASA during its period of maximum growth and capability, he was sworn in on 14 February 1961. The second task entrusted to Vice-President Johnson was longer term and more important. President Kennedy obtained legislation to reactivate and restructure the NASC with the Vice President as its chairman. Thus, the Senate's "Father of the NASAct" and later defender of the NASC's continued existence under Eisenhower became the council's chairman and curator of the nation's civil-military space policy.

Many observers believed that the NASC would become active immediately after the inauguration, but such was not the case. For the first two

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCH: :
PRINTED: 6/23/82 OPERATOR: Laura

months of the new administration, President Kennedy was deeply involved in his first crisis, the decision whether or not to intervene with US troops in Laos where the pro-American government of Phoumvi Nosavan seemed near military defeat by the Communist Pathet Lao forces.²⁷ It was not until late March that the President turned his personal attention toward space policy by nominating Dr. Edward C. Welsh to be executive secretary of the Space Council. Dr. Welsh's first task was to draft revisions of the NASAct to reactivate the Space Council. Completed in less than two weeks, his two recommendations, in addition to the President's desire to make the Vice-President a member and chairman, were simply aimed at giving the council greater flexibility and at clarifying its organizational status in the administration. The former was achieved by elimination of the four appointed members of the council thus reducing its membership to five: the Vice-President, the Secretaries of State and Defense, the Administrator of NASA, and the Chairman of the AEC. The latter change placed the council in the Executive Office of the President. These recommendations were approved by the President and sent to Congress on 10 April. The House held hearings on the revisions on 12 April; the Senate, on 19 April. Congress passed them on 20 April and the President signed them into law on 25 April.²⁸

Quick Congressional approval was almost assured by the Soviet space spectacular of 12 April. The world's first space ship, Vostok 1, with

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

Major Yuri Gagarin onboard, was launched from Russia on an 89 minute, single orbit flight around the earth.²⁹ The five-ton spacecraft was totally automatic and Major Gagarin suffered no apparent problems. Soviet propaganda was quick and stressed the flight was evidence of the virtues of victorious socialism and of the global superiority of the USSR in all aspects of science and technology.

A No high US official had predicted such an event and, for the general public, it came as almost as much of a shock as the Sputnik 1 flight in 1957. Overseas and domestic news media hailed this additional Soviet first. Congress, in addition to considering the NASC proposal, was in the midst of hearings on President Kennedy's supplemental request to add to Eisenhower's Fiscal Year 1962 budget. The hearings were extremely vocal, especially in the House, because the NASA portion of the supplemental, while requesting an increase, contained no specific plans for a follow-on manned program after the limited series of Mercury flights. Right in the middle of this activity came the Bay of Pigs incident. Begun on 15 April, the invasion was crushed in only four days. On 20 April, coincident with Congressional approval of the revised Space Act empowering Vice-President Johnson to be Chairman of the NASC, President Kennedy wrote an historic memorandum to Johnson.

. . . I would like for you as Chairman of the Space Council to be in charge of making an overall survey of where we stand in space.

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

1. Do we have a chance of beating the Soviets by putting a laboratory in space, or by a trip around the moon, or by a rocket to land on the moon, or by a rocket to go to the moon and back with a man? Is there any other space program which promises dramatic results in which we could win?

2. How much additional would it cost?

3. Are we working 24 hours a day on existing programs? If not, will you make recommendations to me as to how work can be speeded up.

4. In building large boosters should we put our emphasis on nuclear, chemical, or liquid fuel, or a combination of these three?

5. Are we making maximum effort? Are we achieving necessary results?

I have asked Jim Webb, Dr. Wiesner, Secretary McNamara and other responsible officials to cooperate with you fully. I would appreciate a report on this at the earliest possible moment.³⁰

Facing a 9 May departure for a 15-day tour of Southeast Asia, the Vice-President did not have much time to prepare an answer for the President. During the days following the 20 April memorandum, the Vice-President met with officials from the NASA, the DOD, the AEC, the Bureau of the Budget, and Dr. Wiesner's office (Wiesner was the Presidents' Science Advisor and head of the PSAC). At no time during these consultations was PSAC asked for its opinion, a significant

AUTHOR SCHICHTLE

DOCUMENT: 1828A ARCHIVE:

PRINTED: 6/23/82 OPERATOR: Laura

departure from the Eisenhower Administration's ²modus operandi. Vice-President Johnson also met with prominent businessmen and personal friends in the Senate to get a feel for possible public reaction to a major increase in the nation's space efforts.

One event helped ensure that an accelerated space program would be accepted by the President and the country. On 5 May Astronaut Alan Shepard made the first American space flight, a 15-minute suborbital journey in the "Freedom 7" Mercury capsule. This success climaxed a long period of difficulties for Project Mercury. With over 500 representatives of the news media present at Cape Canaveral to report America's first manned flight, it was unlikely that the President would have, or could have, endorsed an expanded space program had it not been such an unqualified success, both technically and politically. As the New York Times reported on 6 May, President Kennedy planned to undertake "a substantially larger effort in space."

By this time the NASC discussions had agreed that a program setting a manned lunar landing as its central feature would be a sufficiently difficult goal, and its achievement before the Russians would repair the US image and restore confidence in American technological superiority. In essence this was NASA's Apollo Program disapproved by Eisenhower in

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

1960. In addition to the acceleration of all areas of booster development (liquid fuel and nuclear propulsion by NASA and solid fuel by DOD) and the more rapid development of communications and meteorological satellites, the total program encompassed the following:

1. Completion of the Mercury Program of suborbital and Earth orbital flights.
2. Initiation of the Gemini Program of Earth-orbital flights for developing skills in rendezvous and docking between two ships, developing expertise in extravehicular activity, and extending knowledge of man's space endurance.
3. Commencement of the Apollo Program following Gemini to first orbit and then land Americans on the moon.

The program was outlined in a memorandum, prepared by Secretary McNamara and Mr. Webb, for the Vice-President to give to President Kennedy. Receiving the memorandum the day before he was to leave on his tour, Vice-President Johnson accepted it without change and signed it to the President.

Several days of debate ensued within the White House staff and the President's Council of Economic Advisors. Ultimately the program was

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

totally accepted and on 25 May, three weeks after Alan Shepard became the first American in Space, President Kennedy addressed a joint session of Congress.

. . . I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to earth. No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space; and none will be so difficult or expensive to accomplish. . . . In a very real sense, it will not be one man going to the moon--we make this judgment affirmatively--it will be an entire nation.

Congress and the Nation were willing to make the commitment. Space goals for the next decade were set and the Moon race was on. Prestige and international leadership were clearly the main objectives of the Kennedy space program. Science and applications were important but secondary. While not an overt objective, military security was obviously involved, since the ability to reach the moon with men was indirectly an index of the technical capability to wage nuclear war with missiles.

The status and power with which NASA had been endowed in the Space act could now be used to accomplish this challenge, and Congress was ready to provide generous funding. The Apollo project was the chief beneficiary, but science, advanced technology, and applications programs were also given the go-ahead for expansion. During FY 1962, NASA budgeted \$110 million in geophysics and astronomy, \$160 million in lunar and

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

planetary exploration, \$36 million in nuclear technology research, and \$145 million for communications and meteorological satellites. In comparison, manned spacecraft systems and the supporting launch-vehicle work accounted for \$1.269 billion. That was just the beginning, however, for ultimately the Mercury program would cost \$392 million, the Gemini program \$1.3 billion, and the Apollo lunar program \$25 billion.³¹

While NASA concentrated on the manned lunar landing program, and its other scientific programs, DOD moved along with its activities in space. Some of these were similar to NASA's programs, such as meteorology, communications, and reconnaissance satellites (especially earth resources satellites with substantially better resolution limits). The importance of intelligence-gathering and its impact on DOD's space efforts can not be overemphasized. This subject is treated expertly, especially with respect to the role played by early reconnaissance satellites in the Cuban missile crisis, in a National War College research paper by Colonel Fred H. Wisely, USAF.³²

The development of ballistic missiles was, in a very real sense, an integral part of the story of the DOD in space, since the missiles provided the vital initial launch capability. The Western Development Division (redesignated Ballistic Missile Division in 1958) of the Air Research and Development Command (ARDC) had been developing the nation's stable of IRBMs and ICBMs since 1955. It was, in fact, not until just

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

before President Kennedy's moon race speech to Congress that the military space effort became a separate and distinct program in its own right. On 1 April 1961, in a major Air Force reorganization, the parallel Ballistic Systems and Space Systems Divisions were created, under the Deputy Commander for Aerospace Systems of the newly formed Air Force Systems Command (AFSC). A little more than 10 months after the Space Systems Division came into being, a man-rated Air Force Atlas D boosted the first US manned orbital mission in the Mercury program. Astronaut John Glenn in the "Friendship 7" was safely recovered after three orbits and 4.9 hours in space. Three other successful manned flights followed in the next 15 months, all Atlas boosted, before the program concluded with the Mercury-Atlas 9 flight of 15 May 1963. For NASA's follow-on Gemini program, the Air Force's powerful Titan II was chosen to boost the two-man capsules.

The DOD even dabbled with the idea of its own manned space program. The X-15 "rocket-plane" program, started jointly by NACA and the Air Force in 1956 to explore the characteristics of flight in near-earth space, was the only one to reach fruition, however, completing 199 flights between 1959 and 1969. The Air Force's Man In Space Soonest program was cancelled soon after NASA's limited project Mercury was approved under Eisenhower. The X-20 Dyna-Soar program, a joint Air Force/NACA effort started in 1957, would have developed a space glider capable of maneuverable reentry from orbit. The program was cancelled in

1963 before any test flights were made because the Air Force decided to focus instead on the "Blue Gemini and Manned Orbiting Laboratory (MOL) programs. Blue Gemini would have been the Air Force extension of NASA's manned Gemini program to demonstrate rendezvous and docking in space, extravehicular activity, and relatively long duration flight. These Air Force plans were also cancelled in 1963 because Congress saw no need for such a capability. Similarly, the MOL program, which would have placed a military manned space station in near-earth orbit, was eventually cancelled in 1969.

In summary, through 1960, government and university scientists (with the sympathetic ear of the PSAC), the military, and the aerospace industry had been the dominant influences in shaping space research policy. President Eisenhower exercised veto power over the launching of a large military space program or a large-scale civilian manned program, but the White House had no positive space policy in terms of specific goals formulated on its own or in conjunction with NASA leadership. However, under President Kennedy, the old triumvirate of interests had to share its power with a dynamic and new Administrator of NASA, the Congressional committees, and to some extent the appropriation subcommittees with jurisdiction over NASA. Although the flight of Yuri Gagarin, the Bay of Pigs incident, and the first manned flight of Project Mercury may have spurred President Kennedy, it was largely because of JFK's personal and decisive participation in policy making that gave the

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

nation a clear space policy, managed by a strong civilian agency with a firm goal, and with strong direction expected to continue from the top of the government.

The Johnson Advocacy

President Kennedy did not live to see even the preliminary steps toward the lunar landing, but there was little fear that the pace of the space effort would be slackened under Lyndon Johnson as President. LBJ had, after all, been the "father of the Space Act," and in his abbreviated first term (November 1963-January 1965) there was no lessening of his steadfast support of the space program.

Not only did President Johnson pursue JFK's balanced program concerned with international prestige, international relations, and the building up of US technology, but he also sought an "across-the-board capability" by injecting a series of other goal-values technological achievement, scientific discoveries, commercial applications, domestic political benefits, economic stimulus, and military insurance.³³ It was with this impetus during LBJ's first term that NASA enjoyed a meteoric rise in budget and personnel, and the Air Force and NASA logged many space firsts.

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

The Air Force completed the long meticulous job of man-rating the powerful Titan II booster, and successfully tested it in two initial unmanned flights in preparation for the first two-manned Gemini flight in March 1965. Meanwhile, the Atlas-Agena, Thor-Agena, and Scout boosters continued to launch dozens of other projects in support of NASA and DOD: the Ranger moon probe series; the Tiros series of meteorological satellites; the Mariner Venus probes; Alouette, Canada's first satellite for gathering ionospheric data; Anna 1B and the Transit series for the Navy; Discoverer for ARPA, to return US payloads from space; Vela I and II, nuclear detection satellites, which lasted years past their predicted useful lifespan; Echo, passive communications satellite and first joint space project with the Soviets; and other communications satellites, one of which (Syncom III) relayed television coverage of the Olympic games from Japan to the United States.

The manned portion of the Gemini program, probably the brightest and most publicized single project in the United States space effort, coincided with the start of LBJ's second term, and marked the permanent downturn in NASA's fiscal budgets. In nineteen months of 1965 and 1966, ten flights, carrying a total of twenty men, were launched by Air Force Titan IIs with a 100 percent safety record. The astronauts walked in space and explored the difficulties of working there. They rendezvoused with Air Force Agena D targets, parked in orbit by Atlas SLV-3 launch systems. They docked with the target vehicles and, using their

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

propulsion systems, soared to two world record altitudes of 470 and 850 miles. The end of the program came with the four-day flight of Gemini 12 beginning on 11 November 1966, when Air Force Astronaut Major Edwin Aldrin, Jr., set a world's record for extravehicular activity, remaining outside the spacecraft for a total of five and one-half hours.

The combination of social problems at home, the escalation of the Vietnam war, and inflationary pressures (for which the antidote adopted by the government was reduction in certain areas of federal spending) caused President Johnson to reassess his estimate of the relative priority of the space program in his second term, as compared with other national needs. The depth of the difficulties for the NASA program is shown by his decision to reduce NASA budgets by substantial amounts. For example, for FY 1967 LBJ requested \$163 million less for NASA than appropriated for the previous fiscal year.³⁴ For FY 1969 President Johnson, beset by Vietnam and domestic troubles, slashed the NASA budget request (submitted in January 1968) to \$219 million below the appropriation for FY 1968, bringing the space agency budget request down to \$4.37 billion. Compared to the heyday of the Gemini program in 1965, this represented nearly a \$1 billion cut.

Congressional reaction to these budget cuts was swift and usually more severe (the budget appropriations are shown in the Appendix, Table A-2, and are graphed in Figure A-1). The mood of Congress is clearly

illustrated; in fact, if funding of an agency is used as a barometer to gauge congressional interest or general public support, it would appear that in the eight years following Sputnik, there was indeed a space race. However, taking the final step of getting a man on the moon (Apollo), once the spectacular Gemini program had started, would not appear to be of great congressional interest. Obviously, as the interest in Congress waned rapidly in the mid-1960s, no amount of world acclaim or scientific return could reawaken it.

Manpower in the civilian space program, in terms of total employment (Appendix, Figure A-2), almost duplicates the shape of the funding curve. Beneath the total employment curve a NASA personnel line has been plotted (see Table A-2 for the actual numbers). This subject will be addressed in more detail in Chapter IV, but it should be noted that employment and funding (in terms of buying power), after peaking in the 1965-1967 timeframe, declined rapidly to the previous 1962 levels and remained relatively constant through the Carter Administration.

Relatively speaking, funds for Apollo were not heavily cut due to LBJ's perceived need to keep the lunar landing project on schedule. This was no easy task for several reasons. As the reductions came each fiscal year, Mr. Webb exercised his flexibility in the R&D account by reducing planned scientific projects and slipping the Apollo Applications Program (later renamed Skylab) to the out-years. The scientific community and

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

the PSAC were chagrined for they had questioned the Apollo program for years based upon its total cost, its drain on the technical and scientific manpower needed for other national objectives, and its necessity for man to accomplish a job that robot instruments could do at a slower pace and less cost. The pace of the Apollo program was also questioned in light of the military security it was insuring when the Treaty on the Peaceful Uses of Outer Space, the Moon and Other Celestial Bodies was signed in October 1967, and later indications that Russia may have relinquished its bid to be the first nation to set foot on the moon. Finally, and tragically, there was an actual year and one-half delay in the Appollo schedule due to a fire on the first spacecraft, which killed the three-man crew by asphyxiation on 27 January 1967.

Thus, although his Great Society program was troubled by fiscal problems, Vietnam, and domestic unrest, LBJ remained a strong supporter of space activities, both military and civilian (especially Apollo). He maintained his interest in an across-the-board space effort, including manned and unmanned exploration and development of new propulsion systems. He gave his support to the Air Force plans to orbit the MOL and consistently supported Secretary McNamara's appropriation requests for MOL funding. He remained a strong advocate of NASA's Rover project to develop nuclear rockets for manned planetary flight.

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

As President Johnson's second term drew to a close, the overriding concern of the National Space Program over the first eight years emerged clearly: the commitment to land a man on the moon and return him safely to earth. With the flight of Apollo 11, the Nation accomplished that goal on 20 July 1969, six months into the Nixon Administration, when Neil Armstrong and Edwin Aldrin first ~~stepped~~^{set} foot on the moon. All in all, there were 11 manned flights of the lunar Apollo series between October 1968 and December 1972, six of which landed two-man crews on the moon.

In summary, despite a multitude of technical problems, a chorus of criticisms from the scientific community, severe budgetary constraints due to urban problems and Vietnam, and the tragic setback of the Apollo spacecraft fire, LBJ persisted in pursuit of President Kennedy's goal. Although these difficulties did not deny achievement of the goal, they did have an impact on space policy in the post-Apollo era. This impact related to the questioning of the necessity of human presence in space exploration; the debate concerning the amount of emphasis that science and applications should receive; and the lack of consensus concerning the direction of the space program of the 1970s.

Nixon/Ford Dilemma

For personal reasons, Mr. Webb departed from NASA nine months prior to the first lunar landing. He left at a time of high personal standing

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

with both the Johnson Administration and Congress, closing an extraordinarily successful eight-year tenure. Over the last few years of his leadership of NASA, Mr. Webb consistently hedged in the formulation of concrete post-Apollo goals, preferring instead to list alternatives over which he felt bureaucratic debate would ensue and a national consensus would emerge. His unexpected departure just prior to the 1968 Presidential election left NASA with great expectations for the forthcoming moon landings, but a questionable long range future.

Dr. Thomas Paine, Mr. Webb's deputy, was appointed Acting Administrator of NASA by President Johnson a few days after Webb's 7 October 1968 resignation. Following President Nixon's nomination, Dr. Paine was confirmed as Administrator on 5 March 1969. Dr. Paine's short administration (through 15 September 1970) was characterized by contrast. The world watched the maturing Apollo spectaculars while internally the prime task was to minimize the rising costs of program deferrals and cancellations. The highlights of the period were rewards from investments made in the past, but NASA had entered a period in which investments for future events were increasingly austere.

While Apollo 11, the first human visit to the Moon, was an historic first, it was also an anticlimax. The event and the landings subsequent to Apollo 11, did not alter the downward trend in funding. The NASA budget declined rapidly between 1966 and 1970, averaging \$500 million per

year (Table A-2). The number of people employed on space projects declined from 420,000 in 1966 to 190,000 in 1970 (Figure A-2).

In mid-1969 the civilian space program was at a crossroads. The euphoria at NASA produced by Apollo 11 led Dr. Paine to press for endorsement by the nation of new manned space ventures, including a 1980s mission to Mars, the establishment of a base on the Moon, and a large (50-to 100-man) orbiting space station serviced by a space shuttle. In addition, an ambitious program of unmanned planetary expeditions, other scientific projects, and applications satellites was proposed. These recommendations had an obvious impact on President Nixon's Space task Group (STG) charged with conducting a high-level study of post-Apollo activity. Made up of Vice-President Spiro Agnew (head of the NASC) as chairman, Secretary of Defense Melvin Laird, presidential science advisor Lee Dubridge (head of the PSAC), and Dr. Paine, the STG made public in September 1969 three alternatives the Nation could undertake:

1. Establish a fifty-man space station orbiting the earth, an orbiting lunar space station, a lunar-surface base, and a manned flight to Mars by 1985. A reusable carrier would be needed to "shuttle" between the earth's surface and the earth-orbiting station, and a reusable "space tug" would be needed to service the lunar orbital station.

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

2. Establish the earth-orbiting space station, along with the reusable shuttle, but eliminate the lunar projects and postpone the manned Mars launch to 1986.
3. Develop the earth-orbital space station and the shuttle, but defer any decision on the manned Mars landing, keeping it only as a goal to be realized before the end of the century.³⁵

The first two options carried fiscal price tags in the 1980s of \$10 billion and \$8 billion, respectively, while option three would still require a \$5 billion annual NASA budget in the same timeframe.

President Nixon's position and ultimate policy decision would not come out until March 1970, but its flavor could almost have been predicted. In his 1968 election campaign, President Nixon had pledged to curtail NASA operations until the economy could afford more funding. The Republican national platform had also promised to move civilian space programs "forward with high priority" only once sound fiscal conditions had been restored.³⁶ After entering office, as part a general antiinflation, multibillion dollar government-spending curb, President Nixon slashed the NASA FY 1970 budget request (submitted by President Johnson) by \$45 million to \$3.772 billion, nearly a quarter of billion dollars less than the 1969 appropriation. The general interest of Congress towards space was exemplified by its further reduction of NASA's

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

FY 1970 budget to \$3.749 billion, and its wholesale cancellation of the Air Force's MOL program.

There were other precursors of President Nixon's March 1970 space policy announcement. Critics in the Congress, in the media, and in the American public generally, decried the magnitude of the space program plans presented in the STG report, to say nothing of the funds necessary to meet the program goals.³⁷ Although interested in seeing a continuation of large-space projects, the aerospace industry was not united as to which specific projects should have priority. While several companies had special interests due to peculiar space capabilities, industry as a whole favored DOD over NASA because of the magnitude of its business with the military. Finally, Vietnam, the economy, domestic unrest, state of the welfare program, and other issues commanded more attention than new space ventures. These concerns were reflected in the Administration's FY 1971 budget request to Congress, submitted in January 1970. NASA's budget was cut to \$3.377 billion, \$372 million below the FY 1970 appropriation.

Thus, after President Nixon had been in office only one year, NASA was forced to announce several major program changes. In February 1970, the Apollo Applications Program was renamed Skylab and, originally planned to coincide with the lunar landing flights, was rescheduled to 1973-1974. In addition, instead of seven crews being sent to two space

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

stations, only three crews would be sent to a single space station.³⁸ NASA also announced that the last lunar landing mission (Apollo 20) was being cancelled, and all preliminary work on a space shuttle and a manned flight to Mars was being put on hold. By September 1970, the Apollo 18 and 19 missions were cancelled too.

The President's long-awaited space policy statement of 7 March 1970 was a carefully-considered and carefully-worded document that should not have surprised the space community in light of the activity over the preceding 13 months. It was highly cognizant of political realities and the mood of Congress and the public:

. . . space expenditures must take their proper place within a rigorous system of national priorities What we do in space from here on in must become a normal and regular part of our national life and must therefore be planned in conjunction with all of the other undertakings which are also important to us.³⁹

While the President's pronouncement did not back new large projects, as proposed by Dr. Paine and the STG, the statement did identify three "general purposes which should guide our space program-exploration, scientific knowledge, and practical applications." Clearly, President Nixon considered the space program to be of intermediate priority in 1970, not justifying increased investment or the initiation of large new efforts, but a vehicle for exploiting and extending the technological and scientific gains which had already been realized.

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

NASA interpreted the President's statement as endorsement of its reduced manned space activities (remaining Apollo missions, the Skylab program, and a possible joint US-Russian mission in the mid-1970s); its plans for a "Grand Tour" exploration of the planets by unmanned satellites (Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto in the late 1970s); its expanded programs in the practical applications of space technology (earth resources, meteorology, and communication satellites; and greater international cooperation in space).

NASA's fiscal funding spiral did not stop at the \$3.377 billion level, however (the budget submitted to Congress in January 1970 for FY 1971). In fact, by December 1970 Congress had passed the FY 1971 appropriation bill which cut an additional \$64 million. This pattern would repeat itself through FY 1974 when NASA suffered its lowest budget in over a dozen years (\$3.040 billion in absolute or Then Year dollars). The corresponding figure in relative buying power, or Constant-Year 1967 dollars, was just over two billion dollars, and would remain there throughout the decade (Table A-2). Basically, then, the Nixon (and later Ford) dilemma in approaching civilian space efforts was to try to balance the competing claims of budgetary constraints with the need to keep the national program viable, i.e., to curtail without crippling.

The annual attempt to solve the funding dilemma met its biggest test during the election year of 1972. By this time fiscal stringency had

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AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

caused further project cut-backs, including much of the "Grand Tour," leaving only unmanned visits to Mars and Jupiter in the Mariner and Pioneer series, respectively; and the scaling-down of the Nuclear Engine for Rocket Vehicle Application (NERVA) program and a number of projects, such as the High Energy Astronomy Observatory (HEAO), that were considered of the highest priority by scientists. It was in this environment that NASA had been studying the concurrent development of the Thrust-Assisted Orbiter System (TAOS, later named the Shuttle) and a manned space station. Since such a dual program was estimated to cost \$10 billion, which was not economically (and therefore politically) feasible, and since it did not make sense to build the space station without a low-cost supply system (the shuttle), NASA's only logical choice was to seek approval for the TAOS.

President Nixon gave the go-ahead for the shuttle in January 1972 for mainly three reasons:

1. It promised to drastically reduce launching and operational costs through reusable vehicles.
2. It was of value to DOD. The Air Force had followed the Shuttle studies since cancellation of the MOL program, but did not give its support until NASA redesigned the cargo bay to accommodate DOD payloads.

3. It would employ an additional 40,000 aerospace workers by the mid-1970s, which was important to forecast in an election year.

Even with these important considerations in favor of presidential endorsement, the Office of Management and Budget (OMB) urged disapproval. It took a personal appeal from Dr. James Fletcher, the new Administrator of NASA (since April 1971), to gain final approval from President Nixon.

The White House approval got little fanfare but Congress, in the FY 1973 budget approval process, nailed down the lid on what NASA had agreed to: a first orbital flight in 1979, at a total development cost of \$5.22 billion (in 1972 dollars), and a total program cost (including the development costs, five orbiters, the necessary boosters and tanks, and launch facilities) of \$7.5 billion (1972 dollars).⁴⁰ The congressional debate also put an absolute limit of 20 percent on cost overruns (one billion dollars), which NASA was willing to accept in return for program approval. Knowing the high level of technological risk inherent in the program, opponents of the shuttle, mainly from the scientific community, accused NASA of "buying in" in order to keep man in space to the detriment of more important scientific endeavors.

By the time that Congress had locked-in the total program costs, NASA still had five technological "nuts-to-crack": (a) to use a

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

liquid-propellant booster, not flyable but recoverable, or a totally expendable, inexpensive solid-propellant booster; (b) to reduce the design weight of the shuttle so as to not ~~decrease~~ the 65,000-pound payload capability; (c) to develop a new thermal-protection system since the heat-shield principles of previous manned systems were inadequate for a reusable shuttle; (d) to design and test new high-performance rocket engines for the orbiter; and (e) to solve the requirement for an on-board, self-contained flight-control system. Early in the program, and before President Nixon left office, NASA decided for obvious cost and reliability reasons to discard both booster options in favor of recoverable solid-propellant rockets, with a giant liquid-fuel tank (expendable) for the shuttle's main engines. The design weight problem was solved by dropping the requirement for jet engines thus making the orbiter a glider once it reentered the atmosphere. By the time President Ford completed his term in January 1977, NASA had not solved the heat-shield and shuttle rocket engine problems, and OMB had reduced requested funding (over a three year period) by \$274 million. The net effect was that, while NASA was able to operate within tight fiscal constraints, very real problems existed, with associated cost increases and schedule slippages in the offing for the next Administration.

In summary, the era of space spectacles for NASA, great enough to interest the entire world, began in 1969 with the first Apollo lunar voyages. Five more flights followed, along with the three very

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

successful Skylab flights, in which three astronauts lived and worked in a minispace station--the final mission lasting 84 days. The National Space Program received its final boost in 1975 with the Russian-American Apollo-Soyuz Test Project, a mutual docking of the two spacecraft in which coupled air locks could be opened as a passageway between the ships.

The worldwide enthusiasm over man's first departures from earth was not shared in Congress, at least in the form of increased funding. The hopes of some NASA officials for another Apollo-like commitment in the form of a manned expedition to Mars or a huge manned earth-orbital space station or lunar base were quickly dashed. The declining budget and shrinking activity in NASA began prior to 1969, and continued through both administrations.

NASA saw a dramatic increase in practical space applications covering worldwide communication systems, meteorology, earth resource surveys, scientific stellar and solar observations as well as military surveillance satellites and navigation systems. Since Congress favored these applications over spectacular lunar and planetary voyages, and if the real value of the new domain of space was to mature, then a less costly means of transportation seemed essential. For the then foreseeable future, emphasis shifted from big expendable boosters to development of a versatile "truck" to service near-Earth orbits.

Carter's No Spectaculars

While data are difficult to acquire, during the four years of the Carter Presidency, the Russians had in excess of 430 space launches, of which 17 were manned and included Czech, Polish, GDR, Bulgarian, Hungarian, Vietnamese, and Cuban cosmonauts. One mission, Soyuz 32, had a crew duration time in space of 175 days. In addition, the Soviets designed, developed, tested, and deployed an antisatellite (ASAT) system.

By contrast, the United States had only 65 launches (excluding classified DOD efforts). These included four deep space probes, 15 scientific payloads, and 46 applications satellites (eight navigation, three earth-observation, 11 weather, and 24 communication). As the shuttle development problems started to manifest themselves in terms of schedule slippage, it became obvious that no Americans would be launched into space for the remainder of the decade. With the President's edict for no space spectaculars and maintenance of low-level funding, the space "depression" became firmly entrenched.

Dr. Robert Frosch took over leadership of NASA on 16 June 1977 following Dr. Fletcher's resignation the previous month. His primary task for the next four years was to salvage as much of NASA's scientific and applications efforts as possible in the face of run-away inflation, straight-line budgets, and rising shuttle costs. NASA used several means

AUTHOR SCHICHTLE
DOCUMENT: 1826A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

to minimize the shuttle funding requirements as well as total program costs: it borrowed production funds for the development program; it deferred work to the next fiscal year; it slipped the flight schedule; it eliminated all contingency funds below the headquarters level in order to force managers to be creative in seeking solutions to technical problems within the budget; and it finally cancelled procurement of one orbiter. The cost of the shuttles' four test flights projected in FY 1982 is now estimated to be \$9.9 billion or about 25 percent over the original estimate, and just under two years behind schedule.

In the Nixon Administration the NASC was little used after its work on the STG report, and its staff was cut. In 1973, utilizing statutory reorganization powers granted by Congress, President Nixon abolished the Space Council. During President Ford's last year in office, Congress passed the National Science and Technology Policy, Organization, and Priorities Act of 1976 (P.L. 94-282). Under this act, the Presidents' Office of Science and Technology Policy (OSTP) ostensibly provides a broad overview of new technologies being studied throughout the government. More specifically, the Director of OSTP is the source for scientific and technical analysis and judgment for the President with respect to major policies, plans, and programs of the federal government. After taking office, President Carter retained OSTP within the Executive Office of the President, and within 16 months it would play the dominant role in the formulation of space policy.

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

Early in the Carter Administration, a series of joint studies involving the NSC, DOD, OSTP, and NASA were conducted to address apparent fragmentation and possible redundancy among government sectors with space activities, and to develop a coherent recommendation for national space policy. The product of these efforts matured in the Spring and Fall of 1978 as Presidential Directive (PD-37) on National Space Policy and PD-42 on Civil Space Policy.⁴¹

The emphasis of PD-37, published 20 June 1978, was coherent space principles (increase scientific knowledge, develop technology, maintain leadership, etc.) and did not deal in detail with the long-term objectives of commercial and civil programs. It was not void of specifics, however, the first being the establishment of the NSC Policy Review Committee for Space. Chaired by Mr. Frank Press, director of OSTP, the PRC (Space) was to provide a forum for all Federal agencies in which to advise on proposed changes to national space policy and to provide for rapid referral of issues to the President for decision. In addition, the OMB was tasked to review all programs to identify duplication, prioritization, and efficiency; and NASA was directed to pay virtually all the costs associated with development of the shuttle (for DOD peculiar costs see Table A-4). Lastly, DOD was chartered to design "survivability" into space systems, develop an ASAT capability, and to "bump" civilian payloads from scheduled shuttle flights for national security purposes if required.

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

The heavy emphasis of PD-37 on DOD activity caused much consternation within the civilian space community. Within four months (11 October 1978), President Carter had signed PD-42, US Civil Space Policy (see complete White House Press Releases in Appendix B). Completed by the PRC (Space), PD-42 was a less-aggressive directive to pursue, in an evolutionary manner, research, development and applications of space systems for civilian use in the next decade. There was much criticism of the vague goals established in PD-42, especially in Congress. Four bills were introduced in the 96th Congress addressing alternatives to the policy. The two Senate bills (S.212 and S.244) were originally introduced by Senators Schmitt and Stevenson, respectively, immediately following the release of PD-42. The bills were reintroduced, with changes, at the beginning of the 96th Congress and hearings were held in both the Senate and House in January and February 1979 (even though no House bill had been introduced as yet). On 5 June 1979, Representative Dorman introduced H.R. 4316, which was identical to the original Schmitt bill from the 95th Congress (S.3599), and on 28 January 1980, Representative George Brown introduced H.R. 6304, which was based on the Stevenson bill. Although none of the bills was reported from committee, the hearings were spirited and provided for a very broad space policy with associated programs for the next 30 years, including a world information system by 1990, an orbital Civilization by 2000, manned exploration of the solar system by 2010, and development of technology to support those three program areas.

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

The rhetoric of the 96th Congress was symptomatic of the continuing policy debate within various agencies of the executive branch, especially NASA and DOD, through the election year of 1980. President Carter's policy never ~~waived~~, however, and is best summarized by the third "tenet" of PD-42:

It is neither feasible nor necessary at this time to commit the United States to a high-challenge space engineering initiative comparable to Apollo. As the resources and manpower requirements for shuttle development phase down, we will have the flexibility to give greater attention to new space applications and exploration, continue programs at the present levels or contract them.

STAGE OF TRANSITION

As of this writing, the first 14 months of the Reagan Administration have seen the National Space Program experience some interesting ups and downs from which it is hard to discern just what direction high-level policy and programs are headed. Simply stated, policy is drifting now and the United States is experiencing a stage of transition with regard to space.

President Carter's hoped for phase-down of "the resources and manpower requirements for shuttle development" in order to "have the flexibility to give greater attention to new space applications and

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

exploration" has not occurred. Further, Mr. Edgar Ulsamer, Senior Editor of Policy and Technology for the Air Force Magazine, wrote in an article titled "Space Shuttle Mired in Bureaucratic Feud" (September 1980) that after "Two decades into the Space Age, in the absence of a clear national space program, the Air Force and NASA have yet to sort out precisely how the National defense possibilities in space should be managed."⁴² While pointing out the Shuttle's technical and schedule problems, conflicting military and civilian interests, and DOD's reservations about national security missions, Mr. Ulsamer quotes the Pentagon as believing "that the Shuttle program would benefit if an experienced military program manager were put in charge, and cites in particular the fact that the Apollo program was run brilliantly by a military management expert" (then Air Force Major General Samuel Phillips).⁴³ This particular observation assumes some degree of significance when viewing the new leadership of NASA under President Reagan. Dr. Frosch resigned on 20 January 1981, and his Deputy, Dr. Al Lovelace, acted as the Administrator of NASA until the new appointee, Mr. James Beggs, severed his business interests and was sworn in on 10 July 1981. On that same day and of more importance to the military, Dr. Hans Mark, former Secretary of the Air Force in the Carter Administration, was sworn in as Deputy Administrator replacing Dr. Lovelace. Within four months, the Air Forces' most successful program manager in the late-1970s and fully-trained astronaut for the old MOL program, Major General James Abrahamson, was appointed Associate Administrator of NASA for the Space Shuttle Program.

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

Even though none of the space bills of the 96th Congress were reported out of committee, activity on the Hill has been brisk since Mr. Reagan took office. Two more bills (H.R. 3712 and 4286) were introduced in the 97th Congress dealing with a National Space Policy for the next decade. In addition, hearings were held in the Fall of 1981 on future space programs by the Subcommittee on Space Science and Applications of the House Committee on Science and Technology. Further hearings are expected during the second session of the 97th Congress in 1982. This subject will be addressed in more detail in Chapter III.

President Reagan's policies regarding the US space program are still unknown, but a few statements may provide an indication of his views. In his 18 February 1981 statement to Congress on economic recovery, he said that while "we plan to continue" the space program, "We believe . . . that a reordering of priorities to focus on the most important and cost-effective NASA programs can result in a savings of a quarter of a billion dollars." This was followed by an FY 1982 NASA budget request that was \$600 million less than what had been proposed by President Carter. With the Shuttle being exempted from any cuts, the reduction was accomplished by cancelling or deferring all FY 1981 and 1982 new program starts in space science, applications, and aeronautics. The long-term plans for NASA in the Reagan Administration may show a continued slowing of funding for the agency. In its budget guidelines for FYs 1983-1985, the OMB told NASA to reduce its projected funding requirements,

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

previously established under President Carter, by a total of \$2.36 billion. Despite the Congressional interest in space noted earlier, Congress appropriated only \$5.932 billion for NASA in 1982, an amount which represents an additional \$190 million cut from the \$600 million Reagan had requested.

In the area of policy development, President Reagan abolished the PRC (Space), established within the NSC by President Carter, and after several months of ambivalence on ^{the appointment of} a science advisor, chose Dr. George Keyworth for that post. On 28 April 1981 two weeks after the first successful flight of the space shuttle, the President again addressed Congress on the topic of economic recovery. He stated "the Space shuttle did more than prove our technological abilities. It raised our expectations once more. It started us dreaming again." In an address to the American Association ^{for} ~~of~~ the Advancement of Science on 25 June 1981 Dr. Keyworth revealed that the Reagan Administration, spurred by the successful shuttle flight, had initiated a major interagency review of the shuttle's operational future and other matters concerning the direction of the space program. Since that announcement there have been two more shuttle flights, and the review is now expected to be completed in mid-1982.

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

DECISION POINT

In its report on 1980 space policy hearings, the House Science and Technology Committee's Subcommittee on Space Science and Applications recommended that "The civil and military space programs should be examined separately and their funding adjusted to the requirements developed for each program."⁴⁴ Unlike NASA under this budgeting scheme, DOD has fared well as its reliance on space-based systems has grown. The military depends on satellites for such things as: communications, command and control links to strategic and tactical forces; early warning and attack assessment, intelligence collection, and verification of treaty compliance for the National Command Authority; and a "force multiplier" of land, sea, and air forces throughout any potential conflict. In the authorization process during CY 1981, DOD's budget exceeded NASA's space budget by nearly \$200 million (Table A-1). When the FY 1982 budget was finally passed in December 1981, DOD's space appropriation outstripped the whole of NASA's (including aeronautics) by nearly half a billion dollars (Tables A-2 and A-5). Turning to the budget requests for the two agencies submitted by OMB to Congress for FY 1983, the difference is remarkable (NASA- \$6.6 billion, DOD-\$8.5 billion).

Although the relationship of military and civilian space programs has not been directly addressed in recent legislative initiatives in the Congress, some views expressed in hearings seem to reinforce continued

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

separation of agency activities. However, the line between military and civilian programs is becoming increasingly blurred because of the space shuttle. If it does become the single-launch vehicle used for all US space activities, should not the programs be merged? Indeed, given the direction funding is taking and the preponderance of projected military activity in space, should not the Air Force take over the space shuttle?

~~These questions, as well as others raised at the beginning of this Chapter, point to the fact that~~ This nation is at a decision point with respect to future space activity. The situation currently being experienced is not unlike the post-Apollo period wherein much bureaucratic debate took place but no national consensus emerged. Similarly, what the post-shuttle development period holds is unknown and, as yet, the Reagan Administration has not replaced Carter's wait-and-see program.

As the historical synopsis portrayed, ~~the~~ answers lie in national policy emanating from the highest levels of the executive branch, firm programs to carry out that policy with appropriate push from DOD and NASA leadership, and adequate funding from the legislative branch. Chapter II will focus on the need for policy, and Chapter III will address organizational changes required to implement the programs implied in any ~~new policy.~~

AUTHOR SCHICHTLE
DOCUMENT: 1828A ARCHIVE:
PRINTED: 6/23/82 OPERATOR: Laura

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