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## INTELLIGENCE MEMORANDUM

US AND SOVIET SPACE PROGRAMS:  
COMPARATIVE SIZE

DIRECTORATE OF INTELLIGENCE  
Office of Research and Reports

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FOREWORD

The material presented in this memorandum is the result of a continuing effort by CIA to estimate the costs of the Soviet space program. It is believed that in the aggregate the estimates in this memorandum represent a useful approximation of the magnitude of the funding requirements of the Soviet space program and its major elements. Implicit in this judgment is the idea that in the aggregate the various economies and diseconomies in the Soviet program balance, making the estimate of the total level of resources necessary to mount a vigorous space effort a better approximation than the assessment of the level of technology and costs incorporated in an individual program. The estimates of dollar costs are based on current estimates of the nature of the Soviet space programs now under way and of future Soviet space objectives. As various Soviet space programs unfold and as mission objectives and characteristics of hardware become more clearly defined, the estimates and the cost factors used in their derivation will be reevaluated and periodically updated.

- iii -

~~S E C R E T~~

CONTENTS

	<u>Page</u>
Summary . . . . .	1
1. Introduction . . . . .	3
2. Annual Funding Requirements . . . . .	3
3. Funding Implications of a Manned Lunar Landing . . . . .	5
4. Cumulative Funding Requirements . . . . .	6

Appendix

Methodology . . . . .	9
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Charts

Figure 1. US and Estimated Soviet Civil and Military Space Programs: Funding Requirements, FY 1959-1965 <u>following page</u> . . . . .	4
Figure 2. US and Estimated Soviet Civil Space Programs: Funding Requirements, FY 1959-1965 <u>following page</u> . . . . .	4
Figure 3. US and Estimated Soviet Space Programs: Funding Requirements, Cumulative Through FY 1965 <u>following page</u> . . . . .	6
Figure 4. US and Estimated Soviet Unmanned Lunar/Planetary Programs: Launches and Funding Requirements Through FY 1965 <u>following page</u> . . . . .	8
Figure 5. Analog Approach to Estimating Soviet Space Programs <u>following page</u> . . . . .	10

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US AND SOVIET SPACE PROGRAMS:  
COMPARATIVE SIZE\*

Summary

The space programs of both the United States and the Soviet Union have demanded a very large commitment of resources during the past few years. The US civil and military funding requirement reached about \$7 billion in Fiscal Years 1964 and 1965, whereas the estimated Soviet requirement exceeded \$5 billion in Fiscal Year 1965. Although the US requirement probably has reached its peak at least for the next few years, the Soviet requirement appears to be continuing its rise.

The largest commitments have been to civil space programs with the US allocation now running about \$5.5 billion annually and the Soviet allocation estimated at about \$4.5 billion. Of these amounts, manned spaceflight and launch vehicle development (which is principally in support of manned programs) have absorbed by far the largest share -- about 45 percent in the United States and over 55 percent in the USSR.

\* The estimates and conclusions in this memorandum represent the best judgment of this Office as of 7 February 1966. The US and estimated Soviet data presented in this memorandum are in terms of funding requirements (budgeted expenditures) for space programs. Despite the fact that the budget expenditures and actual expenditures may differ somewhat on a year-to-year basis, the budget plan has been used rather than expenditures because it is the only available series with sufficient detail to permit cost estimates by mission and program. In the period covered by this memorandum, total annual expenditures are below the funding requirements contained in the budget plan and to some extent lag behind these requirements. The terms funding requirements and budgeted expenditures are used interchangeably in this memorandum.

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The judgment that the USSR is making a large commitment to a major manned space program is based on the latest National Intelligence Estimate, NIE 11-1-65. Although the cost estimates are based on a Soviet program to put a man on the moon by 1970, competitive with Project Apollo, the magnitude of the cost estimates is generally consistent with a manned lunar landing program aimed at a somewhat later date, as well as with other major manned space missions such as a large space station.

The one area in which Soviet allocations appear to have outstripped those of the United States is in unmanned lunar/planetary exploration. This difference reflects the heavy Soviet commitment to the planetary program, while the US program, however spectacular it may have been, represents a comparatively modest effort.

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- 2 -

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1. Introduction

An attempt is made in this memorandum to gauge the pace and magnitude of the Soviet space effort. The gauge being used is economic and the unit of measure is the cost of the Soviet effort expressed in US dollar equivalents. Although there is no direct information on the ruble costs of the Soviet space program, it is possible to estimate the cost of this program as if it were undertaken in the United States.\* This approach makes it possible to reduce the heterogeneous hardware and activities that compose the US and Soviet space programs to a common denominator -- that of dollar cost. One objective of this approach, obviously, is to obtain a close approximation of the actual cost of carrying out the Soviet program in the United States, but a still more important purpose is to develop a quantitative index of the Soviet effort, thus providing a measure of the overall magnitude and direction of this effort.

2. Annual Funding Requirements

Estimates of Soviet funding requirements -- the estimated budgeted expenditures of the Soviet space program -- are compared with the US space budget plan for Fiscal Years 1959 through 1965, as shown in Figure 1. Budgeted expenditures have been used for the purpose of this comparison because the requisite details are not reflected in actual US expenditure accounts. Budgeted expenditures represent proposed claims against available resources as contrasted with actual expenditures, which represent resource utilization. Estimates for the Soviet programs are based on the US data and, therefore, are expressed in the same terms; there is no evidence that the USSR has a space budget plan similar to that of the United States.

Space funding requirements, as shown in Figure 1, have been high for both countries, with those of the United States running fairly far ahead of those estimated for the USSR. The US space budget plan grew rapidly until 1964, but since that time has leveled off at about \$7 billion annually. Of this amount, about \$5.5 billion are allocated to civil space activities, and about \$1.5 billion go to military programs. Although the annual funding requirements for Soviet space programs are estimated to be running below those of the United States, they have been growing at a high rate and are approaching the current levels of the United States. There has been no indication as yet that Soviet requirements for space have leveled off.

The estimates for the USSR represent only those programs that are currently identifiable through actual flights. No allowance has been made for military space programs that may be under way but have not yet been identified. Because it is probable that some unidentified

\* See the Appendix.

military space programs are now under way, estimates of the funding requirements of Soviet military space programs are almost certainly understated.

Because of this understatement, a comparison of civil space programs may be more meaningful than a comparison of the total programs. Estimates of funding requirements for civil space for the USSR and the actual budget plan for the United States are shown in Figure 2. Although US budgeted expenditures are still ahead of those estimated for the USSR, the levels for the civil space programs of the two countries are much closer to each other than those for all space programs taken together. The funding requirements for civil space programs of both countries have experienced rapid growth in the past, with the USSR generally lagging behind the United States by about one year. As with the total space requirement, the planned allocation for the US civil space program leveled off in 1964, whereas that for the USSR continued to climb through 1965.

Although there are several reasons for the difference in the funding requirements for civil space programs of the two countries, a principal reason is believed to be economies effected by the USSR through the adaptation and use of facilities originally used to support the military missile program. This is in keeping with the Soviet practice of using facilities for a dual purpose. The cost of those facilities which support Soviet missile programs has been attributed to the military and does not form part of the space estimates.

Another reason for the difference is the estimated lower Soviet funding requirement for manned space flight which stems largely from the fact that the Voskhod program makes considerable use of hardware developed in the Vostok program, unlike the US Gemini program which represents a marked departure from Project Mercury. The Voskhod spacecraft in most important respects is no more than a Vostok, somewhat modified to accommodate three men or two men and an airlock. In addition, the launch vehicle used to boost the spacecraft into orbit has the same first stage, the SS-6, as that used in the Vostok program. Moreover, the USSR man-rated the upper stage (the Venik third stage) during the Cosmos photo-reconnaissance program, and in all likelihood the soft-landing system employed on the Voskhod also was developed as part of this same program.

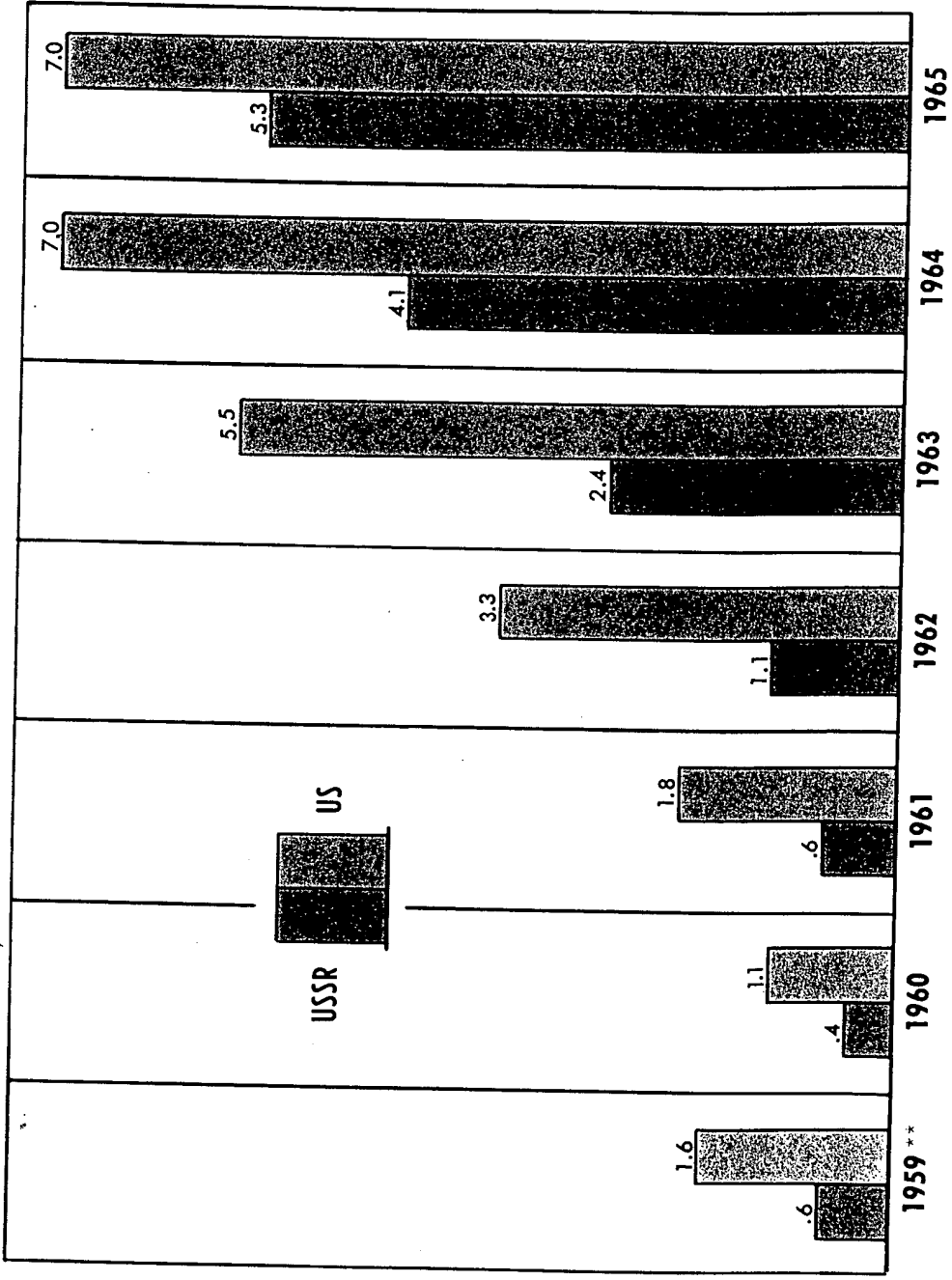
Finally, although the USSR has stressed unmanned lunar and planetary exploration, other programs related to space science and applications, with the possible exception of biomedical programs, apparently have not received the same emphasis in the USSR that they have in the United States. Soviet scientific satellites in general carry fewer, simpler experiments than those of the United States having equivalent missions, and the Soviet applied satellite programs -- communications, meteorology, and navigation -- appear to be considerably behind similar US efforts.



FIGURE 1

US AND ESTIMATED SOVIET CIVIL AND MILITARY SPACE PROGRAMS:  
FUNDING REQUIREMENTS, FY 1959-1965\*

(BILLION US DOLLARS)



\* The US figures include the funding requirements of the National Aeronautics and Space Administration, the Department of Defense, the Atomic Energy Commission, the National Science Foundation, and the Weather Bureau for space-related activities. The figures for the Soviet program conceptually include the same activities as those of the various US governmental organizations mentioned above.

\*\* Including funding requirements prior to FY 1959.

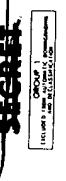
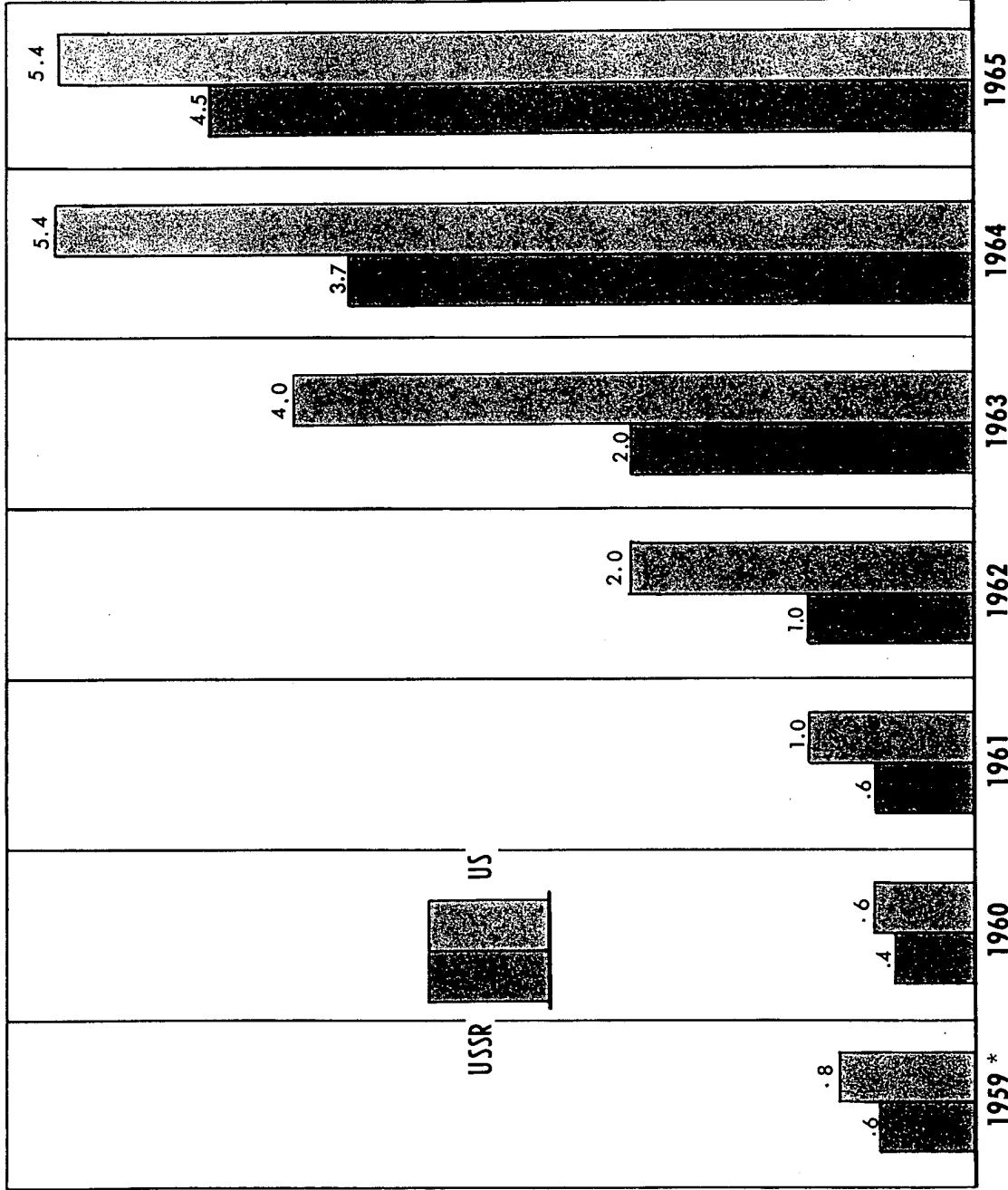


FIGURE 2

US AND ESTIMATED SOVIET CIVIL SPACE PROGRAMS:  
FUNDING REQUIREMENTS, FY 1959-1965  
(BILLION US DOLLARS)



\*Including funding requirements prior to FY 1959.

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3. Funding Implications of a Manned Lunar Landing

The estimates shown in Figure 2 reflect the initial installment of funds assigned to a Soviet manned lunar landing program that would be competitive with the US Project Apollo. The basis for including this program in the estimates is Khrushchev's acknowledgement in November 1963 and again in July 1964 of a Soviet effort to put a man on the moon, as well as the spate of statements by Soviet scientists and cosmonauts concerning a manned lunar landing. Another consideration in this judgment is the urgency with which Soviet scientists have sought information on the lunar surface with the aid of soft landers since at least May 1965.

If the Soviet program is competitive, numerous activities not yet visible to the intelligence community must now be under way. In order to have flight hardware ready for testing during 1967, the USSR should now be developing the launch vehicle, spacecraft, and other mission hardware required in the program. Thus the commitment of resources to the program should already be substantial. It is estimated that, as a minimum, the USSR could be planning expenditures on the order of \$5 billion to \$6 billion for the development of a launch vehicle suitable for the mission. Beyond this minimum, a manned program of the magnitude of a lunar landing or large space station could require on the order of an additional \$8 billion to \$9 billion, bringing the total program estimate to about \$14 billion.\*

Although almost all other Soviet space programs have experienced steady growth in the past few years, the estimated manned lunar landing program is largely responsible for the high level and rapid growth in the estimate of the Soviet civil space budget plan. Almost 55 percent of total budgeted expenditures for Soviet civil space programs in 1965 are estimated to have been absorbed directly or indirectly by this single undertaking. In the United States, Project Apollo and other activities related to this project accounted for more than 50 percent of NASA's 1965 budget plan.

If the Soviet manned lunar landing is not competitive with Apollo but is scheduled for a date in the 1970's, the annual budget plans would be somewhat lower than those estimated. Nevertheless, studies based on the US Apollo program show that the overall program budget plan increases as the duration of the program is lengthened, and annual funding requirements remain substantial throughout the life of the program.

Even if no Soviet manned lunar landing is in progress, the rapid pace of other portions of the space program coupled with the tenor of

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\* Although the total Project Apollo funding requirement is about \$19.5 billion, the Apollo requirement for categories comparable to those included in the estimate for the USSR would be on the order of \$16 billion.

Soviet statements suggests that some other major space program of equivalent scale must be under way. The most likely alternative is a program to orbit a very large manned space station. Estimates for such a program are of the same magnitude as those for a manned lunar landing. Thus, whatever ultimate Soviet intentions may be, there are indications that substantial commitments probably have already been made and that the Soviet civil space funding requirement is likely to remain high in the next few years.

#### 4. Cumulative Funding Requirements

Some concept of the relative importance of different classes of missions in the United States and the USSR is provided by Figure 3, which shows cumulative funding requirements by mission. Through Fiscal Year 1965, the United States has allocated 70 percent of the total space budget plan to civil projects and 30 percent to military. A similar comparison for the USSR is not meaningful, because, as noted above, there is uncertainty about the magnitude of the Soviet military space effort. Thus far, US civil programs have accounted for about \$19 billion, whereas Soviet civil programs are estimated to have received well over \$12 billion, about two-thirds as much as the US programs.

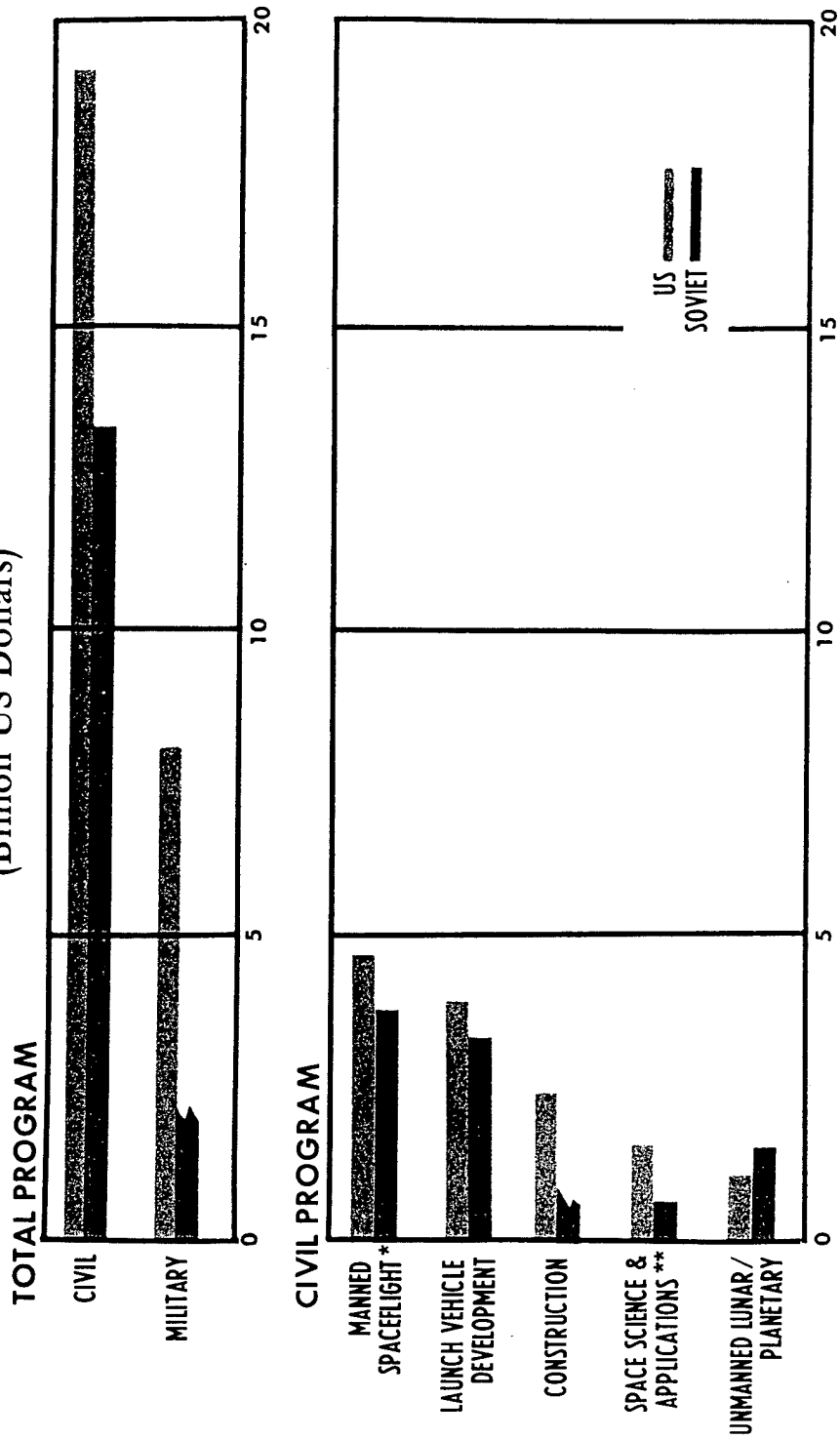
Within the civil space accounts of both countries, the man-in-space program clearly has received top priority. About 30 percent of the total Soviet civil space effort has been devoted to this program, compared with 25 percent of US civil funding requirements. The estimated Soviet manned effort includes Vostok, Voskhod, and a lunar landing program (or a large space station) as well as the leading edge of a circumlunar mission and a small space station. The US program represents budgeted expenditures for the Mercury, Gemini, and Apollo projects. The reason for the relatively low figure in this category is that the budget plan for the development of the Saturn family of launch vehicles is not carried as part of the Apollo program, as is done by NASA, but has been put into a separate category for more direct comparability with what is observable on the Soviet side.

The account covering development of the launch vehicle includes budgeted expenditures only for those launch vehicles, upper stages, and engines intended specifically for use in accomplishing civil space missions. This account does not include budgeted expenditures for developing military missiles adapted for use as space launch vehicles. For example, the development of neither the US Atlas nor the Soviet SS-6 ICBM is included in this account. The cost of these launch vehicles when used in accomplishing missions that form part of a specific space program is, of course, included in the budget plan for that program.

FIGURE 3

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US AND ESTIMATED SOVIET SPACE PROGRAMS: FUNDING REQUIREMENTS,  
 CUMULATIVE THROUGH FY 1965  
 (Billion US Dollars)



\* Excludes development of Saturn family of launch vehicles which is included in Launch Vehicle Development category.

\*\* Less Unmanned Lunar/Planetary.

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In addition to the Saturn series of launch vehicles, the US account also includes such hardware as the Scout launch vehicle and the Centaur upper stage. The Soviet account includes the Proton booster and upper stages such as the Lunik, the Venik third and fourth stages, and the Polet. Based on apparent Soviet intent to mount a major manned space program during this decade, the estimates of Soviet funding requirements also include the development of a large launch vehicle in the Saturn V class, which would be necessary to accomplish a manned lunar landing and which would have no military role as an ICBM.

Despite the large payload capability provided by the SS-6 ICBM, the USSR has found it necessary to make a substantial commitment to development of launch vehicles. The estimated Soviet funding requirement totals about \$3.5 billion and almost equals that of the United States. For the USSR, this sum represents about 25 percent of the estimated civil space requirements, as compared with about 20 percent for the United States.

Construction of facilities represents a major item in the US space budget, with about \$2.5 billion budgeted thus far for this purpose. As noted above, it is believed that the USSR has been able to effect economies in this area through the use of existing military installations in the space program. Comparatively little construction is believed to be related directly to the Soviet space program, and this is reflected in the relatively low estimate of Soviet funding requirements for this purpose shown in Figure 3.

Space science and applications have taken a relatively small share of the total civil space funding requirements of both countries, with that of the United States accounting for about 8 percent and that estimated for the USSR, about 5 percent. One reason for this difference seems to be that the United States has emphasized applied satellite programs to a greater extent than has the USSR. It should be noted that this category excludes budgeted expenditures for unmanned lunar/planetary exploration, which is shown in a separate account.

The unmanned lunar/planetary exploration programs shown in Figure 4 are the only programs for which estimated Soviet funding requirements appear to exceed those of the United States. Ironically, this is one field of space exploration in which the United States had up until the soft landing of Luna 9 scored its most spectacular successes over the USSR. The primary reason for the difference is the large commitment made by the USSR to the planetary program. The USSR initiated this program in the early 1960's and has availed itself of every favorable opportunity to launch one or more probes either to Venus or Mars. The program has been in such difficulty that in 1965 the USSR conducted an engineering test of planetary probe hardware (Zond 3) during an unfavorable period. Nevertheless, this probe and the three attempts in November 1965 provide a strong indication that the USSR intends to

- 7 -

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continue to pursue a vigorous unmanned planetary exploration program in this decade. By contrast the US plans only one Mariner probe between now and 1969, and the sophisticated Voyager vehicles will not be launched until 1973.

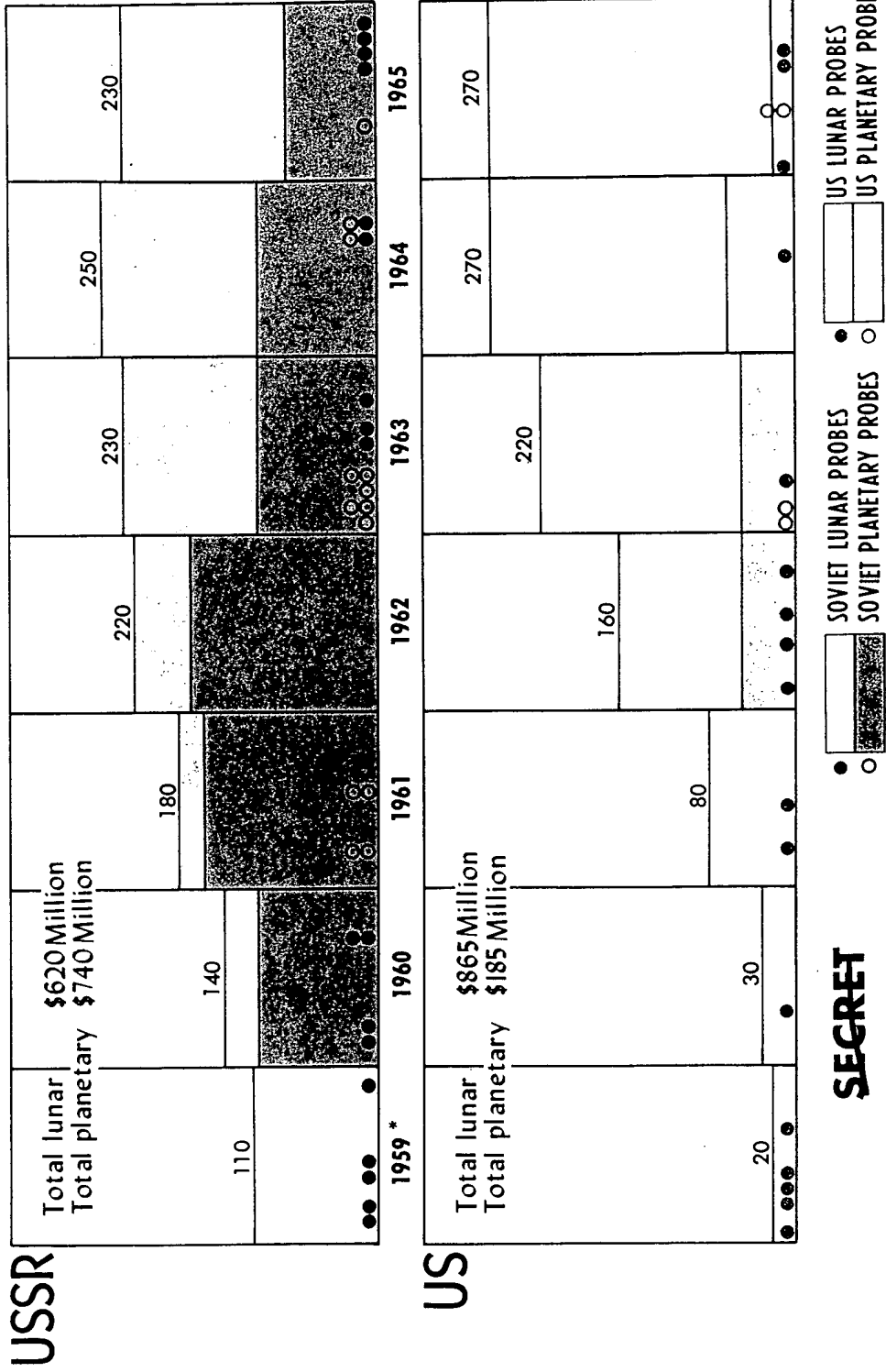
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FIGURE 4

US AND ESTIMATED SOVIET UNMANNED LUNAR/PLANETARY PROGRAMS:  
LAUNCHES AND FUNDING REQUIREMENTS THROUGH FY 1965  
(MILLION US DOLLARS)



\*Including funding requirements prior to FY 1959



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APPENDIX

METHODOLOGY

The cost of the Soviet space program is estimated in terms of budgeted expenditures expressed in dollar equivalents, as if the program were being undertaken in the United States. This approach has been adopted because there is no direct information on the actual ruble costs of the Soviet program. The estimated funding requirement of the Soviet space program can thus be compared directly with that of the US space program.

Because there are no direct cost data, the funding requirement of the Soviet program was estimated by approximating that of its constituent elements. In effect, the total requirement of the Soviet program was reconstructed from its identified and estimated parts. Identified programs are those in which launches have already occurred, such as Cosmos, Elektron, and Molniya-1; estimated programs are those in the pre-launch phase, such as a meteorological satellite program, which is believed to exist because of US-Soviet agreements signed as early as 1962, and a manned lunar landing program, which Khrushchev acknowledged in November 1963.

Scientific and technical analysts, and to some extent the USSR itself, have been relied on to identify a mission or program. Once the nature of a mission has been established, its funding requirement is estimated on the basis of US budgetary information provided by NASA, Defense, and other government agencies. These data were adjusted to reflect actual Soviet hardware known to be used as well as differences in hardware design and fabrication.

The method used to approximate individual Soviet space programs is illustrated in Figure 5. This example shows how the Soviet Vostok program was estimated on the basis of Project Mercury. Both are first-generation manned space programs that took place in about the same time frame, and for that reason, the Mercury program seems well suited as an analog for the Vostok program.

For the purpose of cost estimation, the program was divided into three categories: spacecraft, launch, and support. The cost of the spacecraft represents the planned cost of developing the spacecraft as well as the actual mission hardware. Because in most instances relatively few details are known about the Soviet hardware, use was made of some characteristic of the hardware which can be readily estimated and which bears some functional relationship to costs. In this example the total orbited weight of the Soviet and US hardware was used, which necessitates some further adjustments for more direct comparability. In the example shown, Mercury weighs 3,500 pounds and

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Vostok well over 10,000 pounds. It would be misleading to estimate the cost of the Vostok program using an unadjusted cost factor derived from Mercury, particularly when a large share of the Vostok weight (over 2,000 pounds) is attributable to batteries. Therefore, useful payload was used as the unit of weight to determine the estimated funding requirement for the Vostok spacecraft. Useful payload is an arbitrarily defined unit intended to take account of major differences in spacecraft design and subsystem weight. Applying the Mercury cost factor (\$7,800) to the adjusted Vostok weight yields the estimated program requirement for the Vostok spacecraft.

Launch costs include the booster and launch services and are estimated using a cost factor for placing one pound of payload in a 100-nautical mile orbit. These cost factors are consistent with estimates of the costs of Soviet hardware known to be used in accomplishing the space mission, adjusted to reflect the use of the booster as a space launch vehicle and to include launch operation costs.

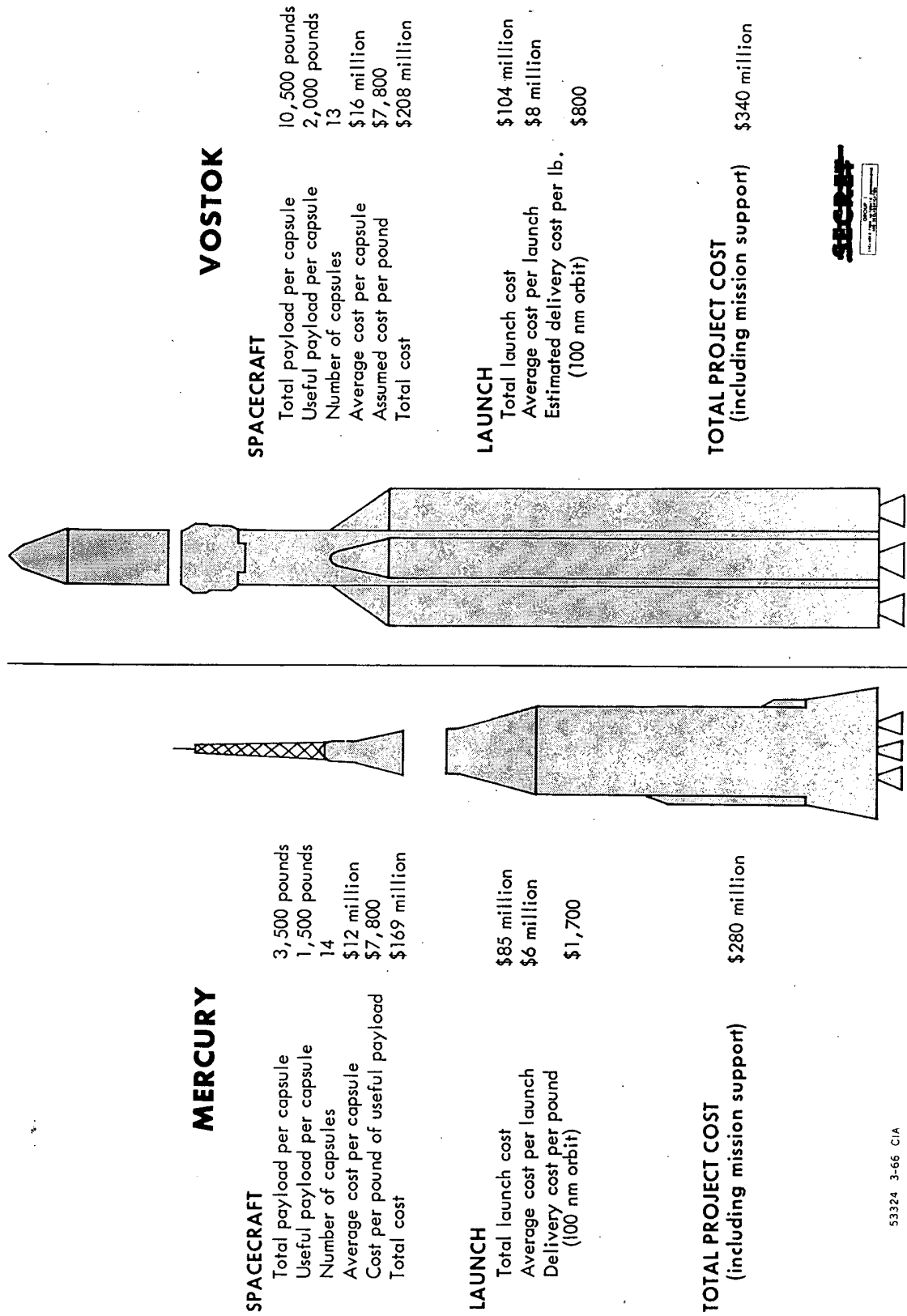
Spacecraft, launch, and mission support make up the total funding requirement for the program. Estimates of mission support costs are taken from the closest US analog. Once the funding requirement for the total program had been established this total was distributed over time in general accordance with the pattern observed in the closest US analog. Adjustments were made in the distribution to take account of differences in the scale of the programs and in the schedules for accomplishing mission objectives.

There are other costs incurred because of specific programs but not directly related to them. These are nonprogram costs for such activities as administration, research and technology, and tracking and data acquisition. The costs for these activities were estimated on the basis of identified programs and were put into separate accounting categories.

Uncertainties arising from poorly defined or unknown hardware characteristics and mission profiles surely result in inaccuracies in the estimates for individual Soviet programs. In addition, individual Soviet programs may enjoy economies or incur penalties which are not present in the corresponding US program. However, despite uncertainties in the estimates for an individual program, it is believed that in the aggregate the estimates presented in this memorandum represent a useful approximation of the magnitude of the funding requirements of the Soviet space program and its major components. Implicit in this judgment is the idea that in the aggregate the various economies and diseconomies in the Soviet program balance, making the estimate of the total level of resources necessary to mount a vigorous space effort a better approximation than the assessment of the level of technology and costs incorporated in a single program.

FIGURE 5

ANALOG APPROACH TO ESTIMATING SOVIET SPACE PROGRAMS



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