National Aeronautics and Space Administration

BUDGET ESTIMATES

FISCAL YEAR 1967

Volume VI

SPACE SCIENCE AND APPLICATIONS PROGRAMS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

SPACE SCIENCE AND APPLICATIONS PROGRAMS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND DEVELOPMENT

GENERAL STATEMENT

The program of research and development and supporting activities of the National Aeronautics and Space Administration is directed toward maintaining the United States in a position of world leadership in aeronautics and space. The major program elements designed to achieve this objective are:

MANNED SPACE FLIGHT: The attainment of a capability for manned space operations and exploration through extended earth orbital flights, development of rendezvous and docking techniques, and manned lunar landing and return.

SPACE SCIENCE AND APPLICATIONS: An unmanned space flight program directed toward scientific investigations of the Earth, Moon, Sun, planets, stars and interplanetary space; and the development of technology and spacecraft systems that can be used in operational systems, such as meteorology and communications.

ADVANCED RESEARCH AND TECHNOLOGY: An effort required to provide the fundamental knowledge and the technological base for the future aeronautics and space programs.

TRACKING AND DATA ACQUISITION: The effort required for the operational support of the NASA manned and unmanned flight programs.

MANNED SPACE FLIGHT

The greatest portion of the FY 1967 request is for the support of the manned space flight program. The development of a capability for manned space operations with a supporting base of engineering, scientific and production capacity remains unchanged as the basic objective of this program. Within this basic objective there is a specific goal of landing men on the lunar surface for limited lunar exploration and returning them safely to earth in this decade. Projects Gemini and Apollo continue to be the hard core of the present flight and ground test and development effort. Supplementing these projects are studies and supporting development activity which are directed toward the exploitation of the hardware and techniques developed by Gemini and Apollo.

Gemini has already established man's capability for useful activities in space for periods of up to two weeks. In FY 1967 its flight operations will be completed. These flights will provide Apollo with important development information on space navigation, guidance, rendezvous and docking techniques.

In addition to continuation of the ground test activities, FY 1967 Apollo efforts will expand into manned spacecraft flight tests using the Saturn IB launch vehicle, and the initial development flights of the Saturn V launch vehicle.

In the area of advanced flight missions, studies and advanced component development will be continued. The aim of this effort will be to exploit and extend the capability of the Apollo spacecraft.

SPACE SCIENCE AND APPLICATIONS

In the FY 1967 budget request the next major program is that of space science and applications. Part of the scientific program is concerned with unmanned space flights, which are used to study the environment and surface of the Earth, Moon, and planets, as well as the intervening space environment. The flight projects concerned with the above objectives include sounding rockets, Geophysical satellites, Explorers, Pioneer probes, Mariners and Surveyor. The project involved with the study of the Sun is the Orbiting Solar Observatory; while the purpose of the Orbiting Astronomical Observatory is to study the stars. The biosatellite program will continue development so as to launch its first flight in 1966. In the area of applications, project Nimbus will continue to support the present and future requirements of the operational weather satellite systems for the Weather Bureau. Effort will also continue in the development of the Applications Technology Satellite which will give useful information for application to meteorology and communications as well as scientific spacecraft systems.

ADVANCED RESEARCH AND TECHNOLOGY

The advanced research and technology effort constitutes a continuing overall program aimed at meeting the technology goals of the nation with particular attention to providing the technical base for carrying out attractive future aero-space missions. This effort covers the spectrum of activity from basic research to improve our fundamental knowledge of physical and life science phenomena, through applied technology to improve our practical capability for developing advanced systems. The specific areas of effort in the advanced research and technology program are basic research, biotechnology and human research, electronics and control, nuclear systems and space power, chemical propulsion, space vehicle research and technology, and aeronautics.

TRACKING AND DATA ACQUISITION

The tracking and data acquisition effort is directed toward providing the necessary support required by the increasing activity of the NASA space flight programs. During FY 1967 increased numbers of launches are scheduled for both the manned and unmanned space flight programs, thereby requiring additional effort by the world-wide network of tracking stations. Additionally, the program provides for supplementing and maintaining the tracking and data acquisition capability of the network as required.

TECHNOLOGY UTILIZATION

The technology utilization program provides for the distribution and dissemination of the scientific, technological and engineering information and concepts resulting from NASA programs so as to permit their fullest use in accomplishing national objectives. In order to assure fulfillment of this basic objective, several subsidiary objectives must be realized. They are: 1. Establishing effective mechanisms and systems for assuring that all new knowledge is identified, collected, evaluated and made available in the most useful manner; and 2. Establishing effective mechanisms for announcing and disseminating this new knowledge in order to assure the widest possible application and utilization thereof.

FINANCING

The FY 1967 budget to support the research and development program, which is discussed in detail in this volume, is $4,246,600,000. This compares with a program totaling $4,511,644,000 for FY 1966.

Expenditures for the current fiscal year are estimated at $4,520,000,000 and $4,340,000,000 for FY 1967

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

GENERAL STATEMENT

This appropriation provides for contractual services for the design, construction and modification of facilities; the purchase of equipment related to construction and modification; and advance design of facilities planned for future authorization. The principal projects in the 1967 program are described below:

MANNED SPACE FLIGHT: The estimates include funding requirements for operational and testing facilities, utility installation, and additions and modifications to existing facilities, to support the Apollo spacecraft and Saturn launch vehicle programs and other research and support activities.

SCIENTIFIC INVESTIGATIONS IN SPACE: Projects in this category will support activities in space science. The estimates provide for modifications to launch facilities; new launch and servicing facilities for Delta vehicles, an Aerobee launch facility, and additional utility installations.

SPACE TECHNOLOGY: These projects comprise research laboratories, a support facility, and a chemical distribution facility.

AIRCRAFT TECHNOLOGY: Funds will provide for a V/STOL wind tunnel, expansion of the propulsion systems laboratory, and modifications for a hypersonic propulsion facility.

SUPPORTING ACTIVITIES: Funds are included for facility planning and design; a 40-foot antenna test bed, and a utility installation to support tracking and data acquisition requirements.

The appropriation for FY 1966 was $60,000,000 and the authorization was $62,376,350. The request for 1967 is $101,500,000; an increase of $41,500,000 from the 1966 appropriation. Total expenditures are estimated to be $300,000,000 in FY 1967, a decrease of $195,000,000 from the $495,000,000 estimated for FY 1966.

The budget request contains $20,000 to provide a fall-out shelter protection for a new facility at Kennedy Space Center. The amount has been determined in consultation with the Department of Defense based on DOD policy and criteria.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ADMINISTRATIVE OPERATIONS

GENERAL STATEMENT

The Administrative Operations appropriation provides for personnel, travel, and other supporting expenses of NASA installations including Headquarters. These installations are institutionally administered by the Associate Administrator who has prime responsibility for the Research and Development programs conducted at each installation. The Associate Administrator for Manned Space Flight is responsible for the Kennedy Space Center, Manned Spacecraft Center, and the Marshall Space Flight Center. Goddard Space Flight Center and Wallops Station are under the institutional cognizance of the Associate Administrator for Space Science and Applications. The Associate Administrator for Advanced Research and Technology is institutionally responsible for the Ames Research Center, and the Electronics Research Center, the Flight Research Center, the Langley Research Center, the Lewis Research Center, and the Space Nuclear Propulsion Office. Headquarters reports directly to the Deputy Associate Administrator, and the Western Operations Office reports to the Assistant Administrator for Industry Affairs. Installation descriptions and funding requirements are grouped in this volume in accordance with the prime missions of the installations.

Manpower

NASA originally planned for a total of 34,100 civilian personnel positions in FY 1966. However, due to the successful acceleration in the manned space flight program, additional manpower was required to support this program. As a result, an additional 424 positions were assigned to the Manned Spacecraft Center and the Kennedy Space Center bringing the total end of year positions to 34,524. In FY 1967 an additional 450 positions are planned for the Electronics Research Center in accordance with the phased build up for that installation. Post-flight studies of the early Gemini flights showed a strong relationship between spacecraft hours in flight and manhours in flight, and requirements for supporting personnel for launch, mission operations, and tracking. As a result of these workload indicators, in addition to the 424 positions assigned in FY 1966, a further allocation of 365 positions for the Kennedy Space Center and the Goddard Space Flight Center to support the heavy emphasis on launching and tracking of manned space flight missions is planned. These increases are partially offset by a target reduction of 400 positions throughout the agency which will not be filled upon becoming vacant. A total of 34,939 positions is requested for FY 1967.

The number of positions requested and the grade level of the employees is a product of the Human Resources Study conducted by NASA over a six month period. This study included a detailed position-by-position study at all NASA installations with the intent of eliminating organizational entities or

positions not considered necessary for the assigned missions. The study verified that manpower was and is being used effectively and that every effort is being made to provide for new requirements by adjustments within the authorized manpower level. An important part of the study was the development of a computer-assisted technique for assignment of grade and salary levels throughout the agency. The historical study had indicated that the factors which had the greatest impact on grade and salary levels were: (1) promotion practices, (2) rate of separation, (3) level of accessions, and (4) statutory within grade pay increases. The computer program utilized these four forcing factors to evaluate sensitivity of policies relating to promotions, separations, and accessions and provided a method to make long range forecasts of the effect on average grade and salary of differing concepts of personnel management. The estimates for personnel compensation contained in the budget have been established through this technique. In addition to developing a technique for estimating grade and salary requirements, the Human Resources Study includes a follow-up procedure which continuously evaluates the progress of the manpower activity against the projection.

The following tabulations indicate the distribution of NASA personnel by program and the numbers of personnel by center:

Personnel Distribution

	1965	1966	1967
Direct Personnel by Program			
Manned Space Flight			
Gemini	1,050	1,168	197
Apollo	9,369	9,528	10,356
Advanced missions	250	273	302
Sub-total, MSF	10,669	10,969	10,855
Space Science and Applications			
Physics and astronomy	1,357	1,330	1,295
Lunar and planetary exploration	342	376	387
Sustaining university program	72	71	71
Launch vehicle development	265	241	176
Launch vehicle procurement	317	351	352
Bioscience	260	267	269
Meteorological satellites	275	244	237
Communication and applications technology satellites	154	158	161
Sub-total, SSA	3,042	3,038	2,948

	1965	1966	1967
Advanced Research and Technology			
Basic research	1,258	1,284	1,286
Space vehicle systems	1,483	1,488	1,485
Electronics systems	1,068	1,264	1,629
Human factor systems	230	235	245
Space power and electric propulsion systems	931	807	800
Nuclear rockets	774	607	593
Chemical propulsion	505	660	680
Aeronautics	1,513	1,679	1,743
Sub-total, ART	7,762	8,024	8,461
Tracking and Data Acquisition	780	831	953
Technology Utilization	47	45	45
Sub-total, direct positions	22,300	22,907	23,262
Support Personnel			
Director and staff	1,092	1,096	1,092
Administration	4,872	4,940	4,941
Research and development support	4,936	4,981	5,044
Sub-total, support positions	10,900	11,017	11,077
Total, permanent positions	33,200	33,924	34,339
Total, other positions	1,100	600	600
Grand Total, all positions	34,300	34,524	34,939

Personnel Requirements

	1965	1966	1967
Manned Space Flight			
Kennedy Space Center	2,428	2,620	2,750
Manned Spacecraft Center	4,237	4,809	4,747
Marshall Space Flight Center	7,510	7,317	7,221
Sub-total, MSF	14,175	14,746	14,718

	1965	1966	1967
Space Science and Applications			
Goddard Space Flight Center.....	3,704	3,577	3,759
Pacific Launch Operations Office	19	---	---
Wallops Station.....	518	518	518
Sub-total, SSA.....	4,241	4,095	4,277
Advanced Research and Technology			
Ames Research Center.....	2,210	2,220	2,191
Electronics Research Center.....	244	550	1,000
Flight Research Center.....	605	604	596
Langley Research Center.....	4,244	4,234	4,179
Lewis Research Center.....	4,815	4,810	4,747
Space Nuclear Propulsion Office.	117	117	115
Sub-total, ART.....	12,235	12,535	12,828
Supporting Activities			
Headquarters, NASA.....	2,163	2,162	2,135
Western Operations Office.....	386	386	381
Sub-total	2,549	2,548	2,516
Permanent positions.....	33,200	33,924	34,339
Other positions.....	1,100	600	600
Grand total, all positions.....	34,300	34,524	34,939

Funding

The FY 1966 NASA budget included a request for $609,400,000 for Administrative Operations. This was reduced by the Authorization Act to $591,048,850 and further reduced by the Appropriation Act to $584,000,000. A detailed analysis of requirements to be funded under Administrative Operations resulted in the conclusion that the estimate could be reduced by $5,892,000 to a total of $603,508,000. With the peak workload approaching, however, any amount below this level would make it impossible to conduct successfully the planned flight missions. In addition to this requirement, the recent Federal Employees Salary Act of 1965 created a new funding requirement of $8,312,000 for a total of $611,820,000 for the Administrative Operations appropriation. As a result, a total of $27,820,000 has been reprogrammed and transferred from the Research and Development appropriation to increase funding to $611,820,000.

The FY 1967 funding request for Administrative Operations is $663,900,000 an increase of $52,080,000. The major reason for the increase requested is related to the manned lunar landing program with the Cape Kennedy Merritt Island Launch Area approaching its full development and the Manned Spacecraft Center approaching its full operational capability, as well as the support of this program in other centers, particularly the Goddard Space Flight Center. The other major area of increase is related to the build up of the Electronics Research Center. The object classification description of resources requested is tabulated below:

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION

(Thousands of Dollars)

	1965	1966	1967
11. Personnel compensation	332,722	355,511	375,354
12. Personnel benefits	23,713	25,299	27,090
21. Travel and transportation of persons	20,427	20,841	21,279
22. Transportation of things	4,543	4,689	5,048
23. Rent, communications and utilities	46,424	49,795	56,417
24. Printing and reproduction	4,174	4,615	4,916
25. Other services	85,045	107,584	127,538
26. Supplies and materials	24,553	21,156	26,122
31. Equipment	86,370	16,998	14,696
32. Lands and structures	6,539	5,300	5,408
42. Insurance claims and indemnities	27	32	32
Total	634,537[a/]	611,820[b/]	663,900

The analysis of changes by Object Classification FY 1966 to FY 1967 follows:

	1965	1966	1967	Change in FY 1967
Personnel Compensation and Benefits	$356,435	$380,810	$402,444	+$21,634

In FY 1967 the cost of personnel compensation and benefits will be $21.6 million greater than FY 1966. Of this amount $3.8 million is caused by the full year effect of the Federal Employees Salary Act of 1965, effective in October 1965. The most significant increase reflects the cost of providing for a net increase of 846 manyears for permanent personnel. Actual increases include 621 manyears for new FY 1967 positions at the Kennedy Space Center, the Electronics Research Center, and the Goddard Space Flight Center, and an increase of 425 manyears related to the new positions filled during FY 1966.

a/Includes $14,573,000 comparative transfer from Research and Development.
b/Includes $27,820,000 appropriation transter from Research and Development.

These increases of 1,046 manyears are partially offset by the saving of 200 manyears resulting from not filling 400 vacancies due to the 1965 retirement legislation. The cost of the net additional manyears is estimated at $9.8 million.

Reimbursement to the Department of Defense for military personnel detailed to NASA will increase by $1.1 million in FY 1967 over FY 1966. In FY 1966, 128 trained military personnel, who became available because of the phase-out of the Atlas and Titan I missile systems, were detailed to NASA for the support of Gemini and Apollo flight operations. In FY 1966 the Department of Defense paid the entire cost of these personnel. NASA will assume the funding responsibility for these personnel in FY 1967.

In addition to the increased costs resulting from the salary increase, additional manyears, and reimbursement for military personnel, there is an increase of $9.9 million resulting from the structural changes in the personnel complement. The total increase of $24.6 million is offset by a decrease of $3.4 million in temporary employment and $2.6 million in overtime and holiday pay, for a net increase of $21.6 million. The net increase for personnel compensation and benefits consists of $19.8 million for compensation and $1.8 million for benefits.

	1965	1966	1967	Change in FY 1967
Travel and Transportation of Persons	$20,427	$20,841	$21,279	+$438

The estimate for travel and transportation of persons in FY 1967 represents an increase of $525 thousand for Electronics Research Center, Kennedy Space Center, and Manned Spacecraft Center offset by a reduction of $87 thousand in other centers. The increase of $45 thousand for the Electronics Research Center is related to the growth of the Center. The increases of $93 thousand at the Kennedy Space Center and $387 thousand at the Manned Spacecraft Center are directly related to the increased flight activity which includes the last third of the Gemini flights, the first manned Apollo spacecraft launching on the Saturn IB and the first Saturn V launch during this time period.

	1965	1966	1967	Change in FY 1967
Transportation of Things	$4,543	$4,689	$5,048	+$359

The majority of the FY 1967 increase of $359 thousand in this object class results from the expansion of personnel and facilities at the Merritt Island Launch Area and Launch Complex 39 at Cape Kennedy as the Apollo program moves into the flight stage. Other increases are related to additional facilities coming into use at the Goddard Space Flight Center and the phased build up at the Electronics Research Center.

	1965	1966	1967	Change in FY 1967
Rent, Communications and Utilities	$46,424	$49,795	$56,417	+$6,622

The major increases in FY 1967 requirements over FY 1966 include: increased space rental at the Electronics Research Center, increased rental of ADP equipment, increased communications, and increased utilities. In FY 1967 the Electronics Research Center will add 450 positions as part of the approved center build up plan. It is estimated that an additional 100,000 square feet of space will be rented at a cost of $544 thousand to accommodate these personnel.

The estimate for ADP rental cost in FY 1967 is $2.7 million greater than in FY 1966. The majority of the increase will be at the Goddard Space Flight Center where an overlapping of equipment will be required during the phase-out of second generation equipment and the installation of the super-speed complex. The Electronics Research Center will begin installation of ADP equipment. In FY 1967 the initial ADP system will be installed, and the cost will increase from $27 thousand in FY 1966 for EAM equipment to $543 thousand for ADP and EAM equipment in FY 1967. The Langley and Ames Research Centers require an increase in equipment rentals to supplement NASA owned systems as a prerequisite to solving the more complex problems presented by planned research programs. Other Centers' requirements reflect minor reductions as the full effects of FY 1965 and FY 1966 equipment purchases are realized.

There is a net increase in the manned space flight centers in FY 1967 of $.3 million. At the Marshall Space Flight Center third generation equipment will be installed to replace the present second generation equipment. In addition, the new equipment will change the method of operation at this Center by replacing several small systems separately located in each of the laboratories with a large central processor with remote inquiry stations. Because of this change in method of operation, NASA will initially lease this equipment. This will cause overlapping of lease costs in FY 1967 in the amount of $.7 million. Offsetting the increase at the Marshall Space Flight Center, the lease cost at the Manned Spacecraft Center will be $.4 million lower in FY 1967 which represents the first full year effect of the lease savings resulting from the FY 1965 equipment purchase program.

The increase in manned flight activity, and the effect of increased Federal Telecommunications Systems rates and lines for the full year, will result in about about $.6 million more communication costs.

In FY 1967 the number of facilities becoming operational will result in an increase of $2.7 million in utility costs. About one-half of this will be for the activation of the Merritt Island Launch Area and Launch Complex 39 at the Kennedy Space Center, NASA. The increase in costs at other centers is a result of the completion of facilities authorized in prior years.

In summary, the increase of $6.6 million consists of $.5 million for rental of space, $2.7 million for ADP leases, $.6 million for communications, $2.7 million for utilities, and $.1 million for all other items in this category.

	1965	1966	1967	Change in FY 1967
Printing and Reproduction	$4,174	$4,615	$4,916	+$301

The majority of the increase in this object class is for Headquarters and for the Kennedy Space Center, NASA. The Headquarters increase of $150 thousand results from the growing volume of scientific and technical information being generated by the NASA research and development programs and the statutory requirement to make this information available to the scientific community. Another increase of $122 thousand is at the Kennedy Space Center, NASA, to provide the necessary support for the greater number of personnel manning the completed Merritt Island Launch Area and Launch Complex 39 facilities. There are minor increases also at the Electronics Research Center and the Goddard Space Flight Center related to increased activity at these centers.

	1965	1966	1967	Change in FY 1967
Other Services	$85,045	$107,584	$127,538	+$19,954

The increase in other services represents requirements resulting from program development and the completion of new construction begun in prior years. The largest increases are strictly related to the support of the planned flight schedules. Flight schedules are being met and the indications are that this will continue. As a result of the greater complexity of the missions, considerably more support is required. This is particularly true at the Kennedy Space Center, where the logistic support for all launch vehicle stage contractors will be provided through this account, and where the huge Merritt Island Launch Area and Launch Complex 39 will become fully operational. The completion of additional facilities at nearly all locations will require additional custodial and maintenance services, and the large scale procurement of ADP equipment in prior years will require increases in maintenance costs and programming effort.

The largest increase for other services is to support the expanded activity at the Kennedy Space Center. FY 1967 requirements reflect the full year effect of the FY 1966 base support services build up. During 1966 the majority of the Merritt Island Launch Area and Launch Complex 30 facilities will be completed and will become operational. Accordingly, as each facility is completed, it will be manned by NASA and contractor personnel. To provide base operational support, $5.7 million more will be required in FY 1967 than in FY 1966. In addition, administrative support for the expanded effort will require an increase of $2.8 million, for a total increase of

$8.5 million for contractual services outside the government.

As the NASA manned and unmanned flight activity increases at Cape Kennedy, NASA is assuming the funding responsibility for more facilities from the Air Force. Also, as the overall NASA activity increases, the amount of services provided by the Air Force on a reimbursable basis increases accordingly. This will result in an increase of $1.3 million in FY 1967.

The combination of the rise in Air Force reimbursements coupled with the increase in contractual services outside the government results in a total increase for other services at Kennedy Space Center, NASA of $9.8 million.

Another significant increase in FY 1967 over FY 1966 will be for the technical documentation and scientific and technical information programs. This expanded activity is occasioned by the advancement in the Apollo program from design and development effort to testing, qualification and flight. In addition, as other NASA flight and research programs achieve additional milestones, the necessity for documentation, classification and dissemination of the results obtained increases. It is estimated that the cost of this effort will require an additional $2.4 million in FY 1967.

The requirements for ADP programming, operations support, and maintenance are estimated to increase in FY 1967 by $2.7 million. The cost of maintaining NASA owned ADP equipment will be $.5 million greater than in FY 1966. This increase reflects the effects of the FY 1965 and FY 1966 purchase programs. The estimates for ADP programming and operations support are $2.2 million higher in FY 1967. The largest increases are in support of the Electronics Research Center and the increased complexity of the work conducted by the Goddard Space Flight Center Institute of Space Studies.

In FY 1967 the estimated cost of maintenance and custodial services will be $3.7 million higher than in FY 1966. The increased physical plant for which custodial services are required, coupled with the full year effect of the Service Contract Act of 1965 on NASA service contracts, will raise the cost in this area by $1.5 million. As the NASA capital investment grows larger and facilities become older, the cost of maintenance and repair increases accordingly. In FY 1967 it is estimated that the cost of maintaining the NASA plant, including equipment, will be $2.2 million greater than in FY 1966.

The balance of the increase over FY 1966 is reflected in minor changes in many categories of service. The largest items in this category are the increase in medical services at the Manned Spacecraft Center caused by greater astronaut activity, and an intensive study by Headquarters of the incentive contracting policy and procedure.

	1965	1966	1967	Change in FY 1967
Supplies and Materials	$24,553	$21,156	$26,122	+$4,966

In FY 1967 the requirement for supplies and materials to support the larger number of facilities which will become operational in FY 1966 and FY 1967, and the greater number of personnel, both civil service and contractor, will increase by $4.6 million as the Apollo program moves into the flight mission stage. The balance of the increase, $.4 million, is required to support the build up at the Electronics Research Center and for adjustments at other centers.

	1965	1966	1967	Change in FY 1967
Equipment	$86,370	$16,998	$14,696	-$2,302

The total cost of equipment required in FY 1967 is $2.3 million less than that needed in FY 1966. The reduction is directly attributable to the ADP equipment purchase program which has been reduced from $7.9 million in FY 1966 to $2.8 million in FY 1967. This reduction is partially offset by an increase of $2.1 million to provide equipment to support the build up required for manned flight support operations at the Kennedy Space Center, the Manned Spacecraft Center, and the Goddard Space Flight Center. The other $.7 million increase is required to offset the deferment of equipment purchases in recent years and to allow for modernization of laboratory equipment.

	1965	1966	1967	Change in FY 1967
Lands and Structures	$6,539	$5,300	$5,408	+$108

In FY 1967 the amount requested for lands and structures reflects a net increase in requirements of $108 thousand. The additional resources required to support the expansion of Apollo flight activity are estimated to be slightly in excess of $313 thousand, offset by a reduction at Ames Research Center of $205 thousand.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

SUMMARY OF RESEARCH AND DEVELOPMENT BUDGET PLAN BY BUDGET ACTIVITY AND RELATED FINANCING

	Fiscal Year 1965	Fiscal Year 1966	Fiscal Year 1967
Budget Activity:			
1. Manned Space Flight:			
(a) Gemini.....	$308,400,000	$226,611,000	$40,600,000
(b) Apollo.....	2,614,619,000	2,967,385,000	2,974,200,000
(c) Advanced mission studies.....	26,000,000	10,000,000	8,000,000
2. Scientific Investigations in Space:			
(a) Physics and astronomy.....	176,029,000	189,132,000	167,300,000
(b) Lunar and planetary exploration....	267,442,000	326,523,000	260,800,000
(c) Bioscience.....	31,001,000	46,200,000	39,900,000
(d) Launch vehicle development....	138,191,000	90,300,000	61,700,000
3. Space Applications.....	70,467,000	83,682,000	88,100,000
4. Space Technology.....	299,320,000	248,500,000	247,900,000
5. Aircraft Technology....	35,240,000	41,496,000	33,000,000
6. Supporting Activities:			
(a) Tracking and data acquisition....	253,236,000	231,065,000	279,300,000
(b) Sustaining university program.....	46,000,000	46,000,000	41,000,000
(c) Technology utilization....	4,750,000	4,750,000	4,800,000
Total Budget Plan....	$4,270,695,000	$4,511,644,000	$4,246,600,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

SUMMARY OF RESEARCH AND DEVELOPMENT BUDGET PLAN BY BUDGET ACTIVITY AND RELATED FINANCING

	Fiscal Year 1965	Fiscal Year 1966	Fiscal Year 1967
Financing:			
Appropriation	$4,363,594,000	$4,531,000,000	$4,246,600,000
Transferred to-			
"Construction of facilities" (78 Stat. 658)	-3,545,000	---	---
"Administrative operations" (79 Stat. 534)	---	-27,896,000	---
Appropriation (adjusted)	4,360,049,000	4,503,104,000	4,246,600,000
Transferred to "Construction of facilities" in FY 1966	-354,000	---	---
Prior year funding applied - available from adjustments to FY 1962 and prior budget plans	2,263,000	---	---
Reprogramming to (-) or from prior year budget plans	-76,690,000	8,540,000	---
Comparative transfer to "Administrative Operations"	-14,573,000	---	---
Total financing of the budget plan	$4,270,695,000	$4,511,644,000	$4,246,600,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

SUMMARY OF RESEARCH AND DEVELOPMENT BUDGET PLAN BY PROGRAM BY COGNIZANT OFFICE

BUDGET ACTIVITY	OFFICE/PROGRAM	Fiscal Year 1965	Fiscal Year 1966	Fiscal Year 1967
	MANNED SPACE FLIGHT.....	$2,949,019,000	$3,203,996,000	$3,022,800,000
1a	Gemini.....	308,400,000	226,611,000	40,600,000
1b	Apollo.....	2,614,619,000	2,967,385,000	2,974,200,000
1c	Advanced missions.....	26,000,000	10,000,000	8,000,000
	SPACE SCIENCE AND APPLICATIONS.....	$732,362,000	$783,237,000	$661,400,000
2a	Physics and astronomy...	139,082,000	143,500,000	131,400,000
2b	Lunar and planetary exploration.....	206,027,000	251,337,000	197,900,000
6b	Sustaining university program.....	46,000,000	46,000,000	41,000,000
2d	Launch vehicle development.....	96,500,000	55,300,000	33,700,000
*	Launch vehicle procurement.....	154,487,000	178,700,000	152,000,000
2c	Bioscience.....	28,501,000	36,700,000	35,400,000
3	Meteorological satellites.....	30,991,000	38,900,000	43,600,000
3	Communication and applications technology satellites.	30,774,000	32,800,000	26,400,000
	ADVANCED RESEARCH AND TECHNOLOGY.....	$331,328,000	$288,596,000	$278,300,000
4	Basic research.....	21,231,000	22,000,000	23,000,000
4	Space vehicle systems...	44,193,000	35,000,000	36,000,000
4	Electronics systems.....	25,622,000	32,300,000	36,800,000
4	Human factor systems....	13,320,000	14,900,000	17,000,000
4	Space power and electric propulsion systems....	58,220,000	45,200,000	42,500,000
4	Nuclear rockets.....	57,000,000	58,000,000	53,000,000
4	Chemical propulsion.....	76,502,000	39,700,000	37,000,000
5	Aeronautics.....	35,240,000	41,496,000	33,000,000
6a	TRACKING AND DATA ACQUISITION.....	$253,236,000	$231,065,000	$279,300,000

BUDGET ACTIVITY	OFFICE/PROGRAM	Fiscal Year 1965	Fiscal Year 1966	Fiscal Year 1967
6c	TECHNOLOGY UTILIZATION...	$4,750,000	$4,750,000	$4,800,000
	TOTAL BUDGET PLAN.....	$4,270,695,000	$4,511,644,000	$4,246,600,000

*Funds for the procurement of launch vehicles are statistically distributed to unmanned flight programs (e.g. Physics and Astronomy, Space Vehicle Systems).

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

DISTRIBUTION OF RESEARCH AND DEVELOPMENT BUDGET PLAN BY INSTALLATION AND FISCAL YEAR

(In thousands of dollars)

PROGRAM OFFICE	TOTAL	J. F. KENNEDY SPACE CENTER, NASA	MANNED SPACECRAFT CENTER	MARSHALL SPACE FLIGHT CENTER	GODDARD SPACE FLIGHT CENTER	PACIFIC LAUNCH OPERATIONS OFFICE	WALLOPS STATION	AMES RESEARCH CENTER	ELECTRONICS RESEARCH CENTER	FLIGHT RESEARCH CENTER	LANGLEY RESEARCH CENTER	LEWIS RESEARCH CENTER	SPACE NUCLEAR PROPULSION OFFICE	HEADQUARTERS	WESTERN OPERATIONS OFFICE
Office of Manned Space Flight															
1965	2,949,019	56,110	1,418,648	1,435,989	389	-	-	39	-	-	2,400	1,160	-	33,367	917
1966	3,203,996	121,109	1,479,182	1,574,635	425	-	-	230	-	-	700	-	-	25,215	2,500
1967	3,022,800	164,505	1,363,400	1,466,295	500	-	-	250	-	-	-	-	-	25,350	2,500
Office of Space Science and Applications															
1965	732,362	2,674	2,608	1,462	186,868	99	1,150	34,683	275	10	67,388	199,083	-	107,230	128,832
1966	783,237	3,327	14,400	10,607	195,404	-	2,830	37,948	650	5	68,217	179,843	-	106,597	163,409
1967	661,400	4,019	15,200	495	189,193	-	3,640	31,463	750	15	35,960	147,371	-	93,146	140,148
Office of Advanced Research and Technology															
1965	331,328	-	1,512	28,911	8,517	-	-	19,391	2,333	7,638	34,953	122,084	45,760	31,648	28,581
1966	288,596	250	2,355	17,264	9,678	-	-	18,775	6,554	14,919	40,749	69,431	50,218	37,765	20,638
1967	278,300	250	3,370	17,496	9,701	-	-	21,455	12,400	7,925	41,127	61,603	48,500	31,833	22,640
Office of Tracking and Data Acquisition															
1965	253,236	-	-	2,000	179,252	-	5,100	-	-	1,900	2,200	-	-	7,015	55,769
1966	231,065	-	-	1,500	155,950	-	5,835	-	-	1,880	2,000	-	-	10,400	53,500
1967	279,300	-	-	1,500	199,600	-	6,400	-	-	2,100	2,100	-	-	12,000	55,600
Office of Technology Utilization and Policy Planning															
1965	4,750	-	-	-	-	-	-	-	-	-	-	-	-	4,750	-
1966	4,750	-	-	-	-	-	-	-	-	-	-	-	-	4,750	-
1967	4,800	-	-	-	-	-	-	-	-	-	-	-	-	4,800	-
Total Budget Plan															
1965	4,270,695	58,784	1,422,768	1,468,362	375,026	99	6,250	54,113	2,608	9,548	106,941	322,327	45,760	184,010	214,099
1966	4,511,644	124,686	1,495,937	1,604,006	361,457	-	8,665	56,953	7,204	16,804	111,666	249,274	50,218	184,727	240,047
1967	4,246,600	168,774	1,381,970	1,485,786	398,994	-	10,040	53,168	13,150	10,040	79,187	208,974	48,500	167,129	220,888

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

DISTRIBUTION OF RESEARCH AND DEVELOPMENT BUDGET PLAN BY INSTALLATION AND FISCAL YEAR

(In thousands of dollars)

PROGRAM		TOTAL	J. F. KENNEDY SPACE CENTER, NASA	MANNED SPACECRAFT CENTER	MARSHALL SPACE FLIGHT CENTER	GODDARD SPACE FLIGHT CENTER	PACIFIC LAUNCH OPERATIONS OFFICE	WALLOPS STATION	AMES RESEARCH CENTER	ELECTRONICS RESEARCH CENTER	FLIGHT RESEARCH CENTER	LANGLEY RESEARCH CENTER	LEWIS RESEARCH CENTER	SPACE NUCLEAR PROPULSION OFFICE	HEADQUARTERS	WESTERN OPERATIONS OFFICE[1/]
OFFICE OF MANNED SPACE FLIGHT, TOTAL	1965	2,949,019	56,110	1,418,648	1,435,989	389	-	-	39	-	-	2,400	1,160	-	33,367	917
	1966	3,203,996	121,109	1,479,182	1,574,635	425	-	-	230	-	-	700	-	-	25,215	2,500
	1967	3,022,800	164,505	1,363,400	1,466,295	500	-	-	250	-	-		-	-	25,350	2,500
Gemini	1965	308,400	-	308,050	-	-	-	-	-	-	-	-	-	-	350	-
	1966	226,611	-	226,211	-	-	-	-	-	-	-	-	-	-	400	-
	1967	40,600	-	40,300	-	-	-	-	-	-	-	-	-	-	300	-
Apollo	1965	2,614,619	55,610	1,100,973	1,430,516	389	-	-	39	-	-	1,200	1,160	-	24,087	645
	1966	2,967,385	120,509	1,249,371	1,569,135	425	-	-	230	-	-	700	-	-	24,515	2,500
	1967	2,974,200	163,905	1,320,500	1,461,795	500	-	-	250	-	-	-	-	-	24,750	2,500
Advanced mission studies	1965	26,000	500	9,625	5,473	-	-	-	-	-	-	1,200	-	-	8,930	272
	1966	10,000	600	3,600	5,500	-	-	-	-	-	-	-	-	-	300	-
	1967	8,000	600	2,600	4,500	-	-	-	-	-	-	-	-	-	300	-
OFFICE OF SPACE SCIENCE AND APPLICATIONS, TOTAL	1965	732,362	2,674	2,608	1,462	186,868	99	1,150	34,683	275	10	67,388	199,083	-	107,230	128,832
	1966	783,237	3,327	14,400	10,607	195,404	-	2,830	37,948	650	5	68,217	179,843	-	106,597	163,409
	1967	661,400	4,019	15,200	495	189,193	-	3,640	31,463	750	15	35,960	147,371	-	93,146	140,148
Physics and astronomy	1965	139,082	-	-	755	110,244	-	1,090	1,557	-	10	2,226	-	-	22,866	334
	1966	143,500	-	-	62	108,498	-	2,550	2,586	-	5	2,272	-	-	27,075	452
	1967	131,400	-	-	25	100,961	-	3,400	2,563	-	15	1,100	-	-	22,836	500
Lunar and planetary exploration	1965	206,027	-	2,608	435	1,267	-	-	15,734	-	-	50,050	97	-	9,256	126,580
	1966	251,337	-	14,400	375	1,164	-	-	12,763	-	-	53,115	-	-	12,913	156,607
	1967	197,900	-	15,200	300	1,200	-	-	7,000	-	-	23,200	-	-	14,300	136,700
Sustaining university program	1965	46,000	-	-	-	-	-	-	-	-	-	-	11	-	45,986	3
	1966	46,000	-	-	-	-	-	-	-	-	-	-	-	-	46,000	-
	1967	41,000	-	-	-	-	-	-	-	-	-	-	-	-	41,000	-
Launch vehicle development	1965	96,500	1,321	-	152	1,557	-	-	-	100	-	735	91,302	-	1,333	-
	1966	55,300	820	-	10,000	250	-	-	-	200	-	570	42,820	-	640	-
	1967	33,700	700	-	-	-	-	-	-	250	-	600	31,550	-	600	-
Launch vehicle procurement	1965	154,487	1,353	-	-	19,496	99	-	-	-	-	13,737	107,673	-	12,129	-
	1966	178,700	2,507	-	-	18,580	-	-	-	-	-	11,600	137,023	-	5,625	3,365
	1967	152,000	3,319	-	-	22,205	-	-	-	-	-	10,400	115,821	-	-	255
Bioscience	1965	28,501	-	-	-	385	-	60	17,392	-	-	-	-	-	9,145	1,519
	1966	36,700	-	-	-	420	-	100	22,599	-	-	30	-	-	11,214	2,337
	1967	35,400	-	-	-	420	-	100	21,900	-	-	30	-	-	10,450	2,500
Meteorological satellites	1965	30,991	-	-	120	29,505	-	-	-	175	-	425	-	-	766	-
	1966	38,900	-	-	170	35,400	-	180	-	450	-	630	-	-	2,070	-
	1967	43,600	-	-	170	39,300	-	140	-	500	-	630	-	-	2,860	-
Communication and applications technology satellites	1965	30,774	-	-	-	24,414	-	-	-	-	-	215	-	-	5,749	396
	1966	32,800	-	-	-	31,092	-	-	-	-	-	-	-	-	1,060	648
	1967	26,400	-	-	-	25,107	-	-	-	-	-	-	-	-	1,100	193

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

DISTRIBUTION OF RESEARCH AND DEVELOPMENT BUDGET PLAN BY INSTALLATION AND FISCAL YEAR

(In thousands of dollars)

PROGRAM		TOTAL	J. K. KENNEDY SPACE CENTER, NASA	MANNED SPACECRAFT CENTER	MARSHALL SPACE FLIGHT CENTER	GODDARD SPACE FLIGHT CENTER	PACIFIC LAUNCH OPERATIONS OFFICE	WALLOPS STATION	AMES RESEARCH CENTER	ELECTRONICS RESEARCH CENTER	FLIGHT RESEARCH CENTER	LANGLEY RESEARCH CENTER	LEWIS RESEARCH CENTER	SPACE NUCLEAR PROPULSION OFFICE	HEADQUARTERS	WESTERN OPERATIONS OFFICE 1/
OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY, TOTAL	1965	331,328	-	1,512	28,911	8,517	-	-	19,391	2,333	7,638	34,953	122,084	45,760	31,648	28,581
	1966	288,596	250	2,355	17,264	9,678	-	-	18,775	6,554	14,919	40,749	69,431	50,218	37,765	20,638
	1967	278,300	250	2,370	17,496	9,701	-	-	21,455	12,400	7,925	41,127	61,603	48,500	31,833	22,640
Basic research	1965	21,231	-	-	916	257	-	-	1,966	95	3	1,901	2,234	-	7,503	6,356
	1966	22,000	-	-	815	117	-	-	1,910	595	30	2,119	2,731	-	8,627	5,056
	1967	23,000	-	-	850	120	-	-	2,100	1,000	30	2,200	2,800	-	8,500	5,400
Space vehicle systems	1965	44,193	-	629	16,444	1,231	-	-	3,354	-	1,825	10,594	2,408	-	3,474	4,234
	1966	35,000	-	435	4,201	1,751	-	-	3,076	250	1,010	11,466	3,087	-	6,006	3,718
	1967	36,000	-	670	3,096	2,081	-	-	3,475	250	1,010	14,282	3,223	-	3,713	4,200
Electronics systems	1965	25,622	-	465	3,685	2,967	-	-	3,480	2,178	1,038	6,660	400	-	2,022	2,727
	1966	32,300	-	525	4,003	2,975	-	-	3,718	5,110	698	7,260	539	-	3,906	3,566
	1967	36,800	-	450	4,200	2,960	-	-	4,100	10,000	660	7,420	540	-	3,180	3,290
Human factor systems	1965	13,320	-	365	355	-	-	-	4,233	60	1,750	4,053	232	-	2,172	100
	1966	14,900	-	795	310	25	-	-	5,224	359	1,500	4,246	125	-	2,216	100
	1967	17,000	-	1,100	300	-	-	-	5,830	700	1,250	5,000	-	-	2,820	-
Space power and electric propulsion systems	1965	58,220	-	53	2,415	3,512	-	-	191	-	-	1,324	43,517	-	1,351	5,857
	1966	45,200	-	100	2,010	4,260	-	-	110	50	-	846	28,768	-	4,565	4,491
	1967	42,500	-	650	1,650	3,990	-	-	50	300	-	700	26,065	-	3,045	6,050
Nuclear rockets	1965	57,000	-	-	1,375	-	-	-	-	-	-	-	9,846	45,760	13	6
	1966	58,000	-	-	1,125	-	-	-	-	-	-	-	6,599	50,218	58	-
	1967	53,000	-	-	900	-	-	-	-	-	-	-	3,550	48,500	50	-
Chemical propulsion	1965	76,502	-	-	3,721	550	-	-	-	-	-	1,369	49,588	-	11,973	9,301
	1966	39,700	250	500	4,800	550	-	-	540	-	-	2,877	15,205	-	11,271	3,707
	1967	37,000	250	500	6,500	550	-	-	500	-	-	2,900	12,800	-	9,300	3,700
Aeronautics	1965	35,240	-	-	-	-	-	-	6,167	-	3,022	9,052	13,859	-	3,140	-
	1966	41,496	-	-	-	-	-	-	4,197	190	11,681	11,935	12,377	-	1,116	-
	1967	33,000	-	-	-	-	-	-	5,400	150	4,975	8,625	12,625	-	1,225	-
OFFICE OF TRACKING AND DATA ACQUISITION	1965	253,236	-	-	2,000	179,252	-	5,100	-	-	1,900	2,200	-	-	7,015	55,769
	1966	231,065	-	-	1,500	155,950	-	5,835	-	-	1,880	2,000	-	-	10,400	53,500
	1967	279,300	-	-	1,500	199,600	-	6,400	-	-	2,100	2,100	-	-	12,000	55,600
Tracking and data acquisition	1965	253,236	-	-	2,000	179,252	-	5,100	-	-	1,900	2,200	-	-	7,015	55,769
	1966	231,065	-	-	1,500	155,950	-	5,835	-	-	1,880	2,000	-	-	10,400	53,500
	1967	279,300	-	-	1,500	199,600	-	6,400	-	-	2,100	2,100	-	-	12,000	55,600
OFFICE OF TECHNOLOGY UTILIZATION AND POLICY PLANNING	1965	4,750	-	-	-	-	-	-	-	-	-	-	-	-	4,750	-
	1966	4,750	-	-	-	-	-	-	-	-	-	-	-	-	4,750	-
	1967	4,800	-	-	-	-	-	-	-	-	-	-	-	-	4,800	-
Technology utilization	1965	4,750	-	-	-	-	-	-	-	-	-	-	-	-	4,750	-
	1966	4,750	-	-	-	-	-	-	-	-	-	-	-	-	4,750	-
	1967	4,800	-	-	-	-	-	-	-	-	-	-	-	-	4,800	-
TOTAL BUDGET PLAN	1965	4,270,695	58,784	1,422,768	1,468,362	375,026	99	6,250	54,113	2,608	9,548	106,941	322,327	45,760	184,010	214,099
	1966	4,511,644	124,686	1,495,937	1,604,006	361,457	-	8,665	56,953	7,204	16,804	111,666	249,274	50,218	184,727	240,047
	1967	4,246,600	168,774	1,381,970	1,485,786	398,994	-	10,040	53,168	13,150	10,040	79,187	208,974	48,500	167,129	220,888

1/Amount for Western Operations Office includes funds for the Jet Propulsion Laboratory as shown in the Research and Development program justification (Vol. II)

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

SUMMARY OF CONSTRUCTION OF FACILITIES BUDGET PLAN AS RECONCILED TO FINANCING SCHEDULE

Budget Activity	Fiscal Year 1965	Fiscal Year 1966	Fiscal Year 1967
1. Manned Space Flight.....	$199,770,096	$21,401,350	$54,378,000
2. Scientific Investigations in Space.....	8,342,600	7,084,000	6,322,000
3. Space Applications.....	---	---	---
4. Space Technology.....	21,291,000	13,435,000	11,089,000
5. Aircraft Technology.....	3,729,000	682,000	21,011,000
6. Supporting Activities.....	27,974,000	16,984,650	8,700,000
Total Budget Plan.....	$261,106,696	$59,587,000	$101,500,000
Financing:			
Appropriation.....	$262,880,500	$60,000,000	$101,500,000
Transferred from (78 Stat. 658) - "Research and development".....	3,545,193	---	---
Appropriation (adjusted).....	266,425,693	60,000,000	101,500,000
Transferred from (78 Stat. 658) - "Research and Development".....	353,800	---	---
Reprogramming to or from (-) prior year budget plans.....	-5,672,797	-413,000	---
Total financing of budget plan.....	$261,106,696	$59,587,000	$101,500,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

SUMMARY OF CONSTRUCTION OF FACILITIES BUDGET PLAN
BY BUDGET ACTIVITY SHOWING LOCATION TOTALS INCLUDED IN EACH ACTIVITY

	Fiscal Year 1965	Fiscal Year 1966	Fiscal Year 1967
1. MANNED SPACE FLIGHT.....	$199,770,096	$21,401,350	$54,378,000
John F. Kennedy Space Center, NASA.....	85,044,000	6,895,000	36,497,000
Manned Spacecraft Center	23,907,500	4,180,000	13,800,000
Marshall Space Flight Center.....	12,454,096	2,309,450	581,000
Michoud Assembly Facility	6,449,500	284,750	700,000
Mississippi Test Facility.....	58,891,000	1,910,450	1,700,000
Various Locations.....	13,024,000	5,821,700	1,100,000
2. SCIENTIFIC INVESTIGATIONS IN SPACE.....	$8,342,600	$7,084,000	$6,322,000
Ames Research Center....	---	2,749,000	---
Goddard Space Flight Center.....	605,000	2,400,000	---
Jet Propulsion Laboratory	3,582,000	---	350,000
John F. Kennedy Space Center, NASA.....	2,180,800	887,000	1,379,000
Various Locations.....	275,800	---	4,388,000
Wallops Station.....	1,699,000	1,048,000	205,000
3. SPACE APPLICATIONS.....	$ ---	$ ---	$ ---
4. SPACE TECHNOLOGY.....	$21,291,000	$13,435,000	$11,089,000
Ames Research Center....	3,038,000	---	---
Electronics Research Center.....	10,000,000	5,000,000	10,000,000
Langley Research Center..	2,540,500	7,568,000	1,089,000
Lewis Research Center...	770,000	867,000	---
Various Locations.....	4,942,500	---	---

	Fiscal Year 1965	Fiscal Year 1966	Fiscal Year 1967
5. AIRCRAFT TECHNOLOGY.....	$3,729,000	$682,000	$21,011,000
Ames Research Center.....	2,630,000	---	---
Langley Research Center....	1,099,000	682,000	5,011,000
Lewis Research Center.....	---	---	16,000,000
6. SUPPORTING ACTIVITIES.....	$27,974,000	$16,984,650	$8,700,000
Goddard Space Flight Center	1,709,000	---	710,000
John F. Kennedy Space Center, NASA.....	1,393,000	---	---
Various Locations.....	14,872,000	14,361,000	990,000
Facility Planning and Design.....	10,000,000	2,623,650	7,000,000
TOTAL PLAN.....	$261,106,696	$59,587,000	$101,500,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

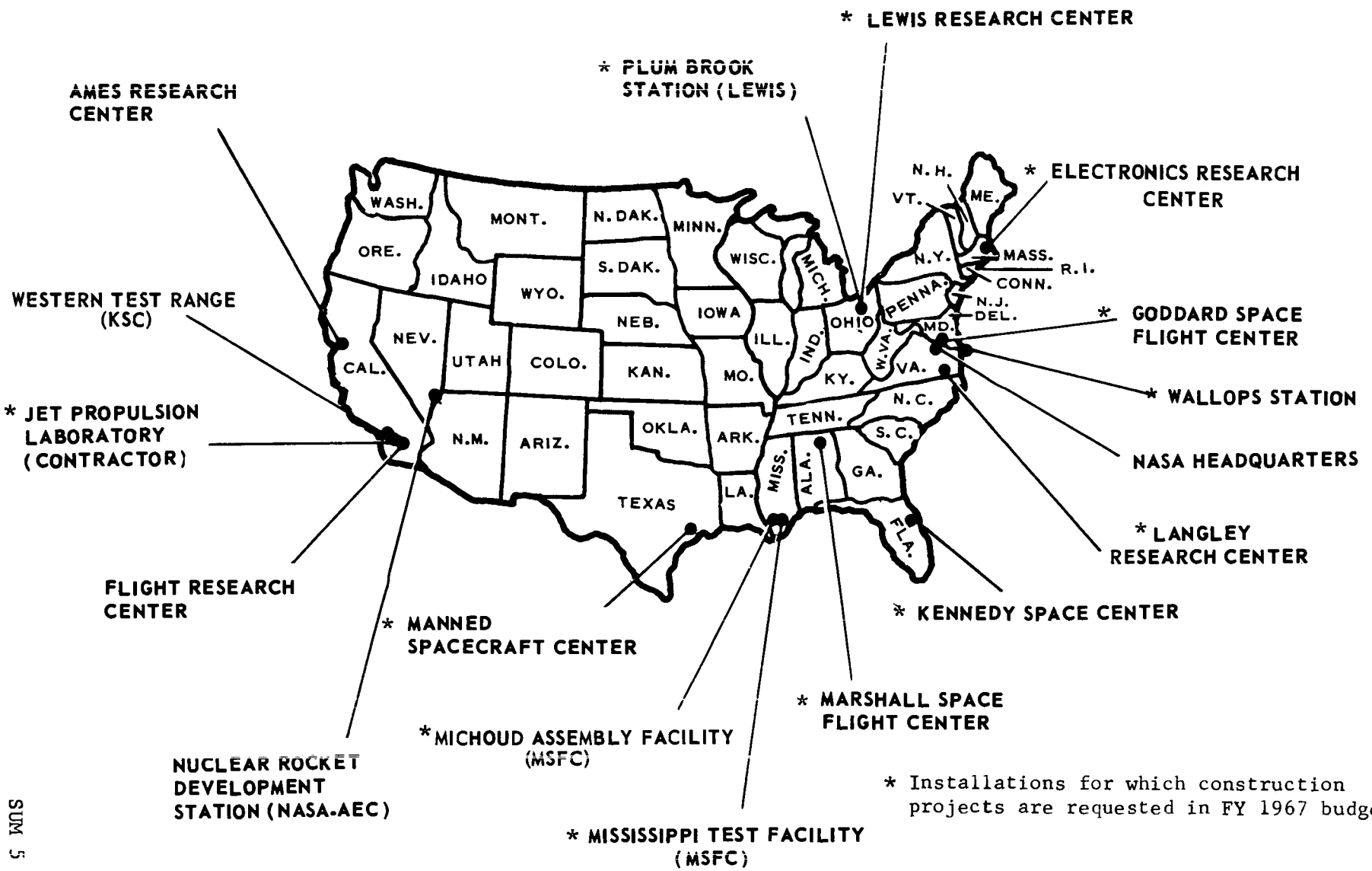
FISCAL YEAR 1967 ESTIMATES

SUMMARY OF CONSTRUCTION OF FACILITIES BUDGET PLAN BY LOCATION

Location	Fiscal Year 1965	Fiscal Year 1966	Fiscal Year 1967
Ames Research Center.....	$5,668,000	$2,749,000	$ ---
Electronics Research Center.....	10,000,000	5,000,000	10,000,000
Goddard Space Flight Center.....	2,314,000	2,400,000	710,000
Jet Propulsion Laboratory.....	3,582,000	---	350,000
John F. Kennedy Space Center, NASA.....	88,617,800	7,782,000	37,876,000
Langley Research Center.....	3,639,500	8,250,000	6,100,000
Lewis Research Center.....	770,000	867,000	16,000,000
Manned Spacecraft Center.....	23,907,500	4,180,000	13,800,000
Marshall Space Flight Center....	12,454,096	2,309,450	581,000
Michoud Assembly Facility.....	6,449,500	284,750	700,000
Mississippi Test Facility.....	58,891,000	1,910,450	1,700,000
Various Locations.....	33,114,300	20,182,700	6,478,000
Wallops Station.....	1,699,000	1,048,000	205,000
Facility Planning and Design....	10,000,000	2,623,650	7,000,000
Total Plan.....	$261,106,696	$59,587,000	$101,500,000

The geographic location of NASA installations is shown on the following page. Installations for which construction projects are requested in the fiscal year 1967 budget are identified.

NASA INSTALLATIONS



* Installations for which construction projects are requested in FY 1967 budget.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

ADMINISTRATIVE OPERATIONS

SUMMARY OF OBLIGATIONS BY INSTALLATION

	Fiscal Year 1965	Fiscal Year 1966	Fiscal Year 1967
MANNED SPACE FLIGHT			
John F. Kennedy Space Center, NASA	$52,416,000	$79,723,000	$98,108,000
Manned Spacecraft Center	91,036,000	87,550,000	98,212,000
Marshall Space Flight Center	137,787,000	128,260,000	131,934,000
SPACE SCIENCE AND APPLICATIONS			
Goddard Space Flight Center	92,570,000	64,040,000	71,687,000
Pacific Launch Operations Office	844,000	---	---
Wallops Station	10,931,000	9,446,000	10,166,000
ADVANCED RESEARCH AND TECHNOLOGY			
Ames Research Center	31,807,000	32,923,000	33,475,000
Electronics Research Center	3,201,000	6,233,000	15,143,000
Flight Research Center	10,523,000	9,335,000	9,641,000
Langley Research Center	58,998,000	63,006,000	62,587,000
Lewis Research Center	68,546,000	67,207,000	66,284,000
Space Nuclear Propulsion Office	1,669,000	1,824,000	1,847,000
SUPPORTING ACTIVITIES			
NASA Headquarters	51,516,000	56,286,000	58,667,000
Western Operations Office	22,693,000	5,987,000	6,149,000
TOTAL	$634,537,000	$611,820,000	$663,900,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

ADMINISTRATIVE OPERATIONS

NUMBER OF POSITIONS BY INSTALLATION

	Fiscal Year 1965	Fiscal Year 1966	Fiscal Year 1967
MANNED SPACE FLIGHT			
John F. Kennedy Space Center, NASA	2,491	2,666	2,796
Manned Spacecraft Center	4,431	4,928	4,866
Marshall Space Flight Center	7,754	7,486	7,390
SPACE SCIENCE AND APPLICATIONS			
Goddard Space Flight Center	3,782	3,625	3,807
Pacific Launch Operations Office	22	-0-	-0-
Wallops Station	555	530	530
ADVANCED RESEARCH AND TECHNOLOGY			
Ames Research Center	2,270	2,240	2,211
Electronics Research Center	250	550	1,000
Flight Research Center	669	618	610
Langley Research Center	4,374	4,304	4,249
Lewis Research Center	4,917	4,842	4,779
Space Nuclear Propulsion Office	117	117	115
SUPPORTING OPERATIONS			
NASA Headquarters	2,263	2,227	2,200
Western Operations Office	405	391	386
TOTAL	34,300	34,524	34,939

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

ADMINISTRATIVE OPERATIONS

DISTRIBUTION OF BUDGET PLAN BY OBJECT CLASSIFICATION BY INSTALLATION

(In dollars)

Object Classification	Total	J.F. Kennedy Space Center, NASA	Manned Spacecraft Center	Marshall Space Flight Center	Goddard Space Flight Center	Pacific Launch Operations Office	Wallops Station	Ames Research Center	Electronics Research Center	Flight Research Center	Langley Research Center	Lewis Research Center	Space Nuclear Propulsion Office	Western Operations Office	Headquarters
FISCAL YEAR 1965															
Personnel compensation	332,722,000	20,107,000	46,076,000	79,345,000	37,512,000	213,000	4,437,000	21,027,000	1,362,000	6,105,000	39,355,000	46,439,000	1,318,000	4,115,000	25,311,000
Personnel benefits	23,713,000	1,355,000	3,154,000	5,528,000	2,671,000	15,000	305,000	1,549,000	100,000	441,000	2,880,000	3,373,000	94,000	289,000	1,959,000
Travel & transp of pers	20,427,000	2,441,000	4,630,000	3,722,000	2,553,000	38,000	166,000	643,000	118,000	221,000	1,430,000	1,469,000	199,000	247,000	2,550,000
Transportation of things	4,543,000	919,000	864,000	379,000	1,162,000	6,000	113,000	23,000	28,000	20,000	373,000	303,000	4,000	8,000	341,000
Rents, communications, and utilities	46,424,000	3,964,000	7,316,000	10,854,000	7,245,000	41,000	625,000	4,575,000	340,000	393,000	4,984,000	3,839,000	---	349,000	1,899,000
Printing and reproduction	4,174,000	216,000	614,000	1,025,000	398,000	6,000	32,000	27,000	13,000	23,000	175,000	50,000	---	15,000	1,580,000
Other services	74,310,000	14,970,000	11,427,000	18,610,000	5,092,000	42,000	1,001,000	1,611,000	316,000	1,467,000	2,699,000	3,862,000	37,000	522,000	12,654,000
Services of other agencies	10,735,000	3,163,000	743,000	2,542,000	399,000	164,000	77,000	137,000	464,000	37,000	63,000	139,000	17,000	12,000	2,778,000
Supplies and materials	24,553,000	3,534,000	4,282,000	5,820,000	1,927,000	91,000	1,450,000	1,296,000	64,000	422,000	2,681,000	2,435,000	---	51,000	500,000
Equipment	86,370,000	799,000	10,694,000	8,744,000	32,840,000	44,000	2,207,000	608,000	396,000	1,293,000	3,401,000	6,323,000	---	17,085,000	1,936,000
Lands and structures	6,539,000	938,000	1,235,000	1,212,000	771,000	184,000	518,000	311,000	---	101,000	957,000	312,000	---	---	---
Insurance claims and indemnities	27,000	10,000	1,000	6,000	---	---	---	---	---	---	---	2,000	---	---	8,000
Totals	634,537,000	52,416,000	91,036,000	137,787,000	92,570,000	844,000	10,931,000	31,807,000	3,201,000	10,523,000	58,998,000	68,546,000	1,669,000	22,693,000	51,516,000
FISCAL YEAR 1966															
Personnel compensation	355,511,000	28,546,000	49,917,000	80,206,000	38,455,000	---	4,692,000	21,935,000	3,389,000	6,312,000	41,036,000	47,993,000	1,460,000	4,289,000	27,281,000
Personnel benefits	25,299,000	1,930,000	3,368,000	5,558,000	2,737,000	---	333,000	1,584,000	262,000	453,000	2,993,000	3,499,000	106,000	309,000	2,167,000
Travel & transp of pers	20,841,000	2,080,000	4,874,000	3,769,000	2,636,000	---	185,000	676,000	302,000	222,000	1,503,000	1,470,000	200,000	282,000	2,642,000
Transportation of things	4,689,000	862,000	893,000	366,000	1,264,000	---	153,000	25,000	70,000	40,000	370,000	303,000	3,000	45,000	295,000
Rents, communications, and utilities	49,795,000	5,565,000	9,068,000	9,255,000	8,000,000	---	430,000	4,733,000	688,000	317,000	5,607,000	3,389,000	---	402,000	2,341,000
Printing and reproduction	4,615,000	339,000	700,000	1,038,000	240,000	---	35,000	27,000	25,000	20,000	201,000	50,000	---	15,000	1,925,000
Other services	94,231,000	28,315,000	13,199,000	19,106,000	7,102,000	---	1,390,000	1,537,000	610,000	911,000	2,807,000	3,654,000	38,000	514,000	15,048,000
Services of other agencies	13,353,000	6,761,000	612,000	2,632,000	188,000	---	53,000	140,000	258,000	4,000	63,000	139,000	17,000	14,000	2,472,000
Supplies and materials	21,156,000	3,550,000	2,918,000	4,322,000	1,928,000	---	1,250,000	1,148,000	229,000	475,000	2,700,000	2,028,000	---	53,000	555,000
Equipment	16,998,000	818,000	800,000	1,000,000	1,040,000	---	480,000	730,000	400,000	480,000	5,256,000	4,380,000	---	64,000	1,550,000
Lands and structures	5,300,000	947,000	1,200,000	1,000,000	450,000	---	445,000	388,000	---	100,000	470,000	300,000	---	----	---
Insurance claims and indemnities	32,000	10,000	1,000	8,000	---	---	---	---	---	1,000	---	2,000	---	---	10,000
Totals	611,820,000	79,723,000	87,550,000	128,260,000	64,040,000	---	9,446,000	32,923,000	6,233,000	9,335,000	63,006,000	67,207,000	1,824,000	5,987,000	56,286,000
FISCAL YEAR 1967															
Personnel compensation	375,354,000	30,777,000	54,866,000	80,271,000	41,563,000	---	4,865,000	22,572,000	9,012,000	6,510,000	41,999,000	49,064,000	1,483,000	4,426,000	27,946,000
Personnel benefits	27,090,000	2,068,000	3,824,000	5,660,000	2,974,000	---	345,000	1,629,000	687,000	481,000	3,043,000	3,581,000	108,000	317,000	2,373,000
Travel & transp of pers	21,279,000	2,173,000	5,261,000	3,724,000	2,633,000	---	185,000	670,000	347,000	220,000	1,489,000	1,455,000	198,000	282,000	2,642,000
Transportation of things	5,048,000	1,127,000	884,000	366,000	1,325,000	---	124,000	25,000	136,000	40,000	370,000	303,000	3,000	50,000	295,000
Rents, communications, and utilities	56,417,000	7,066,000	9,460,000	10,213,000	9,721,000	---	442,000	5,133,000	1,836,000	270,000	6,035,000	3,449,000	---	402,000	2,390,000
Printing and reproduction	4,916,000	461,000	700,000	1,038,000	250,000	---	35,000	27,000	44,000	20,000	201,000	50,000	---	15,000	2,075,000
Other services	112,317,000	36,756,000	16,804,000	20,429,000	8,360,000	---	1,729,000	1,706,000	1,990,000	989,000	3,319,000	3,656,000	38,000	517,000	16,024,000
Services of other agencies	15,221,000	8,146,000	615,000	2,628,000	170,000	---	65,000	150,000	359,000	4,000	63,000	139,000	17,000	58,000	2,807,000
Supplies and materials	26,122,000	6,594,000	3,350,000	5,397,000	1,929,000	---	1,451,000	1,100,000	412,000	506,000	2,720,000	2,055,000	---	53,000	555,000
Equipment	14,696,000	1,970,000	1,147,000	1,000,000	2,312,000	---	480,000	280,000	320,000	500,000	2,878,000	2,230,000	---	29,000	1,550,000
Land and structures	5,408,000	960,000	1,300,000	1,200,000	450,000	---	445,000	183,000	---	100,000	470,000	300,000	---	---	---
Insurance claims and indemnities	32,000	10,000	1,000	8,000	---	---	---	---	---	1,000	---	2,000	---	---	10,000
Totals	663,900,000	98,108,000	98,212,000	131,934,000	71,687,000	---	10,166,000	33,475,000	15,143,000	9,641,000	62,587,000	66,284,000	1,847,000	6,149,000	58,667,000

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

COMPUTATION OF PERSONNEL COSTS BY INSTALLATION AND FISCAL YEAR

(In thousands of dollars)

FISCAL YEAR 1965 ACTUAL	TOTAL	J. F. KENNEDY SPACE CENTER, NASA	MANNED SPACECRAFT CENTER	MARSHALL SPACE FLIGHT CENTER	GODDARD SPACE FLIGHT CENTER	PACIFIC LAUNCH OPERATIONS OFFICE	WALLOPS STATION	AMES RESEARCH CENTER	ELECTRONICS RESEARCH CENTER	FLIGHT RESEARCH CENTER	LANGLEY RESEARCH CENTER	LEWIS RESEARCH CENTER	SPACE NUCLEAR PROPULSION OFFICE	HEADQUARTERS	WESTERN OPERATIONS OFFICE
Personnel Compensation:															
Permanent positions	$325,818	$24,069	$41,391	$73,635	$37,965	$204	$3,862	$21,093	$2,593	$5,689	$38,587	$45,017	$1,419	$26,308	$3,985
Pay above the stated annual rate	1,271	92	159	280	146	1	36	80	10	22	148	173	5	101	15
Lapses (deduct)	-16,039	-5,849	-197	-1,283	-2,100	-14	-112	-638	-1,301	-71	-876	-859	-115	-2,464	-170
Net cost of permanent positions	311,050	18,312	41,363	72,632	36,011	191	3,788	20,535	1,302	5,640	37,859	44,331	1,309	23,945	3,830
Other personnel compensation	22,218	1,795	4,713	6,714	2,046	22	649	492	60	465	1,496	2,108	9	1,366	285
Total personnel compensation	$333,268	$20,107	$46,076	$79,346	$38,057	$213	$4,437	$21,027	$1,362	$6,105	$39,355	$46,439	$1,318	$25,311	$4,115
Reimbursable	546	---	---	1	545	---	---	---	---	---	---	---	---	---	---
NASA funded	332,722	20,107	46,076	79,345	37,512	213	4,437	21,027	1,362	6,105	39,355	46,439	1,318	25,311	4,115
Total personnel benefits	$23,758	$1,355	$3,154	$5,528	$2,716	$15	$305	$1,549	$100	$441	$2,880	$3,373	$94	$1,959	$289
Reimbursable	45	---	---	---	45	---	---	---	---	---	---	---	---	---	---
NASA funded	23,713	1,355	3,154	5,528	2,671	15	305	1,549	100	441	2,880	3,373	94	1,959	289
Total personnel costs	$357,026	$21,462	$49,230	$84,874	$40,773	$228	$4,742	$22,576	$1,462	$6,546	$42,235	$49,812	$1,412	$27,270	$4,404
Reimbursable	591	---	---	1	590	---	---	---	---	---	---	---	---	---	---
NASA funded	356,435	21,462	49,230	84,873	40,183	228	4,742	22,576	1,462	6,546	42,235	49,812	1,412	27,270	4,404

FISCAL YEAR 1966 ESTIMATED															
Personnel Compensation:															
Permanent positions	$353,072	$27,808	$50,226	$76,173	$38,559	---	$4,211	$22,299	$5,919	$5,979	$40,491	$47,854	$1,510	$27,849	$4,193
Pay above the stated annual rate	1,355	107	193	293	148	---	16	84	23	23	156	184	5	107	16
Lapses (deduct)	-20,755	-1,909	-5,793	-2,129	-1,408	---	-106	-997	-2,678	-229	-1,148	-1,900	-64	-2,165	-228
Net cost of permanent positions	333,672	26,006	44,626	74,337	37,299	---	4,121	21,386	3,264	5,773	39,499	46,138	1,451	25,791	3,981
Other personnel compensation	22,471	2,540	5,291	5,869	1,788	---	571	549	125	539	1,537	1,855	9	1,490	308
Total personnel compensation	$356,143	$28,546	$49,917	$80,206	$39,087	---	$4,692	$21,935	$3,389	$6,312	$41,036	$47,993	$1,460	$27,281	$4,289
Reimbursable	632	---	---	---	632	---	---	---	---	---	---	---	---	---	---
NASA funded	355,511	28,546	49,917	80,206	38,455	---	4,692	21,935	3,389	6,312	41,036	47,993	1,460	27,281	4,289
Total personnel benefits	$25,346	$1,930	$3,368	$5,558	$2,784	---	$333	$1,584	$262	$453	$2,993	$3,499	$106	$2,167	$309
Reimbursable	47	---	---	---	47	---	---	---	---	---	---	---	---	---	---
NASA funded	25,299	1,930	3,368	5,558	2,737	---	333	1,584	262	453	2,993	3,499	106	2,167	309
Total personnel costs	$381,489	$30,476	$53,285	$85,764	$41,871	---	$5,025	$23,519	$3,651	$6,765	$44,029	$51,492	$1,566	$29,448	$4,598
Reimbursable	679	---	---	---	679	---	---	---	---	---	---	---	---	---	---
NASA funded	380,810	30,476	53,285	85,764	41,192	---	5,025	23,519	3,651	6,765	44,029	51,492	1,566	29,448	4,598

FISCAL YEAR 1967 ESTIMATED															
Personnel Compensation:															
Permanent positions	$364,599	$29,897	$50,790	$76,720	$41,163	---	$4,315	$22,435	$10,604	$6,009	$40,627	$48,371	$1,501	$27,945	$4,221
Pay above the stated annual rate	1,396	108	196	296	158	---	17	86	40	23	156	186	5	107	16
Lapses (deduct)	-10,644	-1,703	-453	-1,747	-1,100	---	-47	-519	-1,835	-24	-133	-1,399	-32	-1,538	-111
Net cost of permanent positions	355,351	28,302	50,533	75,269	40,221	---	4,285	22,002	8,809	6,008	40,650	47,158	1,474	26,514	4,126
Other personnel compensation	20,568	2,475	4,333	5,002	1,907	---	580	570	203	502	1,349	1,906	9	1,432	300
Total personnel compensation	$375,919	$30,777	$54,866	$80,271	$42,128	---	$4,865	$22,572	$9,012	$6,510	$41,999	$49,064	$1,483	$27,946	$4,426
Reimbursable	565	---	---	---	565	---	---	---	---	---	---	---	---	---	---
NASA funded	375,354	30,777	54,866	80,271	41,563	---	4,865	22,572	9,012	6,510	41,999	49,064	1,483	27,946	4,426
Total personnel benefits	$27,132	$2,068	$3,824	$5,660	$3,016	---	$345	$1,629	$687	$481	$3,043	$3,581	$108	$2,373	$317
Reimbursable	42	---	---	---	42	---	---	---	---	---	---	---	---	---	---
NASA funded	27,090	2,068	3,824	5,660	2,974	---	345	1,629	687	481	3,043	3,581	108	2,373	317
Total personnel costs	$403,051	$32,845	$58,690	$85,931	$45,144	---	$5,210	$24,201	$9,699	$6,991	$45,042	$52,645	$1,591	$30,319	$4,743
Reimbursable	607	---	---	---	607	---	---	---	---	---	---	---	---	---	---
NASA funded	402,444	32,845	58,690	85,931	44,537	---	5,210	24,201	9,699	6,991	45,042	52,645	1,591	30,319	4,743

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

DISTRIBUTION OF PERSONNEL POSITIONS BY INSTALLATION AND FISCAL YEAR

FISCAL YEAR 1965 ACTUAL	Total NASA	J. F. Kennedy Space Center, NASA	Manned Spacecraft Center	Marshall Space Flight Center	Goddard Space Flight Center	Pacific Launch Operations Office	Wallops Station	Ames Research Center	Electronics Research Center	Flight Research Center	Langley Research Center	Lewis Research Center	Space Nuclear Propulsion Office	Headquarters	Western Operations Office
TOTAL EXCEPTED POSITIONS[a/]	439	16	36	49	36	-	2	26	10	6	31	30	2	191	4
General Schedule Positions:															
GS-16	259	14	20	57	29	-	1	20	-	4	25	23	5	60	1
GS-15	1,756	87	211	409	209	1	4	105	27	15	135	146	18	376	13
GS-14	2,824	204	385	692	389	4	10	154	43	27	236	310	24	300	46
GS-13	4,020	340	639	990	566	1	23	205	34	51	327	582	26	178	58
GS-12	4,080	534	635	1,069	512	5	32	169	21	56	363	504	3	91	86
GS-11	3,653	324	600	861	501	3	40	165	10	70	486	461	3	86	43
GS-10	58	1	-	2	-	-	24	6	-	-	-	16	-	8	1
GS-9	2,449	206	381	359	391	-	49	165	14	41	445	308	-	81	9
GS-8	96	3	2	4	11	-	12	-	-	-	2	21	-	40	1
GS-7	1,552	135	304	300	165	-	36	94	13	21	181	138	1	160	4
GS-6	693	56	57	70	80	1	7	35	2	13	73	57	7	221	14
GS-5	1,776	160	263	361	219	1	41	124	14	19	178	139	13	183	61
GS-4	1,677	136	240	458	182	3	30	115	45	19	145	179	7	80	38
GS-3	1,141	95	166	316	124	-	22	55	11	9	112	143	6	75	7
GS-2	195	5	32	83	22	-	9	4	-	2	6	20	2	10	-
GS-1	28	-	25	1	-	-	-	-	-	-	-	-	-	2	-
TOTAL GENERAL SCHEDULE POSITIONS	26,257	2,300	3,960	6,032	3,400	19	340	1,416	234	347	2,714	3,047	115	1,951	382
TOTAL WAGE BOARD POSITIONS	6,504	112	241	1,429	268	-	176	768	-	252	1,499	1,738	-	21	-
TOTAL PERMANENT POSITIONS	33,200	2,428	4,237	7,510	3,704	19	518	2,210	244	605	4,244	4,815	117	2,163	386
OTHER TEMPORARY POSITIONS	1,100	63	194	244	103	3	12	60	6	64	130	102	-	100	19
GRAND TOTAL POSITIONS - FY 1965	34,300	2,491	4,431	7,754	3,807	22	530	2,270	250	669	4,374	4,917	117	2,263	405
FISCAL YEAR 1966 ESTIMATED															
TOTAL EXCEPTED POSITIONS[a/]	439	17	36	49	35	-	2	26	10	6	31	30	2	191	4
General Schedule Positions:															
GS-16	293	16	29	61	30	-	1	20	10	3	25	26	6	65	1
GS-15	1,776	85	211	360	205	-	4	120	46	20	156	155	25	377	12
GS-14	2,879	213	404	761	376	-	10	139	73	23	215	301	17	300	47
GS-13	4,567	447	785	1,012	553	-	38	235	79	64	397	672	27	202	56
GS-12	4,370	602	788	1,020	507	-	36	212	44	58	379	513	3	114	94
GS-11	3,925	350	759	806	491	-	44	186	70	65	508	508	1	95	42
GS-10	51	1	-	2	-	-	13	6	-	-	-	21	-	8	-
GS-9	2,391	200	514	340	384	-	51	110	64	39	400	203	-	81	5
GS-8	92	3	2	3	11	-	5	-	-	-	2	23	-	42	1
GS-7	1,382	102	233	275	145	-	36	90	34	25	151	125	2	159	5
GS-6	707	61	60	59	74	-	17	35	4	14	73	64	6	224	16
GS-5	1,824	170	305	355	184	-	55	125	34	16	179	142	13	185	61
GS-4	1,569	132	248	393	169	-	47	108	59	20	139	149	7	59	39
GS-3	1,039	101	168	313	106	-	15	54	23	2	80	133	6	35	3
GS-2	237	15	49	107	39	-	-	1	-	4	-	15	2	5	-
GS-1	44	-	-	42	-	-	-	-	-	-	-	-	-	2	-
TOTAL GENERAL SCHEDULE POSITIONS	27,146	2,498	4,555	5,909	3,274	-	372	1,441	540	353	2,704	3,050	115	1,953	382
TOTAL WAGE BOARD POSITIONS	6,339	105	218	1,359	268	-	144	753	-	245	1,499	1,730	-	18	-
TOTAL PERMANENT POSITIONS	33,924	2,620	4,809	7,317	3,577	-	518	2,220	550	604	4,234	4,810	117	2,162	386
OTHER TEMPORARY POSITIONS	600	46	119	169	48	-	12	20	-	14	70	32	-	65	5
GRAND TOTAL POSITIONS - FY 1966	34,524	2,666	4,928	7,486	3,625	-	530	2,240	550	618	4,304	4,842	117	2,227	391
FISCAL YEAR 1967 ESTIMATED															
TOTAL EXCEPTED POSITIONS[a/]	439	17	36	49	35	-	2	26	10	6	31	30	2	191	4
General Schedule Positions:															
GS-16	293	16	29	61	30	-	1	20	10	3	25	26	6	65	1
GS-15	1,932	88	219	373	227	-	6	130	77	21	180	175	25	399	12
GS-14	3,158	225	425	801	417	-	13	190	126	22	234	320	17	321	47
GS-13	4,607	472	785	1,000	577	-	38	230	137	63	397	646	26	182	54
GS-12	4,501	662	800	1,012	543	-	37	183	116	58	381	528	3	84	94
GS-11	3,939	367	754	771	537	-	44	180	97	71	506	497	-	75	40
GS-10	50	1	-	2	-	-	13	5	-	-	-	21	-	8	
GS-9	2,300	226	474	315	380	-	43	93	88	36	393	153	-	81	5
GS-8	92	3	2	3	11	-	5	-	-	-	2	23	-	42	1
GS-7	1,378	109	179	265	154	-	36	90	97	16	144	122	2	159	5
GS-6	722	67	62	54	70	-	17	33	22	14	73	64	6	224	16
GS-5	1,780	123	310	365	191	-	55	118	61	16	139	144	13	185	60
GS-4	1,548	139	257	328	174	-	47	116	123	20	109	130	7	59	39
GS-3	1,087	105	159	351	108	-	15	53	36	2	77	135	8	35	3
GS-2	233	26	40	99	39	-	-	5	-	4	-	15	-	5	-
GS-1	28	-	-	26	-	-	-	-	-	-	-	-	-	2	-
TOTAL GENERAL SCHEDULE POSITIONS	27,648	2,629	4,495	5,826	3,467	-	372	1,448	990	346	2,660	2,999	113	1,926	377
TOTAL WAGE BOARD POSITIONS	6,252	104	216	1,346	257	-	144	717	-	244	1,488	1,718	-	18	-
TOTAL PERMANENT POSITIONS	34,339	2,750	4,747	7,221	3,759	-	518	2,191	1,000	596	4,179	4,747	115	2,135	381
OTHER TEMPORARY POSITIONS	600	46	119	169	48	-	12	20	-	14	70	32	-	65	5
GRAND TOTAL POSITIONS - FY 1967	34,939	2,796	4,866	7,390	3,807	-	530	2,211	1,000	610	4,249	4,779	115	2,200	386

a/Total Excepted Positions include two (2) Special Ungraded and twelve (12) P. L. 313 positions.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1967 ESTIMATES

ADMINISTRATIVE OPERATIONS

ANALYSIS OF REQUIREMENTS FOR PASSENGER-CARRYING MOTOR VEHICLES

The appropriation language provides for the acquisition of 31 passenger motor vehicles, of which 15 are for augmentation to the fiscal year 1966 ending inventory and 16 are for replacement. All vehicles scheduled for replacement meet, or will meet, the criteria established by the General Services Administration for replacement of vehicles due either to age, mileage, annual maintenance costs, or a combination of these factors.

A summary analysis of the planned acquisitions by class of vehicle in fiscal year 1967 is as follows:

	Total	Medium Sedans	Other Sedans	Station Wagons	Ambulances	Buses
On hand July 1, 1966..	179	1	42	114	11	11
Acquisitions:						
a. By purchase.....	20	-	3	17	-	-
b. By transfer[1/]....	11	-	2	4	2	3
Subtotal.....	31	-	5	21	2	3
(For replacement)...	(16)	(-)	(2)	(14)	(-)	(-)
(Disposed - not replaced).....	(-)	(-)	(-)	(-)	(-)	(-)
On hand June 30, 1967.	194	1	45	121	13	14

1/ During fiscal year 1966 the Research Range at Fort Churchill, Canada, was transferred from the Department of Defense to the National Aeronautics and Space Administration because NASA was the principle user of the facility. Involved in this transfer are 11 vehicles which will augment the NASA passenger-carrying motor vehicle fleet.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1967 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS — PHYSICS AND ASTRONOMY PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of the Physics and Astronomy program is to increase our knowledge of the space environment of the earth, the sun and its relationship to the earth and the interplanetary medium, and the fundamental physical nature of the universe. In order to achieve this objective, research programs have been undertaken to intensively study the upper atmosphere, the ionosphere, the earth's magnetosphere, the region beyond the boundaries of the magnetosphere, solar radiation and the solar wind and their interactions with these regions, cosmic rays from beyond the solar system, radiation from stars and other celestial bodies in areas of the spectrum which cannot be observed from the earth's surface, and the geodetic figure of the earth.

While the objective of the program has been divided into three major areas, they are by no means independent of each other. Knowledge gained in one area contributes to the understanding of the others. Many studies contribute directly to knowledge in all three areas. The practical applications of the knowledge gained in this program can be clearly demonstrated in terms of support for other national programs such as meteorology, communications, manned space flight, and cartography. However, the program is primarily intended to be a basic research program dedicated to the expansion of human knowledge. As such, it is integrated with the programs of educational and scientific research institutions throughout the United States and in many foreign countries. Substantial efforts are made to insure that the results of the research are made generally available on a basis that will make the knowledge most useful to facilitate future advancements in technology, scientific research, and education.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Supporting research and technology/Advanced studies..	$21,057,000	$23,800,000	$22,900,000
Solar observatories.....	16,597,000	24,500,000	11,900,000
Astronomical observatories.....	32,644,000	24,600,000	29,200,000
Geophysical observatories.....	30,352,000	28,600,000	23,400,000
Explorers.....	21,565,000	21,400,000	23,000,000
Sounding rockets.....	16,867,000	18,500,000	19,000,000
Data analysis.....	---	2,100,000	2,000,000
Total.....	$139,082,000	$143,500,000	$131,400,000

Distribution of Program Amount by Installation:

	1965	1966	1967
Marshall Space Flight Center..	$755,000	$62,000	$25,000
Goddard Space Flight Center...	110,244,000	108,498,000	100,961,000
Jet Propulsion Laboratory.....	334,000	452,000	500,000
Wallops Station.....	1,090,000	2,550,000	3,400,000
Ames Research Center.....	1,557,000	2,586,000	2,563,000
Flight Research Center.....	10,000	5,000	15,000
Langley Research Center.....	2,226,000	2,272,000	1,100,000
NASA Headquarters.....	22,866,000	27,075,000	22,836,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology/Advanced Studies

	1965	1966	1967
Particles and fields.....	$6,714,000	$6,900,000	$6,900,000
Ionospheres and radio physics...	988,000	1,300,000	1,300,000
Interplanetary dust and cometary physics.....	833,000	1,200,000	1,200,000
Solar physics.....	2,382,000	2,800,000	2,800,000
Astronomy and geodesy.....	2,926,000	3,300,000	3,300,000
Spacecraft technology.....	300,000	350,000	350,000
Interdisciplinary space science.	2,179,000	2,850,000	2,850,000
Advanced studies.....	450,000	1,200,000	1,000,000
Manned space science.....	4,285,000	3,900,000	3,200,000
Total.....	$21,057,000	$23,800,000	$22,900,000

The objectives of the Supporting Research and Technology program are to provide a sound theoretical base for the flight programs; to initiate development of instrumentation for future experiments; to provide laboratory data as a basis for evaluation of flight data; to conduct ground based balloon and aircraft observations for correlation with flight program results; and to provide scientific experiments and scientific support for the manned space flight program.

Particles and Fields

Work in this area concerns the development of new instruments for measuring the direction, magnitude and time variations of magnetic fields and for measuring the energy, direction and mass of charged particles. It also consists of theoretical research and ground and balloon-borne observations which will aid in the interpretation of space measurements.

Ionospheres and Radio Physics

Ionospheres and radio physics involves ground-based observations, theoretical studies and instrument development relating to the ionized regions of the atmospheres of the earth and other planets and of interplanetary space.

Interplanetary Dust and Cometary Physics

Interplanetary dust and cometary physics involves the study of extraterrestrial particulate matter; its behavior, structure, composition, and origins; and its significance in providing information on the physical properties of the solar system and the galaxy.

Solar Physics

Solar physics involves ground, aircraft, and balloon-borne observations; theoretical studies; and instrumentation development related to orbital observations of the sun.

Astronomy and Geodesy

Astronomical research and technology efforts include theoretical studies of stellar astrophysics; laboratory spectroscopy; research on optical materials; advanced development of instruments; and ground-based balloon and aircraft observations. Work is also being done leading to the development of extremely precise gyroscopes which could be used in a zero G satellite for tests of Einstein's Theory of Relativity. Theoretical studies in celestial mechanics and geodesy are also included.

Spacecraft Technology

Studies of materials and techniques suitable for future interplanetary spacecraft, which would make close approaches to the sun or operate at great distances from the earth, are being conducted. In addition, work is being initiated in improved electronic and power supply components for explorer satellites.

Interdisciplinary Space Science

This area provides for support of the Space Science Board and for research fellowships administered by the National Academy of Science, which provide an opportunity for selected fellows to work with scientists at the Goddard Space Flight Center in theoretical and laboratory research.

Advanced Studies

Studies to establish the concepts, characteristics and feasibility of future earth orbital and interplanetary missions are funded in this area. Earth orbital mission studies include feasibility studies of small modular scientific satellites which could be assembled with comparatively short

leadtimes to meet a variety of scientific mission objectives, as well as for specialized explorers to conduct experiments requiring unique spacecraft designs. Also included are studies aimed at defining the role of man in astronomical observations from space and in defining systems concepts for carrying out these observations.

Interplanetary mission studies include the development of a concept and preliminary design of a Galactic Pioneer capable of extending interplanetary exploration out beyond the orbit of the planet Jupiter. Also included are studies leading to the development of small probes capable of transmitting signals and a limited amount of data back to earth from distances as close as 0.4 AU to the sun. Studies of scientific payloads for these small probes include solar corona studies, interplanetary plasma studies, and comet simulation studies.

Manned Space Science

Manned Space Science includes the planning, design and development of scientific investigations; procedures and equipment for manned orbital space experiments, analysis of data collected from these experiments; and supporting activities including the selected scientific training of astronauts. Studies in the fields of solar physics, ionospheres, astronomy, relativity, gravity, and interplanetary particles and fields are among the scientific investigations being developed for Gemini and Apollo missions.

Applied research on the space environment is undertaken to meet specific needs for information on space phenomena in the design and development of safe and reliable manned space flight systems. Environmental data is supplied for the Apollo program, including information regarding solar flares and the resulting solar proton radiation, other space radiation, meteoroids, and micrometeoroids. Theoretical and laboratory studies are conducted to evaluate the potential hazard which these space phenomena may present to manned space flight. Fiscal year 1967 funds will be utilized to continue work begun in prior years.

Solar Observatories

	1965	1966	1967
Orbiting Solar Observatory (OSO):			
Spacecraft	$4,814,000	$6,013,000	$6,800,000
Experiments	4,383,000	3,687,000	5,100,000
Subtotal OSO	$9,197,000	$9,700,000	$11,900,000

	1965	1966	1967
Advanced Orbiting Solar Observatory (AOSO):			
Spacecraft	$5,831,000	$10,497,000	---
Experiments	1,569,000	3,324,000	---
Ground operations	---	979,000	---
Subtotal AOSO	$7,400,000	$14,800,000	---
Total OSO and AOSO	$16,597,000	$24,500,000	$11,900,000
Delta (Launch Vehicle Procurement Program)	($761,000)	($1,000,000)	($1,700,000)
Total (including Launch Vehicles)	($17,358,000)	($25,500,000)	($13,600,000)

The objective of the Solar Observatory program is to promote advancement in the study of solar physics through the use of current space techniques. These techniques permit expansion of scientific solar research by eliminating the atmospheric distortions which are normally prevalent with ground-based observations. Accordingly, freedom from atmospherically scattered light is obtained and many more decades of the electromagnetic spectrum can be observed. The solar observatories are designed to provide a thorough investigation of the sun, the rapid changes, as well as the long-term changes in solar radiation during a solar cycle and to probe into the underlying causes of these changes by analyzing regions of activity. The Orbiting Solar Observatories operated during the period of minimum solar activity with the flight of OSO I and OSO II in 1962 and 1965 respectively. Continuous program effort will be pursued with OSO into the period of maximum solar activity in 1968-69.

Orbiting Solar Observatories are stabilized platforms capable of pointing scientific instrumentation to an accuracy of greater than 1 arc minute at the center of the solar disc in order to study the solar ultraviolet light, gamma rays and X-rays, which are absorbed in the earth's atmosphere. Orbiting Solar Observatories are scheduled to be launched between 1965 and 1969 at approximately nine month intervals. This will give reasonable assurance of continuous coverage of solar phenomena as the sun reaches the period of maximum activity.

The first solar observatory, OSO-I, was launched on March 7, 1962, and provided over 2,000 hours of observation of the solar spectrum in the ultraviolet and X-ray regions. Orbiting Solar Observatory-II was successfully launched on February 3, 1965. All spacecraft systems operated at or above their design goals and the spacecraft was commanded "off" after more than nine months of near-perfect operation. All but one of nine experiments provided data during the more than 4100 orbits the spacecraft covered during its useful lifetime. These data are currently being analyzed and publication of scientific results is expected shortly.

Orbiting Solar Observatory-C, the third solar observatory, was launched August 25, 1965. Unfortunately, a malfunction in the third stage of the Delta launch vehicle prevented the booster from placing the spacecraft into orbit. Using spare experiments from the OSO-C, a re-flight of the mission is now scheduled for the middle of 1966. Experiment selection through the seventh OSO mission has been completed. Selection of proposed experiments for the last OSO in the current series (OSO-H) will take place shortly after July 1, 1966.

Management responsibility for the OSO project has been assigned to the Goddard Space Flight Center. The spacecraft are being procured through contracts with the Ball Brothers Research Corporation.

Fiscal year 1965 funds provided for completion, launch, data acquisition and analysis of OSO-II which was launched February 3, 1965, and for completion and launch of the third observatory in August 1965.

In addition, FY 1965 funds were utilized for initiation of experiment development for a follow-on observatory.

Fiscal year 1966 funds provide for continuing work on the fifth observatory, for completion of the hardware and launch of the fourth observatory, and for initiation of work on the three follow-on spacecraft and experimental packages. Fiscal year 1967 funds will provide for completion of data analysis on OSO-II and the fourth observatory, launch and initial data analysis on the fifth observatory, and for continuing hardware effort on the follow-on OSO's.

Fiscal year 1964 and prior funding for the OSO project, including launch vehicles, was $40,715,000. Fiscal year 1968 and later funding required to complete this eight flight program, including launch vehicles, is estimated at $24,800,000.

Astronomical Observatories

	1965	1966	1967
Spacecraft and support.....	$23,170,000	$17,205,000	$23,100,000
Experiments.....	9,474,000	7,395,000	6,100,000
Total Spacecraft and Support.	$32,644,000	$24,600,000	$29,200,000
Atlas-Agena (Launch Vehicle Procurement Program).....	(9,072,000)	(16,703,000)	(9,057,000)
Total (including Launch Vehicles).....	($41,716,000)	($41,303,000)	($38,257,000)

The Orbiting Astronomical Observatory (OAO) is designed to provide a precisely stabilized observatory above the atmosphere so that fundamental

information about the universe can be obtained through astronomical observations particularly in those extensive regions of the electromagnetic spectrum which do not penetrate the earth's atmosphere; and through high resolution observations in the visible and shorter wave length regions of the electromagnetic spectrum which are disturbed when they pass through the earth's refracting and scattering atmosphere. The OAO program is developing a standardized spacecraft that can be precisely stabilized to 0.1 arc second for long observational times, and can carry a wide variety of telescopic instruments weighing up to 1,000 pounds. The first five observatories will carry instruments of increasing capability, starting with exploratory sky mapping surveys and low resolution instruments and progressing to larger apertures, high resolution, and capability of viewing faint celestial objects.

The first OAO (OAO-A1), to be launched in early 1966, will carry ultraviolet photometers and spectrometers developed by the University of Wisconsin for studies of stars and nebulae. In addition, there is a package of three astronomical instruments designed for sky surveys in the X-ray and gamma ray spectral regions. These have been developed by Lockheed Research Laboratories, the Goddard Space Flight Center and the Massachusetts Institute of Technology.

The second OAO (OAO-B), scheduled for flight in early 1967, will carry a 36 inch aperture telescope designed to obtain spectrophotometric data on stars, nebulae and galaxies in the ultraviolet region of the spectrum with a capability of resolution up to 2 angstroms.

The third OAO (OAO-A2), to be launched in 1967, will consist of the refurbished prototype spacecraft carrying Smithsonian Astrophysical Observatory and University of Wisconsin experiments. The Smithsonian experiment consists of four telescopes with television imaging photometers to map the sky in the ultraviolet. The Wisconsin experiment will duplicate the scientific instruments developed for OAO-A1, but will be programmed to view other sky regions.

The fourth OAO (OAO-C), to be launched in 1968, will consist of a 32 inch aperture reflecting telescope combined with a grating spectrograph to study the composition and physical condition of interstellar material and to obtain high dispersion ultraviolet spectra of stars with resolutions up to 0.1 angstrom. This observatory will also carry telescopes developed by the University College, London, England, with the University of Leicester to study the X-ray emission of stars and nebulae. These will probably be the first focusing collimators to be used for studying galactic X-rays.

The OAO-D observatory is planned for launch in late calendar year 1969. This observatory will be utilized primarily for observing very faint celestial objects by guest observers. The lifetime of this observatory will thus be utilized in a variety of short-term viewing programs, just as ground observatories are now used.

Management responsibility for the OAO project has been assigned to the Goddard Space Flight Center. The spacecraft are being developed under prime contracts with the Grumman Aircraft Engineering Corporation.

Development of the OAO was initiated in 1960. This development required major advances in the state-of-the-art, especially in spacecraft stabilization and control, and command and data handling. After great effort, major component development problems were solved and the prototype OAO was ready for qualification in FY 1965. These extensive systems tests took place throughout FY 1965 and were performed with outstanding success. Also, FY 1965 funds provided for the assembly and integration of the OAO-A1 flight observatory, and for manufacture of the components for OAO-B. The contracts for refurbishment of the prototype spacecraft (OAO-A2) and for the OAO-C, a new spacecraft, were awarded in late FY 1965. Fiscal year 1965 funds provided for continuation of work on all experiments through OAO-C, and included the initiation of the repeat Wisconsin experiment for OAO-A2.

In FY 1966 the functional and environmental flight acceptance tests of the OAO-A1 observatory were successfully completed. Fiscal year 1966 funds will provide for final preparations, launch, and initial flight operations and data analysis of OAO-A1. Fiscal year 1966 funds will also provide for assembly and initial flight acceptance tests of the spacecraft and flight experiments for OAO-B. The prototype telescope for OAO-B has been successfully qualified in FY 1966. Also, FY 1966 funds provide for refurbishment of the OAO-A2 spacecraft and for the manufacture of components for OAO-C spacecraft, as well as continued support for manufacture of experiments for these missions.

Fiscal year 1967 funds will provide for continued data analysis of OAO-A1, and will provide for completion of flight acceptance tests, launch support, operations and initial data analysis for the OAO-B mission. The refurbishment and flight acceptance test of OAO-A2 observatory will be performed, and the manufacture and assembly of the flight spacecraft and flight experiment for OAO-C will be completed. Fiscal year 1967 funds will also provide for initiation of the OAO-D observatory, deferred from FY 1966. The FY 1967 funding level represents a buildup toward the level required to support a schedule of one OAO flight per year.

Fiscal year 1964 and prior year funding, including launch vehicles, was $129,040,000. Fiscal year 1968 and later funding required to complete five missions is estimated to be $66,300,000 including launch vehicles.

Geophysical Observatories

	1965	1966	1967
Spacecraft	$19,961,000	$16,971,000	$14,531,000
Experiments	10,391,000	11,629,000	8,869,000
Total Spacecraft and Support.	$30,352,000	$28,600,000	$23,400,000
Thor-Agena (Launch Vehicle Procurement Program)	(2,164,000)	(3,795,000)	(3,595,000)

	1965	1966	1967
Atlas-Agena (Launch Vehicle Procurement Program).....	(2,134,000)	(6,271,000)	(3,154,000)
Total (including Launch Vehicles).....	($34,650,000)	($38,666,000)	($30,149,000)

The Orbiting Geophysical Observatory program has as a prime objective the accomplishment of a series of scientific measurements required to correlate the geophysical phenomena occurring in the near-earth environment with the effluent activity of the sun and interplanetary space. There is increased evidence that this environment has a fine, highly-variable structure of electromagnetic fields and particles which is strongly dependent on events or processes occurring at different locations. Correlative measurements aboard the same satellite obtained over a variety of spatial locations are required if we are to understand this environment. Successful accomplishment of the OGO program will undoubtedly contribute substantially to this understanding and to evaluation of the hazards of manned space travel. There remains, always, the possibility of the discovery of new physical phenomena having potential application to the advancing of earth-bound technology.

Support of these scientific objectives requires the development of spacecraft capabilities to accommodate the many diversified instruments used for the correlative studies. In essence, this requirement establishes the need for an orbital laboratory-type environment where viewing directions, electric power, thermal control, and data handling systems are shared by many experimenters in investigating related problems.

To achieve the planned scientific objectives, OGO missions are scheduled alternately for low altitude, nearly-polar orbits, and highly-elliptical, low inclination orbits at approximately nine month intervals.

The OGO-I mission, launched in 1964, identified design problems with appendage deployment which were corrected on the OGO-II mission launched in 1965. However, the nature of the OGO-I problem prevented detection of an anomalous behavior of the earth horizon sensors to cold clouds which was discovered on the OGO-II flight. Corrections for the OGO-II problem are being incorporated on OGO-B which will be the third OGO mission. In addition to verifying the functional and operational aspects of the OGO spacecraft design, the OGO-I and II missions have provided significant scientific data. Twenty-five presentations of OGO-I results have already been given by the experimenters at various scientific symposia and the number of papers presented, or currently planned for either presentation or publication, is over forty-five.

The next mission will be OGO-B which is in the final phase of environmental testing. Orbiting Geophysical Observatory-B carries essentially the same complement of experiments as OGO-I and will be placed in a similar highly-elliptical orbit during the second quarter of 1966.

The fourth (OGO-D) and fifth (OGO-E) missions are both scheduled for launch in 1967. The OGO-D is in the final stages of integration and will continue the low earth studies started by OGO-II. Fabrication of spacecraft assemblies and experiments for the OGO-E mission is underway.

Procurement has been initiated for refurbishing of the prototype spacecraft for the OGO-F mission, to be launched in 1968, for which an experiment has been evaluated.

Management responsibility for the OGO project has been assigned to the Goddard Space Flight Center. The spacecraft development and fabrication is under contract to Thompson Ramo Wooldridge Corporation.

Funding prior to FY 1965 provided for design and development of the basic spacecraft; fabrication and testing of a prototype; and fabrication, integration, and test efforts on three flight spacecraft; development and initiation of fabrication of experiments for the first four missions.

This effort was continued in FY 1965 with the launch of the first OGO (OGO-A). The appendage release system redesign was incorporated in OGO-C and final preparations made for launch of this mission. Fabrication of spacecraft for the OGO-D and E missions and initiation of OGO-E experiment development was started. The OGO-I data analysis was supported. To accomplish the program within available manpower resources at the Goddard Space Flight Center, missions OGO-D and beyond were rescheduled from approximately six month intervals to nine month intervals. As a consequence, selection of experiments for OGO-F was delayed until FY 1966. In addition, the spacecraft contractor was assigned the added responsibility of experiment handling and testing for the later missions.

Fiscal year 1966 funds provided for the launch of OGO-C (II); continuation of data analysis for OGO-I and OGO-II; final preparations for the launch of OGO-B; continuation of work on OGO-D and E; and initiation of OGO-F experiment development.

Fiscal year 1967 funds are for completion and launch of OGO-D; continuation of observatory testing and launch preparations for OGO-E; and refurbishing the prototype spacecraft for OGO-F. They will also provide for continued support of data analysis for the first four OGO missions; the completion of OGO-E experiment development; and support of experiment development for the OGO-F mission.

Fiscal year 1964 and prior year funding for OGO was $122,712,000, including launch vehicles. Fiscal year 1968 and later funding needed to complete six missions is estimated to be $27,300,000, including launch vehicles.

Explorers

	1965	1966	1967
Geophysical and interplanetary explorers	$16,570,000	$13,120,000	$12,300,000
Astronomy explorers	1,100,000	5,030,000	9,100,000
Geodetic explorers	3,895,000	3,250,000	1,600,000
Total Explorers	$21,565,000	$21,400,000	$23,000,000
Scout (Launch Vehicle Procurement Program)	(3,527,000)	(6,300,000)	(3,329,000)
Delta (Launch Vehicle Procurement Program)	(10,450,000)	(4,817,000)	(11,683,000)
Thor Agena (Launch Vehicle Procurement Program)	(8,839,000)	(6,746,000)	(2,913,000)
Total (including Launch Vehicles)	($44,381,000)	($39,263,000)	($41,425,000)

The Explorer satellites are the smallest of NASA's scientific spacecraft, being launched on Scout, Delta and Thor Agena launch vehicles. Explorers are specifically designed to provide for specialized scientific investigations and are flown in orbits especially selected for the investigations involved. These Explorer spacecraft and their experiments, developed by various NASA centers, industry, universities and cooperating foreign countries, are used for investigations of the earth's environment, solar-terrestrial relationships, solar-interplanetary relationships, astronomical observations, and for geodetic measurements.

The shorter development times associated with these small spacecraft is reflected in the large number of successful missions accomplished (31) from the founding of NASA through 1965. These missions have provided substantial portions of our present knowledge about the earth's environment, including the ionosphere, the atmosphere, micrometeoroid environment, the radiation belts, the earth's magnetic field and some of the principal effects of solar radiation on the atmosphere. As a result of these efforts and other related investigations, the picture of the interactions between solar activity, the interplanetary medium, and the immediate environment of the earth is becoming clearer.

While Explorer spacecraft do not possess the stabilization and control feature, or the high data rates, required for detailed and comprehensive astronomical investigations of the Sun, stars and planets, they do provide an effective and economical means of making exploratory measurements in the radio, X-ray and ultraviolet regions. The first Radio Astronomy Explorer is under development for launch in 1967 to study planetary and celestial

low frequency radio sources. Development of a small X-ray Astronomy Explorer is being initiated to exploit the recent discovery of stellar X-ray sources.

In November 1965, the first Geodetic Explorer was launched marking the commencement of a cooperative geodetic program with participation by the Department of Defense, the United States Coast and Geodetic Survey, universities and other research organizations in the U.S. and cooperating foreign countries. Explorer XXIX (Geos A) is the first of two similar active satellites in the program containing apparatus for optical and electronic geodetic measurement techniques. A passive satellite consisting of an ECHO type balloon with beacons, designated PAGEOS-A, will be launched into a high altitude circular orbit in 1966 to supplement the active satellite program. Comparison studies are planned to evaluate the various techniques employed and to provide a check on the accuracy of individual measurements. The program is planned to continue.

In FY 1965 the major emphasis in the Explorer program was on the development of Interplanetary Explorers and on the joint Canadian-US Satellite for Ionospheric Studies. Fiscal year 1965 funds also provided for the initiation of the Radio Astronomy Explorer (RAE) and the OWL Explorers, a pair of satellites designed to make simultaneous measurements of high latitude geophysical phenomena in out-of-phase orbits. Development efforts on active and passive geodetic satellites, initiated in prior years, were also continued.

In FY 1966 increased emphasis is being given to Astronomy Explorers with major funding of the RAE and initiation of the X-ray Astronomy Explorer. A Scout launch vehicle was also provided for the launch of a Solar Explorer developed by the Naval Research Laboratory. Development of Geophysical and Interplanetary Explorers is being continued at a reduced level of effort, and the Geodetic Satellite program is being continued at a level effort.

The FY 1967 program provides for further reduction of the level of effort in Geophysical and Interplanetary Explorers, providing only for continuation of launches of Interplanetary and Energetic Particles Explorers and international cooperative programs in the 1968-1969 time period. The program in Astronomy Explorers will provide for continuation of observations into the 1968-1969 time period with emphasis on X-ray and radio observations of the Sun. Geodetic investigations will be continued using the four satellites in the currently approved program.

Sounding Rockets

	1965	1966	1967
Experiments	$7,403,000	$6,700,000	$6,700,000
Rocket development	594,000	852,000	1,024,000
Attitude control systems	1,018,000	3,543,000	3,400,000
Engineering support	476,000	442,000	440,000
Test and evaluation	209,000	246,000	250,000
Ground instrumentation	3,332,000	3,004,000	3,233,000
Rocket procurement	3,835,000	3,713,000	3,953,000
Total	$16,867,000	$18,500,000	$19,000,000

Sounding rockets have proven to be the only effective means of making scientifically valuable studies of the upper atmosphere at altitudes above 20 miles and below the perigee altitudes of earth satellites. These rockets are relatively small and inexpensive vehicles, capable of carrying wide varieties of instrumentation for the study of the atmosphere, ionosphere, energetic particles, astronomy and solar physics. The relatively low cost and short lead times make research with sounding rockets extremely useful for carrying out new experiments and testing new instruments soon after the ideas are developed by the nation's scientists.

Sounding rockets have been used to measure atmospheric density and temperature; to analyze the various gases present in the upper atmosphere, and responses of the atmosphere to varying solar activity. Chemicals released from sounding rockets for wind and temperature measurements launched from various sites all over the world have improved our knowledge about the dynamics of the ionospheric region. Recoverable sounding rocket payloads have been used to collect extraterrestrial dust originating in meteor streams, comets, and asteroids. Noctilucent clouds formed by the condensation of ice about this dust have been probed by flights from Sweden and Ft. Churchill, Canada; interplanetary dust has been sampled by rockets recently over White Sands, New Mexico.

The aurora and airglow have been investigated by rocket probes containing spectrophotometers, filter photometers, and particle detectors.

Ionospheric experiments have been carried out with sounding rockets and have proved extremely valuable both for scientific investigations of the physics of the ionosphere and for calibrating instrumentation on satellites already in orbit by simultaneously measuring the same region of the ionosphere. Instruments have been developed to measure electron concentrations and temperature, electromagnetic waves, ionic and neutral mass spectra, magnetic fields, and E region currents. Flights to measure these parameters have been made from many launching sites with a wide global distribution.

Sounding rockets are now being effectively utilized for astronomical observations of the sun and the stars in the X-ray and ultraviolet regions of the spectrum made possible due to the development of improved attitude control systems.

Management responsibility for sounding rocket support activities has been assigned to the Goddard Space Flight Center. Rocket experiments are managed at several NASA centers, with NASA Headquarters retaining responsibility for experiments developed at universities, by researchers in industry, at other agencies and in other countries.

About 125 major sounding rockets of the Nike Cajun/Apache, Aerobee and Javelin types, and 12 of the Arcas type were launched during 1965 from sites in the United States, Canada, Brazil, India, Surinam, New Zealand, Norway, Pakistan, and from shipboard launchings from a converted Navy aircraft transport. This Mobile Launch Expedition, planned as part of the International

Year of the Quiet Sun, provided a very successful series of launchings into the atmosphere and ionosphere in geographical regions which could not be reached by land-based rockets. A large volume of new and useful data about the "equatorial electrojet," a system of electrical currents circulating in the ionosphere near the geomagnetic equator, and on other ionospheric phenomena was obtained during this expedition.

Sounding rocket projects are planned to be continued in FY 1966 and 1967 in many areas where experimentation has begun, including atmospheric and ionospheric measurements, cosmic dust collections, chemical releases in the upper atmosphere; and X-ray, ultraviolet and infrared observations of celestial sources and the sun. Increases in the program for FY 1966 and FY 1967 are largely due to the development and increased use of improved attitude control systems and to an increased use of the larger, more expensive vehicles to carry stabilized payloads, as well as heavier payloads, with several instruments for a number of simultaneous measurements.

Data Analysis

	1965	1966	1967
Operation of the data center ...	---	$300,000	$600,000
Research tasks	---	1,800,000	1,400,000
Total	---	$2,100,000	$2,000,000

A National Space Science Data Center has been established at the Goddard Space Flight Center to provide for the collection, cataloging, storage and dissemination of reduced data from space sciences flight experiments. Data collected will be made available at a cost commensurate with reproduction and distribution cost to those interested in using the data for further research. To encourage the full use of the data obtained on NASA flight programs, support will be provided for scientific research efforts which make use of the data. Proposals for research are being competitively evaluated, and support is being provided for those efforts which can be expected to contribute the most to the total advancement of knowledge in space science. Fiscal year 1967 funds will provide for operation of the Data Center at a level consistent with the input of reduced data and for support of data analysis efforts.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1967 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS — LUNAR AND PLANETARY PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of the Lunar and Planetary program is the scientific exploration of our solar system utilizing unmanned and manned spacecraft and earth-based research. Immediate objectives include the exploration of the moon, the planets Venus and Mars, and the intervening interplanetary space. The fulfillment of long range objectives will see the eventual exploration of the outer planets and their moons, comets, asteroids and corresponding planetary and interplanetary deep space environment. The ultimate achievement of these objectives will provide data to better explain the origin, history and mechanisms of development of our solar system and may provide evidence of the existence of forms of life elsewhere in the solar system.

The lunar program consists of three types of missions. The first of these, the Ranger program, has now been completed, yielding over 17,000 photographs of the lunar surface. The photographs have provided a much better understanding of the nature of the surface of the moon. However, information such as the composition and bearing strength of the lunar surface is dependent upon the next series of missions to the moon. The Surveyor program is intended to soft land a series of unmanned spacecraft with a complement of instruments on the surface of the moon for making first hand observations and obtaining physical measurements of that body. Many of the difficult developments required have been completed and its first flight is planned for later this year. After landing, each Surveyor spacecraft will survey the immediate area to determine the suitability of that site for later manned missions. The Lunar Orbiter program was conceived and initiated to supplement the information obtained by Ranger and to work in a team relationship with Surveyor in conducting scientific investigations, and locating and certifying suitable landing sites for Apollo. The Lunar Orbiter will be capable of photographing all regions of the moon and therefore, will be a useful tool in continuing lunar exploration. Scientific instruments and techniques are also being developed for lunar studies utilizing man's capabilities and the payload return capabilities of the Apollo program.

The Planetary and Interplanetary programs have experienced a high degree of success with the Mariner II flyby of Venus, the Mariner IV photographic mission to Mars and the most recent successful launching of the Pioneer VI spacecraft to an orbit around the sun. Each of the planetary missions have yielded a wealth of scientific information. Mariner II provided new data on the physical characteristics of the atmosphere of Venus. Mariner IV produced the first close up photographs of the Mars surface and, in addition, performed many important scientific measurements permitting a considerably better understanding of the nature of that planet. Pioneer VI and additional

Pioneer launches during FY 1966-1968 are planned to measure interplanetary phenomena at extended distances from earth. The next steps in the evolution of planetary exploration will be fly-by missions to Venus and Mars in 1967 and 1969 respectively utilizing the Mariner IV design. Development efforts will also be continued leading to the detailed exploration of these planets under the Voyager program now being planned for a first operational mission during the 1973 Mars opportunity.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Supporting research and technology/Advanced studies....	$24,140,000	$38,600,000	$40,100,000
Ranger.....	11,037,000	1,000,000	---
Surveyor.....	81,814,000	111,637,000	90,400,000
Lunar orbiter.....	49,500,000	52,400,000	24,600,000
Mariner.....	17,368,000	18,000,000	26,100,000
Voyager.....	7,168,000	17,000,000	10,000,000
Pioneer.....	15,000,000	12,700,000	6,700,000
Total.....	$206,027,000	$251,337,000	$197,900,000

Distribution of Program Amount by installation:

	1965	1966	1967
Manned Spacecraft Center.....	$2,608,000	$14,400,000	$15,200,000
Marshall Space Flight Center...	435,000	375,000	300,000
Goddard Space Flight Center....	1,267,000	1,164,000	1,200,000
Jet Propulsion Laboratory.....	126,580,000	156,607,000	136,700,000
Ames Research Center.....	15,734,000	12,763,000	7,000,000
Langley Research Center.....	50,050,000	53,115,000	23,200,000
Lewis Research Center.....	97,000	---	---
NASA Headquarters.....	9,256,000	12,913,000	14,300,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology/Advanced Studies

	1965	1966	1967
Lunar and planetary science.....	$12,285,000	$12,000,000	$12,000,000
Advanced technical development..	6,151,000	6,800,000	6,800,000
Advanced studies.....	2,059,000	2,500,000	2,500,000
Manned lunar science.....	3,645,000	17,300,000	18,800,000
Total.....	$24,140,000	$38,600,000	$40,100,000

Activities funded under Supporting Research and Technology provide for essential support of approved flight missions as well as the necessary feasibility studies and other advanced work required to establish future missions.

The Lunar and Planetary Science program provides the means of developing new concepts and ideas for scientific investigation of the moon and planets to the stage where they can be proposed as flight experiments for future missions. The activities which are performed provide scientific data for the design and calibration of flight experiments and for the analyses of the results of experiments already performed. Laboratory, theoretical, and observational research in this area is being performed at NASA centers, other government facilities, universities, and industrial concerns.

The moon and planets are being observed with optical and radio instruments in order to obtain information needed for the design of spacecraft and the selection of experiments for lunar and planetary flight missions. The nature and bearing strength of the lunar surface and the variation of pressure with altitude in the Martian atmosphere continue to be the most important problems currently under investigation. Adequate knowledge of the characteristics of the lunar surface is essential for safe manned exploration and for the successful performance of soft landing unmanned scientific payloads. The characteristics of the Martian atmosphere have become of increased concern during the past year due to the occultation experiment of Mariner IV which gave the surface pressure, a value near five millibars. A series of spectroscopic observations completed during 1965 gave values between 10 and 15 millibars. Both of these values are dependent on assumptions which may or may not be valid. It is therefore planned to conduct more comprehensive and definitive studies on this problem in 1967, the next period of closest approach of the planet Mars.

The Advanced Technical Development program involves the development of equipment and technology needed for flyby, orbiting, and landing missions to Mars and other planets. Successful completion of these missions requires equipment which will be extremely reliable and able to survive both a rigorous sterilization and long exposure in a deep space environment. It must also make the greatest possible use of the capability of the improved launch vehicles which will be available in a few years. In the FY 1966 program primary emphasis has been placed on the areas of communications, power management and the sterilization of spacecraft components to prevent contamination of Mars. Mariner IV data on the atmospheric pressure on Mars has confirmed the need for the increased attention given in FY 1966 to landing technology to ensure safe landing on the surface of the planet. The FY 1967 funds will enable the continued effort in support of Mars exploration. Efforts will continue on communications, power, and sterilization, and will also place emphasis on high impact technology. With the identification of technology requirements for a Jupiter mission, derived in the advanced studies area, plans will be made to develop this technology in FY 1967.

Planning for the future in Lunar and Planetary programs requires the continued study of advanced missions. The cataloging of possible missions to the planets is a continuing process as new flight techniques and increased booster capabilities evolve. Fiscal year 1966 funds were utilized in surveying the potential of trajectories which swing-by one planet enroute to a different target planet, in terms of the reduction of trip time to the target and energy required. Included in this survey were Mars, Venus, Mercury, Jupiter, Saturn, and other outer planets. In FY 1966 spacecraft conceptual design studies were initiated to meet the most important lunar and planetary scientific objectives. Highest on the list after Venus and Mars are flights to Jupiter. Some work was also conducted in regard to missions to comets and asteroids. Fiscal year 1967 funds will be used to continue the surveying of possible missions and the generation of concepts for the exploration of the Moon, Venus, Jupiter, comets, and asteroids. In addition, a preliminary study will be conducted to determine the feasibility of a planetary probe to Saturn.

The planning of scientific investigations and the design and development of equipment for manned lunar missions is accomplished by the Manned Lunar Science program. Early manned missions to the moon will stress the observation of natural phenomena, collection of representative samples and emplacement of monitoring equipment. To achieve these goals a lunar surface experiment package capable of conducting geophysical investigations and the environmental measurements; geological surveying systems; equipment and procedures for sampling lunar surface material; and earth-based laboratories for the analysis of return lunar surface samples are being developed. Applied research on the lunar environment is currently underway in order to meet specific needs for information about lunar phenomena required to design and develop safe, reliable manned space flight systems. Lunar mapping required in the planning, development, training and execution of manned and unmanned missions is also being undertaken.

Surveyor

	1965	1966	1967
Spacecraft	$74,479,000	$105,400,000	$82,800,000
Experiments	2,523,000	3,437,000	4,000,000
Ground operations	4,812,000	2,800,000	3,600,000
Total Spacecraft and Support	$81,814,000	$111,637,000	$90,400,000
Atlas-Centaur (Launch Vehicle Procurement Program)	(40,064,000)	(50,000,000)	(50,000,000)
Total (including Launch Vehicles)	($121,878,000)	($161,637,000)	($140,400,000)

The Surveyor system is being developed to soft land an unmanned spacecraft on the lunar surface and make measurements of the nature of that body. A successful landing will yield significant information on landing technology and the surface characteristics which affect the landing. After landing on the surface, each Surveyor spacecraft will survey the immediate area as a possible site for later manned landings.

The major objective of Surveyor is to provide the information which will assure the high confidence required before manned landings can be attempted. Since the Surveyor design concepts are basically the same as those being used on Apollo, the successful landing and operation of a Surveyor in the lunar environment will demonstrate the overall feasibility of later manned landings and many Surveyor spacecraft elements which are also basic to the Apollo Lunar Excursion Module (LEM); e.g., radar altimeter, radar doppler velocity sensors, closed-loop terminal guidance system, variable thrust rocket engines, leg-type landing gear, S-band communications, and tracking to lunar distances. Data obtained on surface characteristics such as roughness, bearing strength, and dust coverage will have direct application in the planning for manned missions.

The Office of Space Science and Applications, NASA Headquarters, is responsible for overall management of the Surveyor program. Responsibility for project management is assigned to the Jet Propulsion Laboratory. The Surveyor spacecraft system is being developed by the Hughes Aircraft Company. Major subcontractors are Thiokol/Elkton for the main retro-rocket, Thiokol Reaction Motors Division for the vernier propulsion system, and Ryan Electronics for the attitude and velocity-sensing radars.

Effort during 1965 was devoted primarily to conducting the tests required to confirm the design of the spacecraft and to identify and correct any existing weak areas. While significant progress was made, including the first successful descent test using the Surveyor closed-loop landing system (radars, vernier engines, and interconnecting control circuits), delays were encountered which made desirable an overall review of how Surveyor could best meet the needs of the Apollo program. Of major concern were the problems associated with developing the 2200 pound spacecraft for missions A through D while simultaneously uprating the design to 2500 pounds for missions E, F, and G. It was concluded that every effort should be taken to maximize the probability of early success with the 2200 pound spacecraft, especially since a significant portion of the data required by Apollo can be obtained with the lighter design. The additional information attainable with the 2500 pound spacecraft may be necessary in the event of encountering a lunar surface which is marginal for manned landings. It would be obtained after the successful accomplishment of the preliminary lightweight missions. Based on the above, the program was redirected whereby missions E, F, and G were converted from 2500 to 2200 pound spacecraft.

Fiscal year 1966 funds are being used to complete testing and to launch the first flight spacecraft (Mission A). Assembly and testing of the second flight spacecraft will also be completed. Hardware has been ordered through

mission G, and a reliability improvement program implemented. Effort is being continued at a modest level on design and development of pacing items for the 2500 pound spacecraft, now planned for flights H through J.

Fiscal year 1967 funds will be used to launch missions B, C, and D. The spacecraft for missions E, F, and G will be assembled and placed under test. Detailed engineering and hardware procurement will be undertaken for three 2500 pound spacecraft. Prior to FY 1965, funds in the amount of $216,433,000 were applied to the Surveyor program, including launch vehicle procurement. Funding for FY 1968 and to completion is estimated to be $157.1 million.

Lunar Orbiter

	1965	1966	1967
Spacecraft	$48,756,000	$49,020,000	$20,300,000
Experiments	---	140,000	2,300,000
Ground operations	744,000	3,240,000	2,000,000
Total Spacecraft and Support	$49,500,000	$52,400,000	$24,600,000
Atlas-Agena (Launch Vehicle Procurement Program)	(9,102,000)	(17,059,000)	(4,567,000)
Total (including Launch Vehicles)	($58,602,000)	($69,459,000)	($29,167,000)

The Lunar Orbiter will team with landed Surveyors to conduct unmanned scientific investigations of the moon prior to the Apollo period. The Orbiter will photograph the lunar surface in both medium and high resolution. High resolution Orbiter photographs from a single Lunar Orbiter mission will be comparable in quality to the final Ranger pictures, but will cover a much greater area, equivalent to a belt of terrain about one mile wide extending from Washington to Los Angeles. The medium resolution photographs will overlap to provide stereo coverage, and in combination with the high resolution photographs, which are taken simultaneously, will permit topographic mapping of extensive portions of the moon. The selenodetic data which will be obtained from the Lunar Orbiter flights will be significant and useful: analysis of orbits will give more precise knowledge of the lunar gravitational field, which is related to its mass distribution, surface shape, internal structure, and possible seismic activity. The improved gravitational and shape data will benefit Apollo guidance calculations.

The Lunar Orbiter is an attitude stabilized spacecraft, relying primarily on solar panels to supply power. Its design and development made maximum use of existing technology; much was developed under the Ranger, Mariner, and other earlier NASA and Department of Defense space programs. The Lunar Orbiter must perform more maneuvers than Ranger or Mariner. Following launch, the spacecraft propulsion system is required to function three or four times--one or two midcourse maneuvers to ensure proper lunar intercept, a firing to reduce velocity to inject the spacecraft into an elliptical orbit about the

moon, and a final firing to lower the perilune of the orbit to as low as 28 miles from the lunar surface. The attitude control system must maintain a Sun-Canopus orientation to provide communications and solar power, and must reorient the spacecraft to set the camera axis vertical each time a strip terrain is to be photographed.

The Boeing Company is the spacecraft systems contractor under the management of the Langley Research Center. The Radio Corporation of America is providing the power system and much of the communications system and Eastman Kodak is developing the photo system. The Lewis Research Center is responsible for the launch vehicle system and the Jet Propulsion Laboratory will manage the tracking and data acquisition system.

The first flight spacecraft and the ground test spacecraft have been assembled and are being tested. The balance of this fiscal year's funds will provide for assembly of all five flight spacecraft, completion of prototype testing and the launching of the first flight spacecraft.

The funds requested for FY 1967 will provide for three additional launches, support post-launch operations, initiate data analysis for the first four missions, and provide for the payment of performance incentive fee to the systems contractor.

Fiscal year 1964 and prior year funding for Lunar Orbiter, including launch vehicles, was $30,268,000. About $3,300,000 will be required in FY 1968 for mission operations and data analysis.

Mariner

	1965	1966	1967
Spacecraft	$10,487,000	$11,260,000	$16,000,000
Experiments	2,274,000	3,400,000	4,000,000
Ground operations	4,607,000	3,340,000	6,100,000
Total Spacecraft and Support.	$17,368,000	$18,000,000	$26,100,000
Atlas-Agena (Launch Vehicle Procurement Program)	(4,583,000)	(2,544,000)	(7,267,000)
Total (including Launch Vehicles)	($21,951,000)	($20,544,000)	($33,367,000)

The objectives of the Mariner program are to conduct initial investigations of the planets Venus and Mars, and to develop the medium size (400-800 pound) fly-by spacecraft and instruments required for such exploration. Accomplishments to date include the December 14, 1962, Mariner II fly-by of Venus which provided the first direct temperature and magnetic field measurements from near the planet. This was followed by the Mariner IV flight past Mars on July 14, 1964, that resulted in the first close-up view of the planet showing a

cratered surface similar to that of the moon. Mariner IV further detected a negligible magnetic field around Mars and found the atmospheric pressure considerably lower than had been previously believed. In addition to the information gained at encounter, the Mariners provided almost a year's accumulation of data on the interplanetary environment including energetic particle flux, magnetic fields and micrometeorite distribution.

Although the Mariner IV spacecraft is presently beyond the limits of telemetry communication, its carrier signal is still being received from over 210 million miles distance, and it is still believed to be operating properly. Attempts will be made to re-establish two-way communications when the spacecraft approaches the earth in 1967. If these attempts are successful, additional valuable information on the space environment and its effects on spacecraft systems will be obtained.

With the postponement of first Voyager flights until 1973 necessitated by the reduced funding level, additional Mariner missions are under development to obtain additional planetary data during intervening opportunities. The additional Mariner missions consist of one flight to the planet Venus in 1967 and two flights to Mars in 1969. The Venus mission will be conducted by modifying the spare spacecraft from the Mariner IV project to perform a Venus fly-by using the Atlas-Agena launch vehicle. The 1969 Mars missions will be planetary fly-bys using the Atlas-Centaur launch vehicle. The Mars 1969 spacecraft will be based on the Mariner IV design modified to carry improved experiments and make the maximum possible contribution to the Voyager program.

Overall management of this program is the responsibility of the Office of Space Science and Applications. Project management responsibility has been assigned to the Jet Propulsion Laboratory. The Lewis Research Center is responsible for the launch vehicles.

Fiscal year 1965 funding supported pre-launch, launch, and the major portion of the in-flight operations for the Mariner 1964 missions. Fiscal year 1966 funding covered operations immediately preceeding and through the Mars encounter of Mariner IV. Most of the experiment data analysis and publication of final project reports will be completed with current fiscal year funds. In addition, work is being initiated on the Mariner 1967 Venus and Mariner 1969 Mars missions.

Funding requested for FY 1967 will provide for activities associated with the return of Mariner IV and related data analysis; the modification of the spare Mariner IV spacecraft for the Venus mission, its testing and preparation for launch; completion of systems design and initial fabrication of the prototype and flight hardware for the 1969 Mars mission.

Funding for the Mariner program in FY 1964 and prior, including launch vehicles, amounted to $173,216,000. Planned funding for FY 1968 to completion through the 1969 Mars missions is $88,800,000.

Voyager

	1965	1966	1967
Mission design	$1,661,000	$2,000,000	1,500,000
Spacecraft system	4,718,000	8,000,000	500,000
Capsule system	789,000	7,000,000	8,000,000
Total	$7,168,000	$17,000,000	$10,000,000

The capability for detailed study of the near planets is being developed through the Voyager project, now planned for flight missions to Mars beginning in 1973. The primary objective of these missions is to obtain detailed information on atmospheric, surface, and body characteristics, with special emphasis on the possible existence and nature of life on the planet. A secondary objective is to further our knowledge of the interplanetary medium between the planets Earth and Mars by conducting scientific and engineering measurements while in transit.

To meet the above objective, a spacecraft is required having the capability to orbit the planet and land a scientific payload on the surface. As presently conceived, this spacecraft would consist of three modules; the bus-orbiter module, the retro-propulsion-module, and the entry capsule module. Definition studies have indicated the desirability of launching two of the Voyager spacecraft on a single Saturn V launch vehicle to take advantage of this vehicle's weight lifting capability and planned reliability. Although the system is being developed to explore the planet Mars, it will provide a basic capability which can be applied to the future exploration of other planets by automated spacecraft.

Overall management of this program is the responsibility of the Office of Space Science and Applications. The Jet Propulsion Laboratory has been assigned management responsibility for Voyager project.

Based on conceptual studies carried out in FY 1964, a project definition effort was initiated in FY 1965 directed toward a decision for initiation of flight hardware development in FY 1967. This schedule would have made possible first flights at the 1971 Mars opportunity. However, first flights have been rescheduled for the 1973 Mars opportunity. The additional time will be used to further define the mission, the spacecraft system specifications and the capsule system. Particular emphasis will be placed upon the capsule. This additional effort should make possible a more sophisticated capsule landing system for the 1973 mission than had previously been planned for 1971.

Fiscal year 1965 funds provided for the initiation of spacecraft system definition effort which included the selection of three industrial contractor teams to conduct preliminary design studies of the bus-orbiter and retro-propulsion-modules. Capsule design studies were conducted in-house by the Jet Propulsion Laboratory supported by the Langley and Ames Research Centers.

Fiscal year 1966 funds are being applied to completion of the contractor design efforts and continuation of the in-house design studies, with particular emphasis on the capsule system design problems.

The funding requested for FY 1967 will be used to continue the overall mission design studies, the capsule design studies, and supporting activities leading to detailed system design and breadboard tests planned to be initiated in FY 1968.

Pioneer

	1965	1966	1967
Spacecraft	$13,189,000	$6,300,000	$4,300,000
Experiments	1,456,000	5,200,000	1,500,000
Ground operations	355,000	1,200,000	900,000
Total Spacecraft and Support.	$15,000,000	$12,700,000	$6,700,000
Delta (Launch Vehicle Procurement Program)	(3,521,000)	(5,583,000)	(1,001,000)
Total (including Launch Vehicles)	($18,521,000)	($18,283,000)	($7,701,000)

The objectives of the Pioneer project are to investigate the interplanetary environment and the propagation of solar and galactic phenomena through this medium. Correlation with similar measurements performed near the earth with satellites are required to attain the full objective. Pioneer spacecraft will be launched during the period of increasing solar activity over the next several years.

The current series of Pioneers weigh about 140 pounds and are launched with the Thrust-Augmented Improved Delta. The first of these Pioneer VI, was successfully launched in December 1965. Four additional Pioneer spacecraft are scheduled to alternate between missions towards and away fron the sun, approaching as close as 0.8 A.U. and going as far away as 1.2 A.U. from the sun. (1 A.U. is equal to the mean earth to sun distance, 92,900,000 miles.)

The Pioneer experiments are designed to measure the solar wind flux, magnetic fields, and the electron density in space; the energy spectra, fluxes, and direction of arrival of solar and galactic cosmic rays will also be observed. To perform these measurements special care is being taken in the design and construction of the Pioneer spacecraft to make it magnetically clean; the residual spacecraft magnetic field is less than one one-hundred-thousandth of the earth's field. Instrumentation to measure micrometeorite impacts will also be included in third, fourth and fifth Pioneers of the current series.

Responsibility for overall management of this program rests with the Office of Space Science and Applications, with the Ames Research Center responsible for project management. The spacecraft are being procured through contract with Thompson-Ramo Wooldridge Corporation. The Jet Propulsion Laboratory is responsible for tracking and data acquisition systems management and the Goddard Space Flight Center for launch vehicle systems management.

Fiscal year 1965 funds provided for assembly and testing of the prototype spacecraft, and the fabrication, assembly and initial tests for the first two flight spacecraft. Fiscal year 1966 funds cover the final testing, launch and post-launch operations for the first flight spacecraft, the final testing and launch preparation for the second spacecraft, and the assembly and initial testing of the subsystems for the third, fourth and fifth spacecraft.

Funds requested for FY 1967 will support the launch and post-launch operations for the second spacecraft, final testing and launch preparation for the third spacecraft, and integration and acceptance tests for the fourth spacecraft. Funding for FY 1964 and prior, including launch vehicles, amounted to $23,219,000. It is now estimated that $9.0 million in FY 1968 will complete funding for the first five missions.

OFFICE OF SPACE SCIENCE AND APPLICATIONS — SUSTAINING UNIVERSITY PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The basic objective for the formation and continuing development of the Sustaining University Program is NASA's desire to strengthen the universities while seeking their help in accomplishing the Agency's mission. NASA supports the training of graduate students in space-related disciplines, the construction of urgently needed facilities at universities engaged to a significant degree in space-oriented research or research potentially applicable to the space program, and the conduct of a variety of multidisciplinary research. Attainment of this objective will help replenish the national manpower supply of highly trained people, make available suitable laboratory facilities in which space-related research may be conducted efficiently, and broaden the national base of research upon which technological progress ultimately depends.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Training.....	$25,000,000	$25,000,000	$22,000,000
Research facilities.....	10,000,000	8,000,000	7,000,000
Research.....	11,000,000	13,000,000	12,000,000
Total.....	$46,000,000	$46,000,000	$41,000,000

Distribution of Program Amount by Installation:

Jet Propulsion Laboratory...	$3,000	---	---
Lewis Research Center.....	11,000	---	---
NASA Headquarters	45,986,000	$46,000,000	$41,000,000

BASIS OF FUND REQUIREMENTS:

Training

	1965	1966	1967
Training.....	$25,000,000	$25,000,000	$22,000,000

The objective of the training grants program is to increase the supply of scientists and engineers highly trained to meet the challenge of national

space goals. By providing opportunities for predoctoral graduate research training, many qualified students are being trained to provide staff leadership for space-related activities in the nation's industries, government research centers, and universities. The result is more effective research in industry and laboratory, and a regenerative training process in the universities. The university phase is sustained by the Summer Faculty Fellowships for young staff members of unusual promise.

The predoctoral research training is designed to yield 1,000 Ph.D.'s annually in science and engineering from an annual input of about 1,300 candidates. Most of these graduates will devote their careers to some aspect of the space program. In September 1965, some 1,275 students began their tenure as NASA sponsored trainees. About 1,335 students will begin their three-year training in September 1966, and it is planned to start another group of about 1,000 in 1967.

Since the inception of the program, 104 students have received the Ph.D. degree. The academic fields in which the degrees were earned are: 56 in the physical sciences, 31 in engineering, 12 in the life sciences, and 5 in other specialized areas with emphasis on space-related problems. Since receiving their degrees, the students have made the following career choices: (a) university research and/or teaching - 65; (b) postdoctoral fellowships or Fulbright awards - 15; (c) employed in government laboratories - 4; (d) employed in industrial laboratories - 20.

In addition to the predoctoral program, a limited number of special training activities will be supported. These activities will be directed toward select groups who will make unique contributions to the space effort. The Summer Faculty Fellowship Program provides an opportunity for about 150 young college or university faculty members to participate in ongoing research projects at a NASA center and concurrently engage in related seminar or classroom discussions at a nearby university. Six NASA centers and twelve universities will participate in this program in 1966.

In addition to summer training for faculty, NASA will sponsor a few summer programs for exceptionally talented undergraduates who are to be chosen on a national basis to participate in an exploratory program in space science or in space technology. In FY 1966 three programs will be supported involving about 150 undergraduate students. Subject to the availability of funds, NASA plans to continue to sponsor these types of specialized training programs in FY 1967.

Research Facilities

	1965	1966	1967
Research facilities.....	$10,000,000	$8,000,000	$7,000,000

The objective of this portion of the program is to provide needed laboratory space for those universities already heavily committed to the space program.

For the nation to reap the maximum benefit from university participation in the space program, adequate facilities in which to perform laboratory research and to develop experimental packages are needed on campus. Good faculty researchers cannot participate fully in programs which keep them off campus and away from their students. However, sufficient facilities made available on campus allows not only for full faculty participation, but also provides excellent opportunities for students to work together with their professors on important space projects. Existing academic buildings, in addition to being overcrowded with the burgeoning student population, are not equipped nor suitable for these space program efforts, hence new campus facilities are urgently needed.

To date a total of seventeen buildings spread throughout the nation's universities have been completed under this program. These completed facilities represent one-half million gross square feet of new area in use or planned for university space research. The facilities completed to date typify the two general types needed by universities in order to contribute their unique input of knowledge and trained individuals to NASA's programs. Highly specialized facilities are provided specifically for certain types of research, such as that involved with propulsion or the preparation of experiments to be carried on satellites. The rocket test stand facilities constructed at Purdue University with a NASA facilities grant are an example of this type of real property which is not normally associated with university buildings, but which is essential to conduct modern research while training future scientists and engineers in such a fundamental aerospace field as propulsion. The other general need toward which NASA facilities are directed is illustrated by the space sciences laboratories built by the University of Pittsburgh. These facilities provide at Pittsburgh, for the first time, a suitably designed and equipped building in which investigators from many departments in the University can work together on the complex problems inherent in space ventures. In the Pittsburgh building, the professors and staff responsible for passing along to the community they serve the useful technology resulting from the space program, work alongside the professors and staff producing the knowledge and interpreting the research results. This particular project points up a prime objective of NASA facilities grants, that is, to provide facilities which are urgently needed and involve the largest possible productive segment of the University in the space program.

In responding to the space-oriented research facilities needs of the nation's universities, NASA has funded grants in most of the major geographical areas of the country, and has cooperated with the other agencies

in the federal government charged with assisting universities in their building program. Cooperative projects have been undertaken with the National Science Foundation, the National Institute of Health, and the Office of Education. Each of these agencies has its separate responsibilities to higher education, and when facilities projects have encompassed more than one of these responsibilities, the agencies have acted in concert without duplication of effort. Despite these combined efforts, the total needs of universities for adequate space in which to conduct graduate training and research are so numerous that many have remained unsatisfied.

The FY 1967 request of $7 million will permit acquisition of about two hundred thousand (200,000) square feet of new laboratory space.

Research

	1965	1966	1967
Research.....	$11,000,000	$13,000,000	$12,000,000

The purpose of research grants is to expand and improve the capabilities of the nation's universities to conduct research in space and aeronautical science and technology.

Research grants are awarded to:

Universities not currently participating in the national space programs. Such grants provide research opportunities which will encourage the development of new research talents and interests responsive to project or discipline challenges likely to be encountered in the exploration of space and;

Universities deeply involved in the space program, to augment and fill gaps in existing work and to consolidate related research activities.

Although the size, scope, and specific nature of each grant differs according to the capabilities of each institution, there is a general pattern common to all of them. This pattern has the following characteristics:

Attention is concentrated on an individual or group which serves as a focal point for space-related activity in the university.

The funding and research descriptions are flexible enough to permit shifts of emphasis within the program to areas of greatest importance as the research progresses.

The choice of specific method of attack rests with the university and the individual investigators, thus affording the institution an opportunity to utilize its resources in the most efficient manner and assuring the continued flow of research ideas.

Forty multidisciplinary research grants now exist in 40 universities, located throughout the country. Each university has different assets and capabilities, and our relationship with each varies accordingly. Through the support of quality work at selected institutions not currently participating in space research, the number of universities involved in space related problems is permitted to grow. By providing new opportunities to these institutions to work with us, many excellent research programs have emerged, new talents and skills have been developed, and new ideas have been brought to our attention. The net result is a broadening of our national base of research participation.

To the university already heavily involved in space-related research, this program provides an opportunity to make more efficient use of its assets by augmenting existing work, filling gaps in research programs, and consolidating related work. More importantly, however, it provides an opportunity for the development of multidisciplinary approaches to broad problems which require a focusing of talents from several different disciplines. Many of the scientific and technological problems facing NASA require an understanding of the behavior of large and complex systems that resist piece-meal attack, and their solution demands the concerted and cooperative effort that universities can provide by bringing together their many specialists from varied technical and scientific disciplines.

For the continuation and growth of these special purpose research programs in FY 1967, approximately 71 projects will be supported at a cost of $12 million. Sixty five of these grants will be for the continuation of projects supported in FY 1965, and the remainder will be to universities participating in this program for the first time.

OFFICE OF SPACE SCIENCE AND APPLICATIONS LAUNCH VEHICLE DEVELOPMENT PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The purpose of the Launch Vehicle Development Program is to ensure a timely and economical availability of launch vehicle capability to meet unmanned mission requirements. Continuing Advanced Studies of mission requirements defines needs in terms of improved vehicle performance. As the mission requirements exceed present vehicle capability, these performance increases are translated into required systems improvements, configuration changes, improved operating techniques, new stages, and new launch vehicles or combinations thereof. If major development is required to meet new mission needs, implementation of the development would be within the Launch Vehicle Development Program. The Scout and Delta programs, generated and implemented in this fashion, were completed in FY 1963. The Centaur development program is expected to be completed in a similar manner in FY 1967.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Supporting research and technology/Advanced studies.....	$7,100,000	$4,000,000	$4,000,000
Centaur development.....	89,400,000	51,300,000	29,700,000
Total.....	$96,500,000	$55,300,000	$33,700,000

Distribution of Program Amount by Installation:

John F. Kennedy Space Center, NASA.....	$1,321,000	$820,000	$700,000
Marshall Space Flight Center.	152,000	10,000,000	---
Goddard Space Flight Center..	1,557,000	250,000	---
Electronics Research Center..	100,000	200,000	250,000
Langley Research Center.....	735,000	570,000	600,000
Lewis Research Center.....	91,302,000	42,820,000	31,550,000
NASA Headquarters.....	1,333,000	640,000	600,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology/Advanced Studies

	1965	1966	1967
Advanced studies.....	$842,000	$500,000	$500,000

	1965	1966	1967
Supporting research and technology:			
Propulsion	$2,729,000	$1,245,000	$600,000
Guidance, control and navigation	285,000	200,000	500,000
Instrumentation and electronics	285,000	20,000	---
Structures and materials	229,000	605,000	500,000
Vehicle engineering	130,000	1,430,000	1,900,000
FLOX	2,600,000	---	---
Total	$7,100,000	$4,000,000	$4,000,000

The purpose of Advanced Studies is to define vehicle requirements for future missions and to establish the methods by which needed performance, beyond current capabilities, can best be developed. These studies also provide indications of those areas of research and new technology development which may be most fruitful in terms of future mission benefits. The Supporting Research and Technology efforts are directed toward developing the new technology and techniques shown to be needed by the Advanced Studies. This facet of the program also provides for demonstration of new technology prior to full scale development efforts.

The FY 1966 and FY 1967 studies and technology efforts have been focusing on high-energy mission requirements for a small energetic (kick) stage as an addition to existing launch vehicles. The FY 1967 kick stage efforts will be directed at mission analyses, investigations of subsystem alternatives and vehicle adaptions, and program planning.

Studies are being conducted in the FY 1966 program on solid propellant performance prediction, operational hazards of electrostatic charges on vehicles, improved destruct systems, feasibility of adaptation of the Surveyor retromotor for use as launch vehicle stage propulsion, strapped down inertial guidance and radio guidance feasibility, fluorine hazards and comparison studies of high and low thrust for high velocity missions. Work will continue in FY 1967 on solid propellant prediction efforts, fluorine safety and, for the overall Launch Vehicle and Propulsion Programs, studies of advanced mission requirements, vehicle alternatives and program analysis.

The FLOX technology effort directed toward verifying the feasibility of adding liquid fluorine to the Atlas propellant system for performance improvement was completed with FY 1965 funds.

Centaur Development

	1965	1966	1967
Vehicle development	$77,206,000	$40,480,000	$17,000,000

	1965	1966	1967
Supporting services.....	$4,200,000	---	---
Instrumentation.....	100,000	---	---
Atlas boosters.....	4,250,000	---	---
RL-10-A3 engine improvements...	500,000	$10,000,000	$12,000,000
Propellants.....	3,144,000	820,000	700,000
Total.....	$89,400,000	$51,300,000	$29,700,000

The Atlas/Centaur is under development as a high-energy upper stage vehicle burning liquid hydrogen and liquid oxygen that will provide the required capability for NASA's unmanned lunar and planetary missions. The Centaur program has provided techniques for the handling, storage and use of liquid hydrogen in the space environment. Another feature of the Centaur vehicle is its utilization of an all-inertial guidance system through the complete mission profile.

This development program, initiated by the Advanced Research Projects Agency of the Department of Defense and transferred to NASA in 1959, consists of eight flight tests of the Centaur vehicle. Six of these flight tests have been completed.

After the failure of the first flight test, AC-1, on May 8, 1962, an extensive evaluation was made of the entire program by NASA and the various contractors. A basic reformation of the program was accomplished. With the exception of AC-5, which was destroyed when the Atlas booster failed shortly after launch, all subsequent flights have met all major development test objectives. The failure of AC-3 to achieve orbit occurred after all major test objectives had been met. The most recent success was AC-6, launched August 11, 1965, carrying a 2,084 pound dynamic model of the Surveyor into a simulated lunar intercept trajectory. AC-6 then successfully performed a retromaneuver so that the spacecraft stabilization system would not lock on the Centaur vehicle as a reference point. Flight data indicated that all planned flight events were nominal, and the injection was so accurate that a mid-course correction would not have been required to achieve lunar impact.

The last two development launches will demonstrate the parking orbit or two-burn capabilities of the Centaur vehicle. This is to be accomplished by first launching the vehicle into a 90 nautical mile parking orbit. The Centaur engines will be stopped for a 20 to 25 minute coast period, and then the engines will be restarted to burn until the required velocity is attained for a simulated lunar transfer trajectory.

General Dynamics/Convair is the prime contractor for the Centaur stage. This stage uses the RL-10-A3 engines developed under contract with Pratt and Whitney Aircraft Corporation, and a guidance system developed by Minneapolis-Honeywell as a subcontractor to General Dynamics. NASA has subsequently contracted directly with Minneapolis-Honeywell for the guidance system.

The Lewis Research Center has been assigned management responsibility of the Centaur project. The RL-10-A3 development and improvement programs are under the direction of the Marshall Space Flight Center. Integration of the engines with the Centaur vehicle is under the management of Lewis Research Center.

Funding for FY 1967 is for completion of the developmental effort on the Centaur vehicle and improvement effort on the RL-10-A3 engines.

OFFICE OF SPACE SCIENCE AND APPLICATIONS LAUNCH VEHICLE PROCUREMENT PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of the Launch Vehicle Procurement program is to provide launch vehicles and launch support for unmanned space missions. In addition to the purchase of vehicle hardware, this program includes a broad spectrum of supporting activities required to meet each specific mission objective. The launch vehicles currently procured through this program are: Scout, Delta, Thor-Agena, Atlas-Agena, and Centaur.

Launch Vehicle Procurement is presented as a separate program, which is consistent with actual vehicle procurement practices, i. e., vehicles are ordered in specific quantities. However, in order to identify the amount of launch vehicle funding related to each of the various flight projects for the purpose of identifying total project requirements, such amounts are also shown with the applicable project presentation as a parenthetical notation.

To establish the quantity of vehicles to be ordered the following factors are considered: (1) the current and projected inventory; (2) vehicles ordered but not delivered; (3) current and projected launch schedules; and (4) procurement leadtimes required for vehicle delivery. Procurement of vehicles is adjusted to maintain minimum inventories; however, maintenance of some inventory level is necessary to provide the flexibility to meet changing requirements.

In addition to vehicle hardware procurement, the purchase of services associated with the launch of each mission is included in the Vehicle Procurement program. The costs of trajectory studies, mission modifications to the vehicle, launch crews, propellants, and other similar support are also included.

The Sustaining Engineering and Maintenance effort associated with each vehicle provides the means for keeping the operational vehicles and ground support equipment up-to-date to ensure high performance and reliability. This goal is achieved through product improvement programs, maintenance of ground support equipment, vehicle system engineering, and other supporting services. The cost of this part of the procurement program is not clearly identifiable with a specific mission and therefore these costs are not included in the parenthetical notations shown with each project.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Scout	$13,287,000	$11,700,000	$10,400,000
Delta	32,374,000	27,900,000	22,900,000
Agena	55,040,000	71,100,000	54,700,000
Centaur	44,814,000	64,000,000	64,000,000
Atlas	8,972,000	4,000,000	---
Total	$154,487,000	$178,700,000	$152,000,000

Distribution of Program Amount by Installation:

John F. Kennedy Space Center, NASA	$1,353,000	$2,507,000	$3,319,000
Goddard Space Flight Center	19,496,000	18,580,000	22,205,000
Pacific Launch Operations Office	99,000	---	---
Langley Research Center	13,737,000	11,600,000	10,400,000
Lewis Research Center	107,673,000	137,023,000	115,821,000
NASA Headquarters	12,129,000	5,625,000	---
Western Operations Office	---	3,365,000	255,000

The overall mission plan for launches during this period is:

Vehicle	Calendar Year 1965	Calendar Year 1966	Calendar Year 1967
Scout	4	3	8
Delta	6	6	9
Agena	4	7	11
Atlas	1	-	-
Centaur	2	4	4
Total	17	20	32

BASIS OF FUND REQUIREMENTS:

Scout Procurement

	1965	1966	1967
Vehicles	$1,962,000	$3,600,000	$3,600,000
Motors	3,279,000	1,928,000	2,500,000
Logistics and other	546,000	2,172,000	300,000
Sustaining engineering and maintenance	7,500,000	4,000,000	4,000,000
Total	$13,287,000	$11,700,000	$10,400,000

The purpose of the Scout Procurement program is to provide a reliable, relatively inexpensive vehicle for general space research. It is the smallest of the basic NASA family of launch vehicles and meets the requirements for a variety of small sized payloads for orbital, probe, and re-entry missions.

The Office of Space Science and Applications has assigned management of the Scout project to the Langley Research Center. Ling-Temco-Vought is the prime contractor for the production of Scout vehicles. There are two launch sites capable of launching the Scout vehicle: the Western Test Range in California, and Wallops Island, Virginia.

The logistic support of these launch sites has been integrated into a single effort within this program.

The first operational Scout vehicle was launched April 23, 1962. There have been 40 launches through the end of calendar year 1965 for a wide variety of NASA, Department of Defense, Atomic Energy Commission, and international missions.

The FY 1967 funds for Scout Procurement will be utilized to initiate new procurements of Scout vehicles and launch services. Funds will be applied to continued procurement of first, second, third, and fourth stage motors to meet CY 1967 launch requirements. Funding is also provided for other support requirements, such as adaptation of the Scout vehicles to satisfy spacecraft and other mission peculiar requirements.

To adequately provide Sustaining Engineering and Maintenance support for Scout missions, funds are required for continued effort in the areas of environmental testing, data reduction and analysis, engineering support, maintenance of ground support equipment at the two launch sites, publication of manuals, and other similar support.

Delta Procurement

	1965	1966	1967
Delta stages	$ 6,678,000	$10,300,000	$ 8,725,000
Thor boosters	10,200,000	9,144,000	9,000,000
Propellants	200,000	595,000	695,000
Third stages	554,000	861,000	480,000
Sustaining engineering and maintenance	14,742,000	7,000,000	4,000,000
Total	$32,374,000	$27,900,000	$22,900,000

The purpose of the Delta Procurement program is to provide a reliable launch vehicle for a wide variety of medium size satellites and small space probes.

The Office of Space Science and Applications has assigned management of the Delta project to the Goddard Space Flight Center. The prime contractor for the Delta launch vehicle is the Douglas Aircraft Corporation. Thor boosters are procured through the Air Force.

To date, the Delta vehicle has been launched only from the Eastern Test Range at Cape Kennedy. A second launch site capability is scheduled for completion in the Spring of 1966 at the Western Test Range in California, with an ensuing first Delta launch planned shortly thereafter. Launch services associated with the Delta vehicle are procured on an annual basis, and FY 1967 funds are planned to support requirements at both launch sites. Included in the FY 1967 request are funds to continue procurement of Thor boosters, Delta second stages and third stages to meet launch schedule requirements for the Delta vehicle.

Fiscal year 1966 Sustaining Engineering and Maintenance funds (along with the related funds for Construction of Facilities) will complete the establishment of the Western Test Range launch capability, and the improvement of the Delta vehicle to provide increased payload volume and weight.

Fiscal year 1967 Sustaining Engineering and Maintenance funds are planned to continue maintenance and updating of ground support equipment, mission analyses, performance studies, and miscellaneous minor improvement efforts.

Agena Procurement

	1965	1966	1967
Agena production	$15,756,000	$12,666,000	$11,339,000
Agena mission modifications	12,949,000	31,049,000	14,613,000
Thor procurement	4,111,000	3,796,000	3,885,000
Atlas procurement	14,948,000	17,073,000	17,734,000
Propellants	577,000	516,000	1,129,000
Sustaining engineering and maintenance	6,699,000	6,000,000	6,000,000
Total	$55,040,000	$71,100,000	$54,700,000

In combination with Thor and Atlas boosters, the Agena second stage is employed extensively by NASA. The restartable Agena stage provides considerable latitude in mission capability among the various earth orbital and lunar or planetary missions.

The Agena was developed by the Air Force as a second stage for use in its programs. Early in 1960, NASA decided to use the Agena in combination with the Thor and Atlas boosters rather than develop a similar stage. However, each Agena stage must be modified to meet the specific mission requirements. NASA missions utilizing the Thor-Agena vehicle are presently planned to be launched into polar or near-polar orbits from the Western Test Range.

NASA uses the Atlas-Agena for its unmanned lunar and planetary exploration missions, such as Ranger, Mariner, and Lunar Orbiter; and to launch heavier scientific and applications satellites such as the Geophysical Observatories, the Astronomical Observatories, and the Applications Technology satellites. The Atlas-Agena is normally launched from the Eastern Test Range to support NASA missions, although capabilities for its launch exist at the Western Test Range.

The Office of Space Science and Applications has assigned project management to the Lewis Research Center. The prime contractor is the Lockheed Missiles and Space Corporation. Thor and Atlas boosters are procured through the Air Force.

Funds requested for FY 1967 will provide for continued procurement of the basic Agena stages, Atlas and Thor boosters, and the adaptation of the Agena stages for mission peculiar requirements. The necessary Atlas, Thor and Agena launch support, i.e., launch services, propellants, etc., will also be provided.

Fiscal year 1967 Sustaining Engineering and Maintenance funds are planned to continue efforts in shroud improvement, modifications and improvements to launch pad ground support equipment at both launch sites, and miscellaneous engineering support services.

Centaur Procurement

	1965	1966	1967
Vehicle production	$27,828,000	$39,100,000	$35,381,000
Atlas procurement	5,496,000	6,470,000	9,769,000
RL-10 engine procurement	4,700,000	3,200,000	3,100,000
Propellants	2,040,000	1,230,000	1,750,000
Sustaining engineering and maintenance	4,750,000	14,000,000	14,000,000
Total	$44,814,000	$64,000,000	$64,000,000

The Centaur vehicle is a high performance, general purpose launch vehicle for use on unmanned lunar, planetary, scientific, and applications missions which exceed the capability of the Atlas-Agena vehicle. The present procurement of operational Centaur vehicles is programmed to meet the requirements of the Surveyor unmanned lunar surface exploration project, and the Mariner unmanned planetary exploration project.

As with the Centaur development project, the Office of Space Science and Applications has assigned project management to the Lewis Research Center, and the prime contractor is General Dynamics/Convair, San Diego, California. Pratt and Whitney Aircraft Corporation of East Hartford, Connecticut and West Palm Beach, Florida is an associate contractor for the 15,000 pound thrust liquid hydrogen engines, and Minneapolis-Honeywell of St. Petersburg, Florida is an associate contractor for the Centaur guidance system.

Funds requested for FY 1967 are to continue Centaur procurment in support of the Surveyor program and to initiate procurement for the 1969 Mariner missions to Mars. They will complete procurement of Atlas-Centaur vehicles for the first seven Surveyor missions; provide launch services and other supporting services for CY 1967; and provide for initiation of procurement of additional Atlas boosters, RL-10-A3 engines, and Centaur stages.

Fiscal year 1967 Sustaining Engineering and Maintenance funds will provide for maintenance of ground support equipment at the launch test sites, and for pre-flight and post-flight engineering analyses of performance and reliability aspects of the operational Centaur. Funds will also be utilized for product improvement efforts directed toward systems integration and improving vehicle reliability.

Atlas Procurement

	1965	1966	1967
Atlas vehicles	$972,000	---	---
Sustaining engineering and maintenance	8,000,000	4,000,000	---
Total	$8,972,000	$4,000,000	---

This project consists of procurement of Atlas launch vehicles for unmanned missions. Two vehicles were procured for the Space Vehicles Systems program-project fire. Project management for the Atlas procurement project was assigned to the Lewis Research Center. Funding for the procurement of these vehicles was completed in FY 1965.

Funds indicated for Sustaining Engineering and Maintenance are for the SLV-3X, Atlas improvement program. This effort was initiated late in FY 1965 and will provide greater payload capabilities for all missions utilizing the Atlas booster.

OFFICE OF SPACE SCIENCE AND APPLICATIONS — BIOSCIENCE PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Bioscience program continues to have two primary objectives. The first is the search for extraterrestrial life, with the primary emphasis directed initially to the planet Mars. The specific aims of this objective include: (a) physical and chemical evaluation of the martian surface as a possible environment for life; (b) determination of whether or not life exists, or has existed, on Mars; (c) if life in some form exists, determination of its characteristics; and (d) if no life exists on Mars, investigation of the pattern of chemical evolution in order to evaluate the probability of its future occurrence either spontaneously or by contamination. The search for life on Mars is being implemented in two ways. Since a determination of the existence of martian life requires at least the landing of life-detection experiment packages, the feasibility of conducting such studies using an Automated Biological Laboratory is being studied. Such an integrated system will be capable of performing various experiments in a sequential fashion rather than having completely discrete experiments aboard. The concept of such a system includes the ability to reprogram its analyses, repeat various experiments; and perform necessary computations on the data it obtains. In addition, a program of planetary quarantine effort was established to minimize the possibility that terrestrial organisms could contaminate Mars and thus destroy its scientific value as a means of testing the various hypothesis regarding the existence of extraterrestrial life. The Voyager spacecraft will provide the first capability for landing a sterilized scientific package on the surface of Mars. Continuous effort will be made before initiation of the Voyager flights to assure an adequate understanding of and solution to the very complex problems associated with this effort before commitment to flight hardware procurement.

The second objective is directed towards attaining a thorough understanding of the effects of the space environment on terrestrial organisms. Its implementation includes ground-based experiments and the Biosatellite project. The Biosatellite will study the biological effects of weightlessness, the effects of an environment disassociated from the influence of the earth's rotation, and the combined effects of radiation and weightlessness. Nineteen experiments have been assigned to the respective payloads of the Biosatellite spacecraft. Each of the three principal payloads has a backup in the event of failure. If the flights are successful, the backup spacecraft can be utilized to repeat the experiments for confirmation of the results.

A supporting program of basic and applied research is being conducted in conjunction with and support of the Bioscience program objectives. This effort includes such work as structural and chemical analysis of terrestrial fossils as a means of tracing the history of life on earth in order to improve our capability of looking for life or its precursor chemicals on the moon and planets, the development of automatic systems for conducting chemical urinary analyses during flight, analysis of perception in relation to continual transformations of the visual scene of the perceiver, and the development and miniaturization of a biological telemetry device which may be utilized for telemetry of biological activity aboard space vehicles.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Supporting research and technology	$12,501,000	$15,100,000	$14,700,000
Biosatellite	16,000,000	21,600,000	20,700,000
Total	$28,501,000	$36,700,000	$35,400,000

Distribution of Program Amount by Installation:

Goddard Space Flight Center	$385,000	$420,000	$420,000
Jet Propulsion Laboratory	1,519,000	2,337,000	2,500,000
Wallops Station	60,000	100,000	100,000
Ames Research Center	17,392,000	22,599,000	21,900,000
Langley Research Center	---	30,000	30,000
NASA Headquarters	9,145,000	11,214,000	10,450,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

	1965	1966	1967
Exobiology	$4,900,000	$5,000,000	$5,000,000
Environmental biology	2,800,000	2,800,000	2,300,000
Behavioral biology	2,100,000	2,100,000	2,100,000
Physical biology	1,900,000	1,900,000	1,900,000
Automated biological laboratory	---	1,000,000	1,000,000
Planetary quarantine	---	1,000,000	1,000,000
Bioscience investigations for manned missions	801,000	1,300,000	900,000
Total	$12,501,000	$15,100,000	$14,700,000

Exobiology

The Exobiology program supports the search for extraterrestrial life, including ground-based studies regarding the origin of life on earth, with particular emphasis on the possibility that some form of life may exist on the planet Mars. The ground-based studies are directly relevant to the search for extraterrestrial life since the data derived from these studies may lead to the formation of testable hypotheses regarding the origin and nature of long-evolved or incipient planetary life. In addition, the development of spacecraft experiment packages for biological exploration of the planets may be affected by these investigations as well as by studies of the planetary atmospheres and surfaces and fly-by missions by spacecraft such as Mariner IV.

An analysis of fossil remains in ancient terrestrial rocks has provided data of great interest in tracing the history of terrestrial life. One study employing high resolution mass spectrometry has provided quantitative indications that when molecules associated with life are analyzed in recent and ancient sediments, the quantities of these molecules decrease at a predictable rate as the age of the sediments increases. This technique is applicable to the geochemical analysis of Apollo lunar samples, the analysis of organic matter in meteorites, and the automated analysis of life-related compounds on Mars.

Proteins and their amino acids are universal components of all terrestrial organisms, and the most commonly abundant organic chemical components of living things. Although about 60 amino acids are known to exist, 18 are constituents of our contemporary biota. Of these, about half remain stable for millions of years. These facts suggest that gas chromatography, mass spectrometry, and the application of classical chemical techniques may be utilized in the biological exploration of Mars.

The development of a completely automatic soil processor capable of analyzing surface planetary substances such as soil, dust, and debris provides another way of seeking to detect and analyze extraterrestrial biological activity. This device is based on the property of organic chemicals generated by living matter to twist a beam of plane polarized light as the light passes through. All living species select, contain, and produce optically active substances. The property is retained in recent biological residues and in ancient organic deposits.

The moon is considered by many biochemists to represent a unique opportunity for study of prebiological chemistry and to provide an indication of organic chemistry that would probably have existed on the earth prior to the origin of life, maintained in "cold storage" for millions or billions of years. This is amenable to study by means of samples returned by Apollo missions or in-situ study by automated analytical equipment.

Environmental Biology

Research in the Environmental Biology area is concerned with the biological effects of the space environment on various living earth organisms, including man. Ground-based bedrest experiments with men were made for the primary purpose of determining the extent and cause of musculo-skeletal changes that occur with prolonged bedrest. Studies associated with these experiments indicated that definite cardiovascular deconditioning occurs after 30 days of bedrest and that almost complete recovery can be achieved by two weeks of ambulatory activity.

Research on the effects of stress on the cardiovascular system during simulated space flight has shown that cardiac rhythms (pulse and pressure) have been seriously altered by high noise levels and changes in light intensity.

The metabolic effects of prolonged weightlessness will be studied in the Biosatellite and other manned and unmanned space missions by a system under development by the Jet Propulsion Laboratory. This system will provide for in-flight analyses of physiologically significant urinary biochemical constituents. The system will be automated and will have a functioning capability of about 45 days. Once every six hours, samples of urine will be analyzed and the results telemetered to the experimenter providing him with information regarding the well-being of the subject relative to skeletal, muscular, and general nutritional status as these are affected by space flight.

Other studies have extended our knowledge of the environmental extremes which organisms can endure and still survive. Organisms obtained from such earth habitats as hot springs, deserts, and cold arctic tundra have been grown under circumstances usually considered lethal. The data resulting from these studies are of interest in considering the possibility of life in the reducing atmosphere of Jupiter.

Behavioral Biology

Recent research has emphasized ground-based studies preparatory to in-flight experiments on the effects of zero gravity and other conditions peculiar to the space environment on the behavior of organisms. Emphasis has been placed on the capacity of organisms to adjust to alterations in gravity, particularly the determination of responsiveness of gravity receptors to transient and prolonged stimulation. Additional studies have been conducted on the orientation of biological organisms in time and space in the absence of terrestrial cues.

Research has involved neurophysiological, biochemical, and behavioral analyses which have further elucidated brain-behavior relationships of importance to organisms in environmental adaptation. These studies have emphasized those neurobehavioral relationships which maintain activation and alertness. Other research has been concerned with problems of information storage and

retrieval in living systems, using biochemical biophysical, and electrophysiological approaches. Related studies on processes such as attention, discrimination, perception, and motivation, as well as complex sensori-motor functions have been productive of new insights into the mechanisms of behavior and their interactions with the space environment.

Physical Biology

The Physical Biology program supports research in comparative physiology, bio-instrumentation and molecular biology. Research in comparative physiology includes studies on living organisms which specifically lend themselves to investigations in orbiting biological vehicles, on the nutritional requirements of living organisms for prolonged space travel, and on physiological phenomena and dynamics of various systems. Nutritional studies have shown that men can live on chemically-defined liquid diets for at least six months without apparent ill effects. The dynamics of the body temperature regulatory system, the blood flow (cardiovascular system), and the hormonal system are being studied by physical modeling and analysis in an attempt to understand the mechanics of these systems under normal conditions as well as in stress situations.

Various types of biological instrumentation are being developed to measure and analyze various biological, biochemical, and biophysical phenomena. In biological telemetry, work is proceeding on the development of a multichannel sensing implantable device in order to measure, simultaneously, a number of biological and behavioral activities. In electron microscopy, the development of superconducting lenses may make it possible to observe microscopic material for longer periods of time.

In the area of molecular biology, research is being conducted on biological systems at the molecular and cellular levels. In work on the coding of amino acids during protein synthesis, it has been calculated that the numerical possibilities of amino acids sequence in DNA (deoxyribonucleic acid) are of such magnitude that they can account for the evolution of all living forms.

Automated Biological Laboratory

In order to conduct life detection studies on Mars, it will be necessary to develop an automatic, highly reliable, technically sophisticated biological experiment system. The concept of an Automated Biological Laboratory (ABL) is based upon the conviction of biologists that no single life detector will provide results capable of unambiguous interpretation. The concept approach being investigated through a feasibility study with the Aeronutronics Division of the Philco Corporation envisions a system which can look for many characteristics of life at one time, and which has the capability of reprogramming its analyses, repeating its experiments, performing the necessary computations on the resulting data, and transmitting this data to earth.

This integrated experiment system could perform scientific explorations designed to determine the physical and chemical characteristics of Mars, detect the existence of macromolecules, directly determine the existence and

characteristics of "life", and take pictures, both macroscopic and microscopic, through the light spectra from infrared through the visible and into the ultraviolet.

The aeronutronics' study established the feasibility of the concept of an integrated package of biological experiments, and presented a possible design for an ABL based chiefly on the current state of technology. The study also resulted in the suggestion that thirty five experiments could be included on the first ABL. These experiments would only require twenty seven instruments, however, since several of the instruments could perform multiple experiments.

Planetary Quarantine

The search for extraterrestrial life has the prerequisite that no terrestrial organisms must be conveyed to the planets prior to the time scientific payloads are landed. It is also highly important that life detection instruments are devoid of earth organisms when they land on the planet. Otherwise, they would detect the life they carried when operated on the planets. In order to achieve the goal of preventing the transmission of earth organisms to the planets, various methods have undergone rigorous and intensive study. Current evidence indicates that neither cold, vacuum, ultraviolet, nor solar radiation will reduce microbial life to acceptable levels.

Since the only two agents that kill microbial life, both on the surfaces and in the interiors of solids, are heat and ionizing radiations, and since radiation as a sterilizing agent is expensive, complex, and dangerous, the planetary quarantine program is seeking to utilize heat as the primary means of spacecraft sterilization. As a result, it is necessary to develop spacecraft parts that will withstand the heat required. A related requirement is that the quantity of biological loading on the spacecraft at the time it is ready for sterilization must be limited. Research indicates this may be accomplished most effectively by applying heat or a decontaminate to the spacecraft parts and then assembling them in ultraclean rooms. Subsequently, terminal sterilization will be accomplished by heating the spacecraft in dry nitrogen for a period of time proportional to the number of living organisms on board. Finally, it will be necessary to protect the sterile spacecraft from recontamination during launch from the earth by enclosing the sterile landing capsule in a hermetically sealed canister which would be removed when the spacecraft has reached outer space.

Bioscience Investigations for Manned Missions

For Gemini and Apollo earth-orbiting missions, experiments are in the development or flight stage; three of these have already flown, yielding significant results. The synergistic effects of radiation and weightlessness on human white blood cells were demonstrated during the GT-3 flight. Vision experiments conducted on GT-5 and GT-7 showed that the visual performance of the astronauts did not decline during the period of flight and that the ground observations made from orbital altitudes were within the predicted range of statistical probability. Two unique experiments being prepared for Apollo earth-orbital development flights deal with cell microscopy and stimulus-response relationships of the gravireceptors under conditions of acceleration and weightlessness.

Promising experiments have been identified, and preliminary mission parameters, and spacecraft requirements for a manned zero-gravity laboratory are in the process of definition for the post-Apollo time period. Other manned projects under study concern the use of spacecraft for the sterile collection and return of lunar samples for biological analyses on earth, and bioscience problems associated with manned interplanetary missions.

Biosatellite

	1965	1966	1967
Spacecraft	$10,980,000	$12,334,000	$12,900,000
Experiments	4,936,000	8,641,000	7,100,000
Ground operations	84,000	625,000	700,000
Total Spacecraft and Operations.	$16,000,000	$21,600,000	$20,700,000
Thor Delta (Launch Vehicle Procurement Program)	(2,500,000)	(9,500,000)	(4,500,000)
Total (including Launch Vehicles)	($18,500,000)	($31,100,000)	($25,200,000)

The Biosatellite represents the first systematic effort to investigate the effects on biological systems of such unique aspects of the space environment as weightlessness, the effects of combined weightlessness and radiation, and the removal of living systems from the direct influence of the earth's periodicity. The experiments will study biologic functions at the cell, tissue, organ, and organism levels in a wide variety of plants and animals. In order to accommodate the various experiments, three missions are required.

The first flight will investigate the biological effects on seedlings, plants, and simple forms of life of weightlessness, and the effects on plants, animal cells, and insects of the combination of weightlessness and radiation. It will have a duration of three days. The second flight, scheduled for 30 days, will investigate the effects of weightlessness on a primate's general metabolic behavior and performance, and cardiovascular and nervous systems. The 21-day flight consists of general biology experiments to determine the effects of weightlessness on plant growth and development, growth of isolated human cells, gross body composition and function in mammals, and circadian (24-hour) rhythms indigenous to the organism.

The Biosatellite will be launched from Cape Kennedy by the two-stage, thrust-augmented Thor Delta launch vehicle. The experiments will be contained in the re-entry vehicle while other supporting equipment will be placed in the adapter section. The adapter will be separated from the re-entry vehicle prior to the retro maneuver. Recovery of the spacecraft will be by the United States Air Force using aerial recovery techniques. A backup recovery method will employ various water recovery techniques. The recovered capsule will be delivered to the laboratory at Hickam Air Force Base, Honolulu, within six hours for post-flight examination of the experiments.

It is anticipated that the Biosatellite flights will result in data which will have a wide range of applicability. The testing of biological hypotheses in the areas of genetics, developmental biology, environmental physiology, and general metabolism will be one result of these flights. The Biosatellite should also provide valuable data pertaining to biological requirements for prolonged manned space flight, and the possibility of delayed effects appearing in later life or subsequent generations of animal subjects, with possible applications to man. Also, these flights should result in the development and test of new instrumentation techniques, surgical preparations, and other procedures and devices which may have medical and other applications to human beings.

Fiscal year 1964 and prior years funding for this six flight program amounted to $10,412,000. Funding for FY 1965 provided for design, fabrication, and testing of the spacecraft, and continued funding for experiment development. Funding for FY 1966 provides for fabrication and testing of the spacecraft, subsystem and system acceptance and qualification tests of the prototype vehicle, assembly and functional testing of the 3-day and 30-day flight vehicles and continued funding for experiment development with primary emphasis on the 3-day flight. Funding for FY 1967 will emphasize fabrication, qualification, and systems testing of the 30-day and 21-day spacecraft, and continued funding on experiment development for these two spacecraft. Funding requirements for FY 1968 to completion including launch vehicles are estimated to be $15,628,000.

OFFICE OF SPACE SCIENCE AND APPLICATIONS METEOROLOGICAL SATELLITES PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objectives of the Meteorological Satellites Program are: (1) to develop a satellite capability for global and local readout of cloud cover day and night, global quantitative measurement of temperature, wind, moisture, and other meteorological factors as a function of height under continuous and variable time scales; (2) to develop and implement for the Department of Commerce, Environmental Science Services Administration (ESSA), the Tiros Operational Satellite (TOS) System; (3) to develop a meteorological soundings system to explore and study the atmosphere in the region 20 to 60 miles above the earth; (4) to develop the necessary meteorology-related spacecraft technology and supporting equipment; and (5) to explore the use of manned spacecraft for meteorology.

Objectives (1) and (2) are accomplished by the Tiros/TOS Improvement, Meteorological Flight Experiments and Nimbus projects; objective (3) is accomplished by Meteorological Sounding Rockets; and objectives (4) and (5) are accomplished by the Supporting Research and Technology/Advanced Studies.

Ten Tiros spacecraft, including Tiros X funded by ESSA, have been successfully launched since April 1960 providing cloud cover and meteorological data for research and operational use. Tiros IX and X were launched in 1965. Tiros IX, a research and development satellite in a "wheel" configuration, was essentially the prototype spacecraft for the TOS System to be operated by ESSA starting in 1966. Tiros X was launched into polar orbit instead of a sharply inclined orbit to provide more global coverage.

Nimbus I, successfully launched in August 1964, had an active life of about one month due to failure of the solar array drive mechanism. Three additional flights are planned, one each in 1966, 1967 and 1969. These flights will test: (1) improved power supply and data acquisition systems; (2) initial sensors for obtaining vertical measurements of meteorological data; and (3) sensors and systems to provide full global daytime and nighttime cloud cover data for operational use by utilizing both direct readout capability and stored data for release to data acquisition stations. Research and application of meteorological sensors on non-meteorological satellites is conducted in the Meteorological Flight Experiments project with present effort directed to tests on the Applications Technology Satellites (ATS). Approximately 50 large research rockets and 100 small developmental sounding rockets are launched per year at the current level of effort to explore the region 20 to 60 miles above the earth and to obtain meteorological data from this region. In addition, the project includes field experiment support to acquire atmospheric data in the 20 to 60 mile region with cooperating foreign countries. The investigation of scientific techniques; design and development

of advanced components for general application; improved component reliability and lifetime; study of data acquisition techniques; and feasibility studies on future spacecraft design and capabilities are conducted under Supporting Research and Technology/Advanced Studies.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Supporting research and technology/advanced studies.....	$7,311,000	$8,300,000	$9,100,000
Tiros/TOS improvements.....	4,100,000	3,700,000	2,600,000
Meteorological flight experiments.....	1,200,000	3,900,000	5,500,000
Nimbus.....	16,000,000	20,000,000	23,400,000
Meteorological soundings.....	2,380,000	3,000,000	3,000,000
Total.....	$30,991,000	$38,900,000	$43,600,000

Distribution of Program Amount by Installation:

Marshall Space Flight Center.	$120,000	$170,000	$170,000
Goddard Space Flight Center..	29,505,000	35,400,000	39,300,000
Wallops Station.....	---	180,000	140,000
Electronics Research Center..	175,000	450,000	500,000
Langley Research Center.....	425,000	630,000	630,000
NASA Headquarters.....	766,000	2,070,000	2,860,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology/Advanced Studies

	1965	1966	1967
Synchronous meteorological satellite.....	---	$145,000	---
Sensor requirements and evaluation.....	$2,554,000	2,635,000	$2,335,000
Meteorological component development.....	2,215,000	2,044,000	1,795,000
Meteorological sensor development.....	1,276,000	496,000	690,000
Advanced systems and components	975,000	1,680,000	2,080,000
Advanced studies.....	---	100,000	100,000
Applications for manned space missions.....	291,000	1,200,000	2,100,000
Total.....	$7,311,000	$8,300,000	$9,100,000

The objectives of the Supporting Research and Technology/Advanced Studies are: (1) to develop and evaluate components for potential meteorological satellite system application; (2) to design and develop satellite sensors for the detection and controlled acquisition of meteorological data directly from the atmosphere and from other sources; (3) to investigate scientific techniques and tools for the systematic observation, analysis and subsequent interpretation of meteorological atmospheric phenomena; (4) to optimize satellite performance and information retrieval techniques through advanced system analyses; and (5) to conduct advanced studies on future meteorological satellite systems and components. The results obtained from this endeavor contribute both to achieving the research and development goals of NASA and to the development of the operational meteorological system for ESSA.

Project direction is assigned to the Office of Space Science and Applications at NASA Headquarters, with implementation by Headquarters, Goddard Space Flight Center, Electronics Research Center, and Marshall Space Flight Center.

Funds were expended in FY 1965 and prior years for the design and evaluation of electronic and mechanical instrumentation packages to convert, amplify and process data that will be acquired by advanced optical and infrared sensors. Significant advances were achieved in developing engineering prototypes of separate satellite cameras to achieve automatic day-night coverage; to obtain panoramic high resolution data; and to provide real-time readout by continuous image dissection. New strides were made in satellite data storage techniques; data compaction studies were initiated to gain greater data capacity. Advanced satellite control and stabilization methods were investigated, leading the way to vastly improved meteorological instrument platforms. Funds were also utilized for new developments in rocket wind measurements, on initial efforts to measure stratospheric temperatures and the thermal structure of the atmosphere, and in the study of microwave sensing techniques and sferics measuring techniques. A feasibility study of a synchronous meteorological satellite and studies of necessary camera resolutions for highly eccentric and synchronous orbits were also conducted.

In FY 1966 efforts are continuing in many of the above areas, such as an improved automatic picture transmission (APT) camera and storage system, and improved elements for the interrogation, recording and location subsystem (IRLS) for processing meteorological data from remote instrumented platforms. Research has been continued into the relationship between the heat energy budget of the earth and large scale atmospheric phenomena, and into continued development of an interferometer, spectrometer and other instruments to measure the structure and radiation of the atmosphere. Techniques are being developed to measure the intensity and location of sferics signals, and the atmospheric density by measurement of the refraction of starlight. The flight model of a rocketborne ozonesonde is being completed. Advanced simulated and scaled down systems are being completed for the optimization of satellite control and power components with emphasis on long life and reliable operation. Studies are also being performed in the area of meteorological experiments for manned earth orbiting satellites. An advanced mission study will be undertaken to determine the system parameters of future operational missions for meteorological satellites.

In FY 1967, funds are required for design and development work on remote microwave radiation sensors to take advantage of recent break-throughs in frequency-multiplier components at experimental millimeter wavelengths in the electromagnetic spectrum. Prototypes of advanced new cameras on which work was initiated in prior years will be qualified for space flight. Advanced satellite control techniques, to replace present reaction wheels and associated gas-fed nozzles with passive gravity reacting masses and improved momentum damping techniques, will proceed beyond initial study stages. The design of a flexible automatic computerized telemetry system will begin a two-year development period, providing an extremely versatile method of collecting several types and rates of environmental data aboard the satellite for transmittal to the ground. Microminiaturized transmitters and receivers will be produced for various satellite needs, and will significantly advance the present capabilities for very low power, high reliability, and compactness in physical size. Solid state devices will be investigated as a possible replacement for some of the pick-up tubes presently used, and will result in improvements in life and reliability. Advanced mission studies will be continued on future operational meteorological systems, leading towards a second generation operational satellite system.

Applications for manned space missions include the study and development of scientific investigations and advanced remote sensing equipment for manned orbital spacecraft. These experiments will be utilized for the observation of atmospheric phenomena and its effects on the terrestrial environment. Several investigations of this type have taken place on manned Gemini flights. Studies of experiments for Apollo manned orbital missions were initiated in FY 1965 and FY 1966 to select experiments to take full advantage of manned space flight missions and capabilities. Fiscal Year 1967 funds will be used to continue this effort.

Tiros/TOS Improvements

	1965	1966	1967
Spacecraft	$1,400,000	---	---
Ground support	1,250,000	$400,000	---
TOS improvements	1,450,000	3,300,000	$2,600,000
Total Spacecraft and Support	$4,100,000	$3,700,000	$2,600,000
Delta (Launch Vehicle Procurement Program)	(400,000)	(---)	(---)
Total (including Launch Vehicles)	($4,500,000)	($3,700,000)	($2,600,000)

The successful launch and operation of Tiros IX has demonstrated the feasibility of obtaining nearly global cloud coverage of the sunlit portion of the earth on a daily basis. The objectives of the continuing Tiros research and development project are to provide developmental support for the TOS system.

During 1965, the ninth and tenth Tiros satellites were successfully launched. Tiros IX demonstrated the capability of a cartwheel configured spacecraft to provide global daylight cloud cover pictures on a daily basis. Tiros IX has definitely established the feasibility of the cartwheel concept for the Tiros Operational Satellite (TOS) system. With Tiros IX data, ESSA routinely prepared daily global cloud maps for use in operational weather forecasting. Tiros X, which was the first Tiros spacecraft funded by ESSA, was launched in July 1965 to insure that there would be satellite coverage during the 1965 hurricane season. These satellites, together with Tiros VII and VIII which continue to operate in orbit, have made possible world-wide cloud coverage since February 1965.

The Tiros Operational Satellite (TOS) improvements effort initiated in FY 1965 provides for the research and development of components and subsystems towards meeting the stated evolutionary requirements of the TOS system. The requirements include the following objectives: (1) increased reliability, (2) extended life, (3) expanded sensor capability, and (4) improved operational capability. Attainment of these objectives will result in less frequent satellite replacement and a more economical operational system. Presently, two separate TOS spacecraft are required, one to provide global cloud cover data and another to provide local cloud cover data. The major objective of our TOS improvements effort has been directed towards the incorporation of both of these capabilities into a single spacecraft by combining a tape recorder with automatic picture transmission (APT). The next step beyond this is the effort to replace the camera systems with the High Resolution Infrared Radiometer (HRIR) to give TOS a nighttime global cloud cover capability. A feasibility study has already been completed covering the synchronization of the radiometer scan with spacecraft rotation to produce good quality cloud pictures. A further effort to extend the HRIR capability to both day and night (only the latter was demonstrated by Nimbus I) is already underway. This is the program to attain the desirable objective of a single operational spacecraft with both day and night global cloud cover capability.

The Office of Space Science and Applications is responsible for the overall management of this project. Responsibility for project management is assigned to Goddard Space Flight Center. The major spacecraft contractor is Radio Corporation of America.

The FY 1964 and prior year funding for the currently approved 10 flight program, including launch vehicles, amounted to $43.5 million. The 1965 funds were utilized to complete funding for the development and launch of Tiros IX, ground operations to support Tiros VII, VIII, and IX in orbit, and improvements to the TOS system. The FY 1966 funds are being used to incrementally fund for the APT with recorder developments, ground operations to support Tiros VII, VIII, IX, and X, and improvements to the TOS system. The FY 1967 request will continue funding of TOS improvement subsystems.

Meteorological Flight Experiments

	1965	1966	1967
Meteorological flight experiments.....	$1,200,000	$3,900,000	$5,500,000

The objective of the Meteorological Flight Experiments effort is to conduct meteorological research and development on non-meteorological satellites and space vehicles. Meteorological experiments will be conducted on Applications Technology Satellites to: (1) evaluate feasibility of the operation of meteorological sensors and components aboard gravity gradient stabilized spacecraft at medium and synchronous altitudes; (2) test new camera systems and techniques aboard both spin stabilized and gravity gradient stabilized spacecraft; (3) demonstrate new concepts in weather data collection via synchronous satellites; and (4) evaluate the utility of weather data dissemination via synchronous altitude satellites. The spin scan camera experiment planned for the first ATS, ATS-B, will investigate the meteorological utility of cloud photographs taken from synchronous altitude to detect and track storms, particularly short-lived phenomena such as thunderstorms, waterspouts and tornadoes. Experience derived from this initial experiment will be used to develop new sensors and techniques for obtaining cloud data from synchronous altitude on ATS-C, D, and E.

The Office of Space Science and Applications is responsible for the overall management of this project. Responsibility for project management is assigned to Goddard Space Flight Center.

This project was initiated in FY 1965. Fiscal Year 1965 funding was utilized to procure and modify high and low resolution cameras and provide for ground equipment and integration support for the experiments for ATS-A. Fiscal Year 1966 funds are being used to procure vidicon cameras for ATS-A, to procure image dissector cameras for ATS-C, flight hardware for the weather data dissemination (WEFAX) experiment, and to provide ground support of the spin scan camera experiment on ATS-B. The FY 1967 funds are required to complete procurement of the high and low resolution cameras for ATS-A, the image dissector or equivalent spin scan camera, and Omega Position Location Experiment (OPLE) spacecraft hardware for ATS-C; to initiate the camera and WEFAX hardware development for ATS-D and E; and to incrementally fund the unique ground equipment, plus operations and data evaluation for the ATS meteorological experiments. It is anticipated that these experiments will help to define the configuration of a synchronous meteorological satellite.

Nimbus

	1965	1966	1967
Spacecraft.....	$9,032,000	$11,795,000	$9,500,000
Experiments.....	3,891,000	4,825,000	9,900,000
Ground operations and support..	3,077,000	3,380,000	4,000,000
Total Spacecraft and Support.	$16,000,000	$20,000,000	$23,400,000
Thorad-Agena (Launch Vehicle Procurement Program).....	(3,898,000)	(3,742,000)	(5,331,000)
Total (including Launch Vehicles).....	($19,898,000)	($23,742,000)	($28,731,000)

The objectives of the Nimbus project are: (1) to develop a spacecraft with adequate power supply and stabilization to test a number of meteorological sensors; (2) to develop a variety of meteorological sensors to obtain day and night cloud cover and to obtain atmospheric data such as pressure, temperature, wind, and water vapor at various altitudes over the globe; and (3) to test these sensors and associated data acquisition and handling techniques prior to recommending their use on the operational systems funded by ESSA. The data obtained are made available for meteorological research and operational use to the ESSA and other domestic and foreign weather services. The Nimbus spacecraft is larger than the TIROS or TOS and is oriented to view the earth at all times; thus, it provides a basic satellite system for testing a variety of subsystems sensors and meteorological experiments.

The successful launch of Nimbus I on August 28, 1964, proved the basic spacecraft configuration and the usefulness of the meteorological sensors tested which included three vidicon cameras for global daytime cloud cover data, a high resolution infrared radiometer (HRIR) for global nightime cloud cover and the automatic picture transmission (APT) system for direct transmission of realtime daylight cloud cover pictures to small local weather stations. A failure in the solar array drive reduced power which caused the termination of useful data after approximately one month of successful operation. A new experiment, a Medium Resolution Infrared Radiometer (MRIR) will be flown, in addition to improved versions of the sensors tested on Nimbus I. The MRIR experiment will permit a full global study of the earth's heat balance, and represents one of the most significant meteorological experiments so far undertaken. In addition to the MRIR, the Nimbus C spacecraft will test vidicon cameras and a High Resolution Infrared Radiometer (HRIR) for global and local cloud cover data, both day and night. Nimbus C will provide ESSA in nearly realtime HRIR data for operational purposes and initiate experimentation with nighttime direct local readout of HRIR data through local APT ground stations. Modifications have been made to the solar array drive mechanisms in the spacecraft.

The current Nimbus program includes the development of two additional spacecraft (Nimbus B and D) scheduled for launch in 1967 and 1969 respectively. Significant spacecraft and meteorological sensor advances are being developed for testing on these flights such as: (1) a 50-watt radioisotope thermoelectric generator (RTG) which will demonstrate the feasibility of RTG long life power supplies for meteorological satellites; (2) new experiments for determining the temperature profile and the water vapor content of the atmosphere such as spectrometers developed by NASA and ESSA; (3) a sensor to measure the solar flux in the ultraviolet spectral region to determine its influence on the upper layers of the atmosphere; and (4) initial experimentation in collecting, recording, and relaying data from a number of sensors placed on and above the earth's surface to record atmospheric and meteorological data. These Nimbus flights will test the initial sensors for obtaining vertical measurements of meteorological data such as temperature and water vapor content, and test sensors and systems to provide full global daytime and nighttime cloud cover data for operational use by direct readout and also by stored data for release to data acquisition stations.

The Office of Space Science and Applications, NASA Headquarters is responsible for the overall management of the Nimbus project. Responsibility for project management is assigned to the Goddard Space Flight Center. The major contractors are General Electric for integration and test of the spacecraft and for the controls subsystems and the Radio Corporation of America for camera subsystems.

Fiscal Year 1964 and prior years funding including launch vehicles amounted to $107.3 million. Fiscal Year 1965 funds were utilized to complete the Nimbus C spacecraft, incremental funding of the Nimbus B spacecraft, experiments, and related ground operations and support. Fiscal Year 1966 funds are being utilized for final preparation, launch and ground operations for Nimbus C, incremental funding to continue the Nimbus B spacecraft, experiments, ground operations, and support efforts, and to initiate definition and design studies of the Nimbus D spacecraft and experiments. Fiscal Year 1967 funds are required for ground operations and support of the Nimbus C spacecraft to be launched in 1966; to continue the development of the Nimbus B spacecraft; and more advanced experiments and initial hardware development for the Nimbus D spacecraft. Funding requirements including launch vehicle procurement for FY 1968 to completion of this four spacecraft flight program are estimated to be $56.2 million.

Meteorological Soundings

	1965	1966	1967
Large research sounding rockets.	$1,920,000	$1,920,000	$1,920,000
Sounding rocket system development.....	425,000	630,000	630,000
Field experiment support.....	35,000	450,000	450,000
Total.....	$2,380,000	$3,000,000	$3,000,000

The objectives of Meteorological Soundings Program are to: (1) develop the systems and techniques for exploration of the region 20 to 60 miles above the earth; (2) investigate the structure and characteristics of the upper atmosphere; and (3) provide for the exchange of data obtained from this region among cooperating countries. Research indicates that this region may act as an important link between the sun's energy and the dynamics of the weather of the lower atmosphere.

The objective of the large research sounding rockets effort is to develop and improve sensors and techniques for obtaining meteorological data on the composition, structure and behavior of the atmosphere in the region 40 to 60 miles above the earth. The objective of the small sounding rocket system development effort is to develop a reliable, inexpensive, simplified system, including the rocket, sensors, and data acquisition techniques, for obtaining similar data in the region 20 to 40 miles above the earth. The field experiment support effort provides for the sounding rocket experiments in cooperation with other countries. NASA is cooperating with several foreign countries in assisting them to establish meteorological rocketsonde facilities. Through this support, useful data are obtained over the territories of cooperating foreign countries on a cost-sharing basis, involving no exchange of funds.

Fiscal Year 1964 and prior year funding amounted to $4.1 million of which $3.5 million was utilized for large research rockets and $600,000 for small rocket development.

During FY 1965, 49 large research rockets were launched consisting of 26 grenade experiments, 13 sodium vapor trail and 10 pitot-static tube experiments. In January 1965, Point Barrow, Alaska was established as a launch site and provided measurements of the atmospheric structure during the Arctic night for comparison with measurements at other sites with which they were coordinated. Eight of the pitot-static tube experiments were launched from shipboard in the South Pacific off the coast of South America spaced from the equator to 60°S latitude to provide for the first meteorological measurements above 30 miles in this area. In the small meteorological sounding project, 100 small developmental sounding rockets were launched to provide upper atmosphere data and to test several developments, such as a new parachute configuration, a ruggedized transmitting tube and an improved temperature sensor. In addition, studies were conducted on the design and performance of rocket motors and on the development of consumable rocket motor casings.

In FY 1966, approximately 50 large research rocket launches are planned. These launches will continue the study of the relation of the Arctic atmospheric structure to that in the sub-Arctic, mid-latitudes, and the tropics during various seasons including the time of greatest frequency of noctilucent clouds. Flight tests will be conducted with a new payload to measure the amount of ozone in the upper atmosphere. Also, the funds will be utilized to continue the development of the small sounding rocket system involving the launch of about 100 small developmental sounding rockets, flight test of various payload components and research to improve rocket performance and reduce falling mass hazard. An international cooperative field experiment

project was initiated with Argentina and Brazil for the establishment of two launch sites in South America and the coordination of meteorological launches from these sites with launches in North America.

In FY 1967, funds are required to provide for the launch of approximately 50 large research rockets and 100 small developmental sounding rockets, development and improvement of sounding rocket systems and initiation of design and development efforts on an advanced system. Also, funds are required for the continuation, extension and development of field experiment projects jointly with countries in South America, Europe and Asia to study and observe the upper atmosphere through the coordinated launches of small developmental sounding rockets.

OFFICE OF SPACE SCIENCE AND APPLICATIONS

COMMUNICATION AND APPLICATIONS TECHNOLOGY SATELLITES PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The previously separate Communication Satellite Program and the Applications Technology Satellites Program are combined into one program entitled Communication and Applications Technology Satellites. The objectives of the combined program are to; (1) assure that technology required for establishment of future communication, navigation, and other applications satellite systems is developed, (2) study requirements for, and technically assess the applicability of satellites to the future needs of communication, navigation, and other promising applications systems, and (3) fulfill NASA's responsibilities under the Communications Satellite Act of 1962.

Serving as relay stations at altitudes that are within line-of-sight of distant points on the earth's surface, communications satellites offer microwave communication over long distances, not presently attained by high frequency radio. They therefore offer the potential for providing all types of telecommunications services on a world-wide basis. Studies are underway to determine the need for an improved world-wide navigation system, traffic control, search and rescue, and communication systems for aircraft and ships. Satellites offer great potential in this area. Applications Technology Satellites offer the potential of testing and evaluating advanced subsystems applicable to communications, meteorology, navigation and other purposes; testing and evaluating satellite structures and stabilization systems peculiar to communications, navigation, and other satellite endeavors; and offer the potential for determining the radiation levels and the long term effects of this environment on spacecraft components at different altitudes, particularly the synchronous altitude where very little environmental data exists.

The Echo, Relay, and Syncom projects are completed except for continued data reduction and analysis activity. Five Applications Technology Satellites launches are planned for the 1967-69 period, one at 6,500 mile altitude and four at synchronous altitude.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Supporting research and technology/Advanced studies.....	$2,124,000	$4,500,000	$4,600,000
Echo II.....	325,000	---	---
Relay.....	462,000	200,000	---

	1965	1966	1967
Syncom	$168,000	$100,000	---
Early gravity gradient test satellite	5,000,000	---	---
Applications technology satellites	22,695,000	28,000,000	$21,800,000
Total	$30,774,000	$32,800,000	$26,400,000

Distribution of Program Amount by Installation:

	1965	1966	1967
Goddard Space Flight Center	$24,414,000	$31,092,000	$25,107,000
Jet Propulsion Laboratory	396,000	648,000	193,000
Langley Research Center	215,000	---	---
NASA Headquarters	5,749,000	1,060,000	1,100,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology/Advanced Studies

	1965	1966	1967
Communication and navigation	$874,000	$1,700,000	$1,900,000
Applications technology	700,000	2,000,000	2,100,000
Advanced mission studies	550,000	800,000	500,000
Data analysis	---	---	100,000
Total	$2,124,000	$4,500,000	$4,600,000

The supporting research and technology effort is being conducted in four areas namely, (1) communication and navigation, (2) applications technology, (3) advanced mission studies, and (4) data analysis.

There are no additional passive communication satellite launches planned, however, a modest effort will continue in FY 1967 as in past years, on materials, structures, and erection system development for advanced passive satellites. Passive satellite technology is being continued because such satellites have unlimited multiple access and frequency response capabilities, inherent long life, and high reliability. Investigation effort will continue in FY 1967 on active satellite systems capable of linking terminals of greatly reduced size and cost, making possible communications with over-ocean aircraft, ships at sea, and small land stations. Investigations will continue on the effect of scattering of electromagnetic waves by earth's atmosphere and space environment; results have and will make important contributions to the International Telecommunications Union Conference on Space Communications. Measurement techniques have been developed for measuring radio reflectivity

characteristics of large inflatable structures on the ground so that their potential usefulness in space can be predicted. In FY 1967 these techniques will be used to measure small segments of new and improved passive satellite materials and structures, and on advanced antenna designs to determine their characteristics.

Navigation traffic coordination satellite system conceptual studies funded in prior years indicated that satellites could assist over-ocean aircraft and ships at sea to obtain more precise position information under all weather conditions, and could aid air-sea traffic control, and coordination of emergency rescue operations. As a result interagency review of existing and future agency needs is continuing. We will analyze and compare various navigation traffic coordination systems (including those involving satellites) to determine the course of our future research and development efforts in this area. In FY 1967, studies will be conducted in the navigation-traffic control area to determine the feasibility of incorporating position-fixing experiments on future NASA satellites to establish the operational capabilities of the more promising techniques.

Past investigations of multiple beam forming, electronically steerable spacecraft antenna array techniques have yielded promising results. Laboratory models of promising arrays are now being developed for experimental purposes to determine their potential for space applications such as multiple access communications with small mobile terminals, and possibly direct broadcast satellites. Efforts in FY 1967 will be continued in the area of attitude measurement and control devices. Attitude measurement devices such as starfield readers, RF sensors, and non-RF sensors and control devices such as gravity gradient components, momentum wheels and small thrusters will be investigated. Effort will be continued on the design and preliminary development of a spaceborne millimeter propogation experiment for Applications Technology Satellites. The frequency range 10 to 100 gigacycles per second is of great interest because the lower frequency bands are crowded.

Studies on long-lived, fully stabilized spacecraft having a large space erectable antenna which can be pointed precisely to selected geographic areas on earth will be continued. Active and hybrid gravity gradient stabilization control systems will be considered. Feasibility studies on voice broadcast and TV broadcast satellites will be continued in FY 1967. A feasibility study will also be conducted in 1967 to determine satellite system concepts and approaches to provide wide band communications between interplanetary probes and earth terminals via satellite relays; provide aids to interplanetary navigation and tracking; and provide spacecraft-to-spacecraft communications and global navigation aids.

There is a new SR&T item in FY 1967 to cover data analysis in three projects otherwise completed by FY 1967, namely Echo II, Relay, and Syncom. In order to completely ascertain spacecraft performance and economic factors, there must be available spacecraft reliability, degradation, and lifetime data.

Therefore, it is desired to delineate this phase of the effort in FY 1967, and close out the research and development spacecraft phase of the projects at the end of FY 1966. Funding requirements beyond FY 1967 will depend on the lifetime of the spacecraft.

Echo II

	1965	1966	1967
Ground operations and support....	$325,000	---	---

The Echo II project consisted of design, development, launch, and evaluation of a 135 foot large inflatable passive communication satellite. Other than a low level effort in experiments on Echo II, the project was completed in FY 1964. Fiscal year 1965 and prior year funding, including launch vehicles, amounted to $20.1 million. No funds are required for FY 1966. A minimal amount of funds are required in FY 1967 for continued data analysis. This requirement is included in the SR&T line item.

Relay

	1965	1966	1967
Ground operations and support....	$462,000	$200,000	---

Project Relay consisted of the design, development, launch, and evaluation of two intermediate altitude active communication satellites. This project demonstrated the capability to reliably and economically perform narrowband and wideband communications, including telephone, digital data and TV demonstrations, between widely separated ground stations for long periods of time. In addition, Relay satellites are equipped to measure levels of radiation in the space environment and the effects of radiation on certain critical components.

Relay I was successfully launched in December 1962, as was Relay II in January 1964. The FY 1965 and prior years funding for the two launches including launch vehicles amounted to $40.2 million. Fiscal year 1966 funds are being used for continued data reduction and analysis. A minimal amount of funds are required for FY 1967 for continued data analysis. This requirement is included in the SR&T line item.

Syncom

	1965	1966	1967
Ground operations and support....	$168,000	$100,000	---

Project Syncom consisted of the design, development, launch, and evaluation of synchronous altitude active communication satellites. This project demonstrated the capability of reliably and economically performing communications experiments from synchronous orbits including telegraph, digital data, and TV demonstrations.

Three Syncom spacecraft have been launched: Syncom I in February 1963 was unsuccessful; Syncom II in July 1963 was successful in achieving the desired inclined synchronous orbit; and Syncom III was successfully launched into an equatorial synchronous (stationary) orbit. Syncoms II and III continue to function satisfactorily. Syncoms II and III were turned over to the Department of Defense on April 1, 1965. The FY 1965 and prior years funding for this three flight program including launch vehicles amounted to $30.8 million. Fiscal year 1966 funds are being used for continued data reduction and analysis. A minimal amount of funds are required for FY 1967 for continued data analysis. This requirement is included in the SR&T line item.

Early Gravity Gradient Test Satellite

	1965	1966	1967
Spacecraft.....	$5,000,000	---	---

The Early Gravity Gradient project consists of the design, development, and flight testing of a gravity gradient stabilization system. The primary objective of this effort is to demonstrate a gravity gradient stabilization subsystem in support of the advanced Defense Communication Satellite Program in the near synchronous altitude region, provide data to support the selection of design parameters, and assess the feasibility of gravity gradient stabilization for advanced space systems. NASA and DOD entered into an agreement whereby the Air Force Space Systems Command will be responsible for the procurement of flight hardware, and will flight test the gravity gradient system as an integral part of the initial Defense Communications Satellite flights. NASA will continue to monitor this effort and provide technical assistance to the Air Force. Fiscal year 1965 funds of $5.0 million are available to the Air Force to cover the costs of the spacecraft. No FY 1966 or subsequent year funds are required for this project by NASA. A flight test is scheduled for 1966 by DOD.

Applications Technology Satellites

	1965	1966	1967
Spacecraft.....	$20,695,000	$24,850,000	$17,800,000
Operational support.....	2,000,000	3,150,000	4,000,000
Total Spacecraft and Support...	$22,695,000	$28,000,000	$21,800,000
Atlas-Agena (Launch Vehicle Procurement Program).....	(4,404,000)	(8,240,000)	(12,803,000)
Total (including Launch Vehicle).....	($27,099,000)	($36,240,000)	($34,603,000)

The objectives of the Applications Technology Satellite project are (1) to design, develop, flight test, and evaluate a spacecraft capable of performing communications, meteorological, gravity gradient stabilization, scientific and other technological experiments in a 6,500 mile circular orbit, (2) to perform communications, meteorological, scientific and other technological experiments utilizing a spin stabilized spacecraft in synchronous orbit, and (3) to perform communications, meteorological, scientific and other technological experiments utilizing gravity gradient stabilized satellites in synchronous orbit. The basic spacecraft will weigh about 650 pounds. Five launches are scheduled--one in 1966 and one in 1968 in synchronous orbits utilizing spin stabilized satellites; one flight planned for 1967 in the 6,500 mile circular orbit primarily to evaluate the gravity gradient stabilization system; and two flights in synchronous orbit using gravity gradient stabilized spacecraft scheduled for 1968 and 1969.

The Office of Space Science and Applications, NASA Headquarters, is responsible for over-all management. Responsibility for project management is assigned to Goddard Space Flight Center. The major contractors are Hughes Aircraft Company for spacecraft development, and General Electric Corporation for gravity gradient stabilization system development.

Funding for this project commenced in FY 1964 with $16.8 million. Funding through FY 1966 has provided for continuation of development including assembly of the first spin stabilized synchronous spacecraft, its experiments and their integration; parts fabrication and prototype model assembly of the second spacecraft and its experiments; and procurement of common components for the remaining spacecraft. Funding in FY 1967 will provide for the first launch, completion of the second spacecraft and its experiments, and preparation for its launch. This funding will also provide for fabrication of the third spacecraft and its experiments and for continuation of development on the fourth and fifth spacecraft. Operational and data analysis efforts on the first launch will be initiated. Funding requirements, including launch vehicles, for FY 1968 to completion of this five flight program are estimated to be $35.1 million.

OFFICE OF TECHNOLOGY UTILIZATION — TECHNOLOGY UTILIZATION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The primary objective of the Technology Utilization program is to provide for the widest practicable and appropriate dissemination to industry of information concerning NASA activities and results which appear to have industrial applications potential. The NASA program offers U.S. industry unique opportunities to improve existing industrial techniques and to develop new products and methods. It is the purpose of Technology Utilization to assist in identifying quickly these many opportunities and to insure their expeditious dissemination for the benefit of American industry, and ultimately the individual U.S. citizen. Technology Utilization also includes projects to study and evaluate those factors which will improve our understanding of the implications of the space program.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Identification	$1,235,000	$1,220,000	$1,165,000
Evaluation	645,000	680,000	650,000
Dissemination	1,970,000	2,000,000	2,085,000
Analysis	900,000	850,000	900,000
Total	$4,750,000	$4,750,000	$4,800,000

Distribution of Program Amount by Installation:

	1965	1966	1967
NASA Headquarters	$4,750,000	$4,750,000	$4,800,000

BASIS OF FUND REQUIREMENTS:

Identification

The Identification effort is carried out by NASA personnel; specialists from research institutes, universities and industry; and, by scientists and engineers working for NASA and NASA contractors. These personnel search for ideas, innovations, processes and techniques which appear to have potential for non-aerospace application and report them quickly to NASA Headquarters. These reports are now coming in at the rate of 1,200 per year and with the present emphasis on the implementation of the New Technology Reporting Clause

in NASA contracts the rate of reporting is expected to increase. The identification effort also includes the identification of incremental advances in technology. Research institutes, universities and private companies identify these incremental advances in technology by reviewing broad areas of space research and developing state-of-the-art summaries, called Technology Surveys. During FY 1965, contracts for 12 surveys were negotiated. This program will be continued at about the same level during FY 1966 and FY 1967.

Evaluation

The technical information reported to Headquarters is forwarded to a group of Research Institutes and evaluated for novelty, technical feasibility and relevance to non-aerospace industry. A preliminary review is conducted by the Illinois Institute of Technology Research Institute. Innovations of merit are then evaluated in detail by that Institute and one of four other contractors: Arthur D. Little, Batelle Memorial Institute, Stanford Research Institute, and Southwest Research Institute. The product of this evaluation is a flow of new items, processes and techniques having non-aerospace potential. These processes are then made available in one of several publications: Tech Briefs, Technology Utilization Notes, or Technology Utilization Handbooks. Tech Briefs are one to two page bulletins about innovations, published in this format in order that the new developments may reach the potential user as quickly as possible. The Technology Utilization Reports, Notes and Handbooks are more comprehensive publications resulting from in-depth evaluations by research contractors and preparation of more complete information on the subjects covered. Although the current emphasis on new technology reporting is expected to increase the rate of documents coming into the system, the funding requested for FY 1967 will permit continuation of this evaluation effort at about the same level as for FY 1966 and FY 1965.

Dissemination

Dissemination activities are focused on exploiting the normal channels of communication that are in existence or which can be developed. Two general techniques of dissemination are employed. The first is by mailing lists consisting of over 8,000 industrial companies and individuals who receive information in some cases on all Technology Utilization publications, and in others only those in their technical areas of interest. The second form of dissemination is through experimental regional dissemination centers. The first experimental regional program was established in January, 1962, with the Midwest Research Institute (MRI) at Kansas City, Missouri. MRI has employed a broad, generalized approach in disseminating ideas and innovations to over 1,000 industrial firms in the Midwest area. During FY 1967, MRI will continue the basic program and develop new programs for working more closely with the Midwestern industry on a problem solving basis, using computer support from the Aerospace Research Applications Center (ARAC) at Indiana University. This center was established in January, 1963. It offers three basic services: (1) Industrial Applications Service, a weekly dissemination to companies of the Technology Utilization publications with follow-up applications engineering service, (2) Selective Dissemination Service,

a bi-weekly computer read-out of the new additions to the NASA magnetic tapes to provide companies with current announcements of items coming into the information system; and, (3) Retrospective Search Service, which are responses to special technical questions, accomplished by computer searching of the entire file of NASA documents (now totalling approximately 200,000 items). During FY 1964 and FY 1965, six Centers in addition to MRI and ARAC were established. These are at Wayne State University (Detroit); the University of Pittsburgh; University of Maryland; Southeastern State College at Durant, Oklahoma; the North Carolina Science and Technology Research Center; and the University of New Mexico. These Centers are serving over 120 member companies with more than 3,000 firms receiving some degree of service. Fiscal year 1967 funds will be used to support current programs at these Centers with appropriate modifications and improvements; and also provide support for several pilot projects with other agencies. In addition, two new experimental dissemination centers are planned.

Analysis

In recognition of the much broader impact of NASA programs than simply that of a major one in advancing science and technology, support is given to a study program to analyze the impact of the space program on the regional and local economy, and on industries, private institutions and different types of manpower. The principal aim here is to have researchers assist in characterizing NASA's impact as it has affected their regions and to develop analyses which lead to consideration of improved policies within the constraints of existing legislation. Under one grant, for example, a study is being made of the distribution of subcontracts under the Gemini program, regional differences in the distribution of NASA and the other Federal expenditures, the role of Defense/Space programs in the national economy, and the supply and demand for scientific manpower. These and similar studies will be conducted during FY 1967 to enhance NASA's understanding of the implications of the space program.

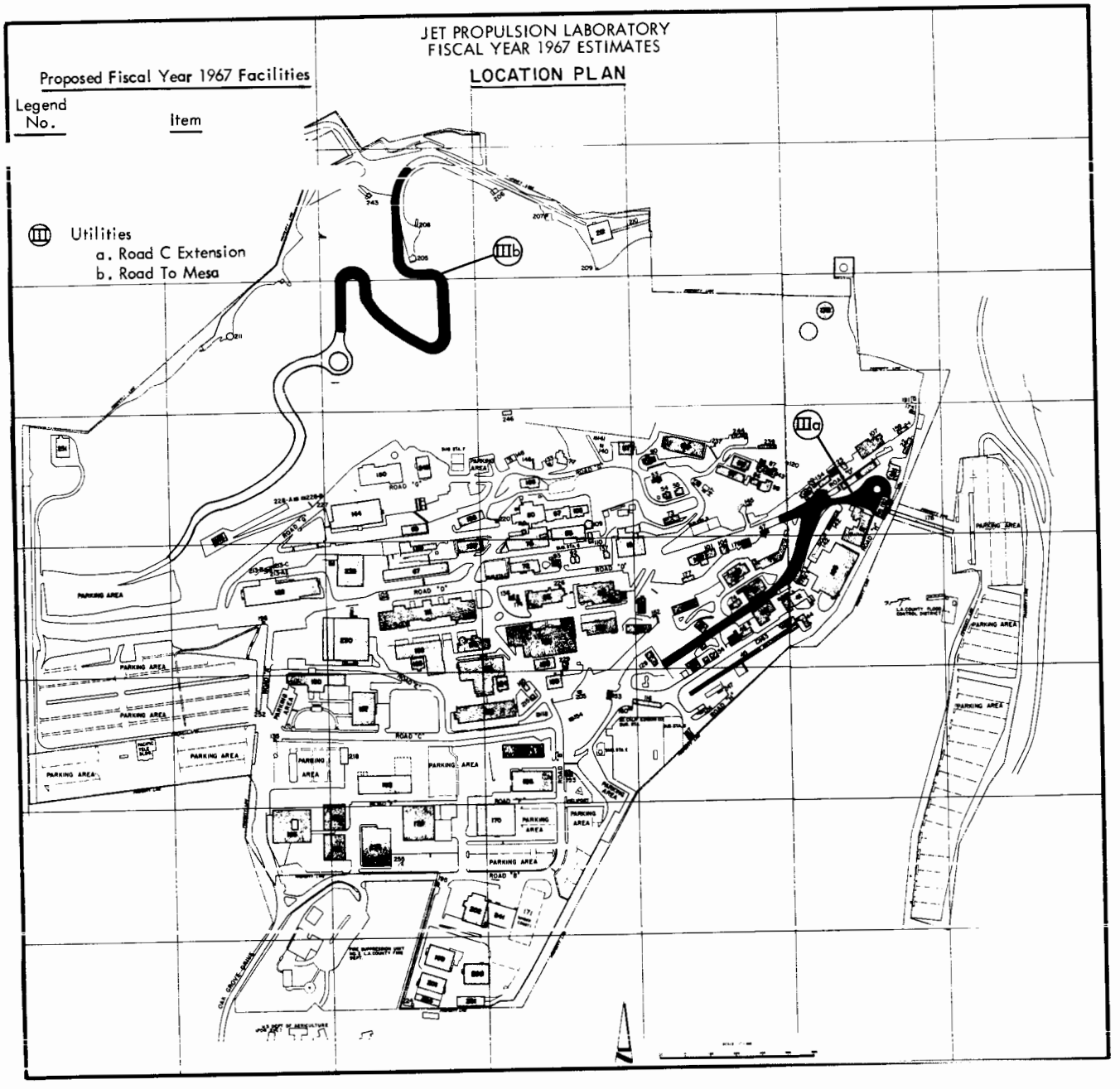
A recognition of the need to solve critical management problems and possibly to develop wholly new techniques for managing such a large and complex research and development enterprise as the NASA led to the support of study areas that include the organization and management of large R&D projects, the diversified roles of the research director, the government-industry contracting system, conditions under which the transfer of new technology takes place in the economy, and top level policy and decision-making in large R&D organizations. During FY 1967 NASA will continue to support a modest program of research on such management problems, the solution of which will promote increased management efficiency both within the agency and within those industries with whom NASA has contacts.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1967 ESTIMATES

JET PROPULSION LABORATORY


JET PROPULSION LABORATORY
FISCAL YEAR 1967 ESTIMATES
LOCATION PLAN
Proposed Fiscal Year 1967 Facilities
Legend
No.
Item
III Utilities
a. Road C Extension
b. Road To Mesa
IIIa
IIIb
ROAD "C"
ROAD "D"
ROAD "B"
PARKING AREA
OAK GROVE DRIVE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY
CONSTRUCTION OF FACILITIES
FISCAL YEAR 19 67 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION	COGNIZANT PROGRAM OFFICE FOR INSTALLATION	LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Jet Propulsion Laboratory	Space Science and Applications	Pasadena, California	Los Angeles	Pasadena, California

INSTALLATION MISSION

The Jet Propulsion Laboratory (JPL) is a government-owned research and development facility, operated by the California Institute of Technology under a contract with the National Aeronautics and Space Administration. The Laboratory carries out research programs and unmanned lunar and planetary space projects for NASA, and conceives and executes advanced development and experimental engineering investigations to further the technology required for the nation's space program.

PERSONNEL STRENGTH	FY 1965	FY 1966	FY 1967
JPL PERSONNEL *(End of Year)*	3998	4250	4250
CONTRACTOR AND OTHER PERSONNEL	932	1061	1173
TOTAL ALL PERSONNEL	4930	5311	5423

LAND	NO. ACRES
NASA-OWNED	145.9
OTHER GOVERNMENT AGENCY-OWNED	--
NON-FEDERAL *(Leases, easements)*	25.8
TOTAL LAND	171.7

TOTAL CAPITAL INVESTMENT* *(Including NASA-Owned Land) (as of June 30, 1965)*	$ 128,177.2

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YEAR	FY 1967 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Utilities Installations	SSA	3,308	350	2,000	5,658
ALL OTHER PROJECTS		34,569			
TOTALS		37,877	350		

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* *Includes work in process.*

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1967 ESTIMATES

UTILITIES INSTALLATION

AUTHORIZATION LINE ITEM: Jet Propulsion Laboratory

PROGRAM OFFICE FOR THE PROJECT: Office of Space Science and Applications

LOCATION OF PROJECT: Pasadena, Los Angeles County, California

COGNIZANT NASA INSTALLATION: Jet Propulsion Laboratory

TYPE OF CONSTRUCTION PROJECT: Extension

FUNDING:

FY 1966 and Prior Years	$3,308,000
FY 1967 Estimate	350,000
Total Funding Through FY 1967	$3,658,000

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$350,000
Road "C" Extension				276,985
Grading and paving	Sq. Ft.	71,200	$1.84	131,133
Sidewalks, curb and gutter	Sq. Ft.	4,896	.69	3,378
Street lights	Each	19	789.81	15,006
Sanitary sewers and storm drains	LF	830	14.58	12,092
Power and communications	LF	3,440	23.89	82,187
Underground utilities	LF	1,317	25.20	33,189
Mesa Road				73,015
Grading and paving	Sq. Ft.	37,000	1.74	64,380
Storm drains	LF	240	35.98	8,635

	Unit of Measure	Quantity	Unit Cost	Total Cost
Equipment	---	---	---	---
Design	---	---	---	---
Fallout Shelter (Not feasible)	---	---	---	None
		TOTAL		$350,000

PROJECT PURPOSE:

This proposed project will provide a new east-west road and a road to the Mesa.

PROJECT DESCRIPTION:

This project will complete the main east-west road and extend a road to the research and development facilities located on top of the Mesa on Laboratory grounds.

Road C - Road C will be extended from its present termination south of building 129 to the intersection with road D and the eastern entrance to the Laboratory at the bridge across the Arroyo. As part of this project it will be necessary to demolish buildings 65 and 204 and move the electric substation A which are in the path of the road extension.

The materials processing equipment previously housed in building 65 is now installed in building 157 and the reduction in on-Lab propulsion systems testing has released building 204 for removal in accordance with the demolition plan which encompasses the original temporary structures which were the dominant buildings in the immediate post war era.

Road to Mesa - This road will be a continuation of the road to the one million gallon water storage tank built under the FY-65 utility program. The road will terminate in the vicinity of the spacecraft antenna range facility.

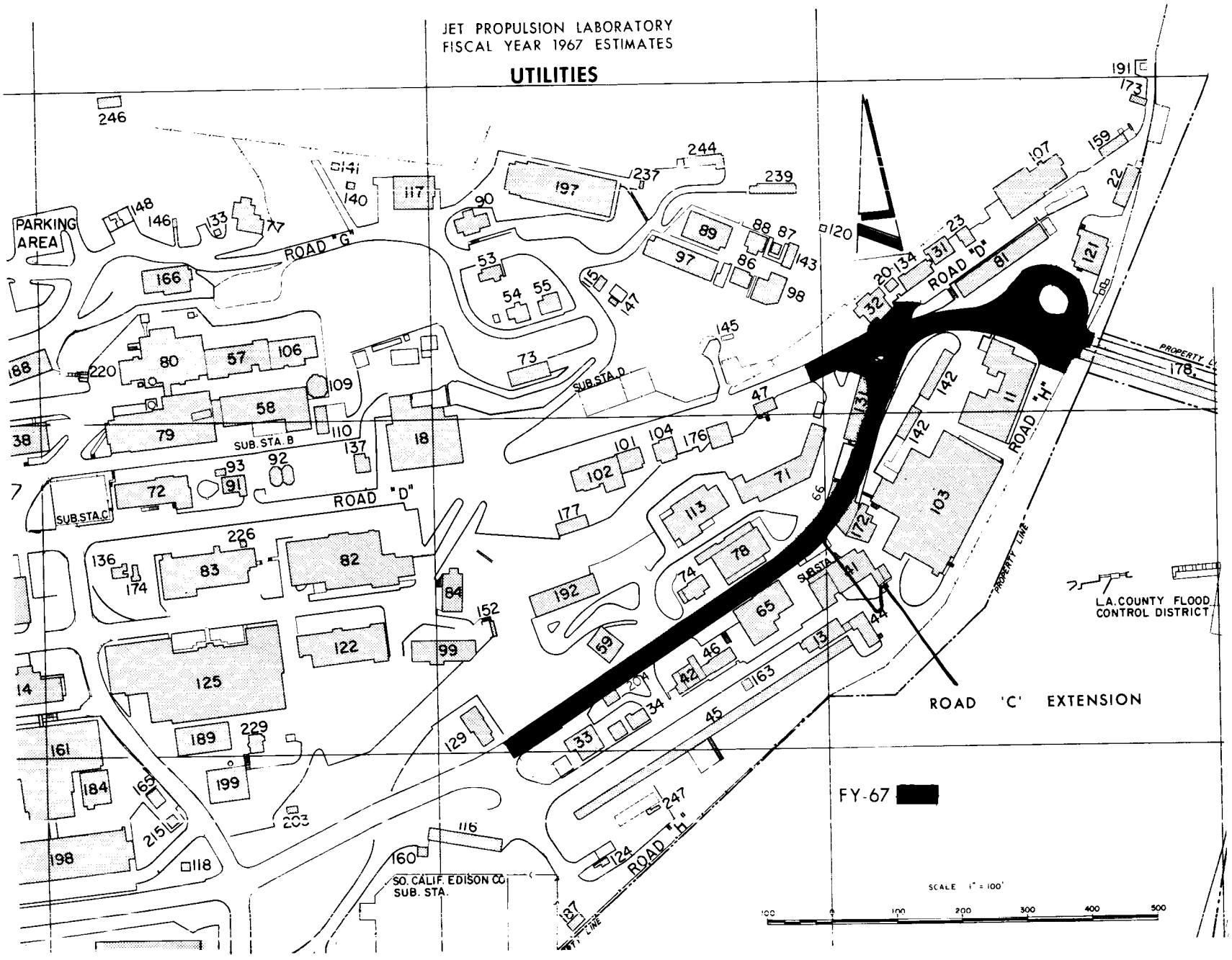
PROJECT JUSTIFICATION:

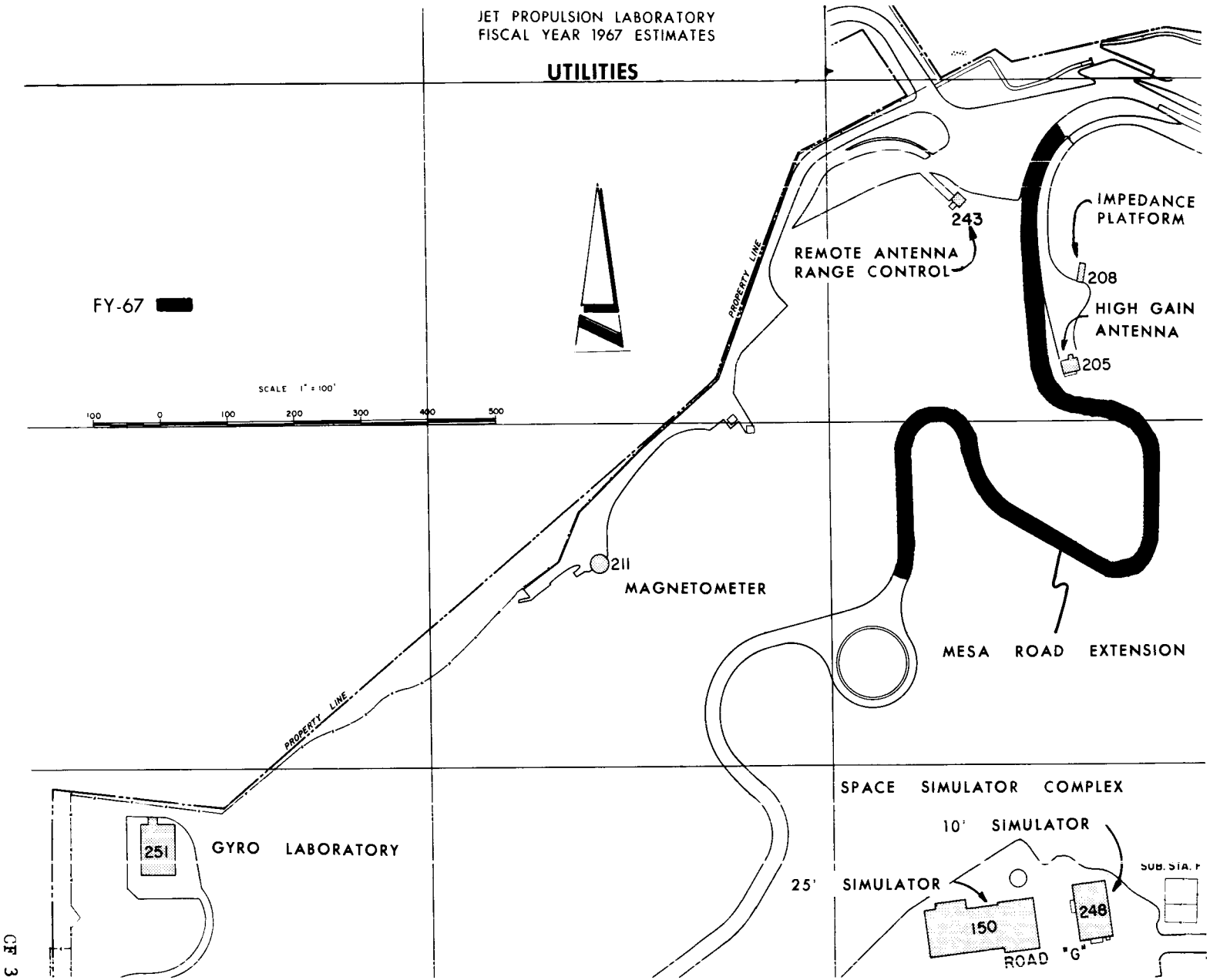
The present east-west road is inadequate to handle the on-Laboratory bus and truck traffic. The extension of road C will alleviate this traffic congestion. Construction of the road will also allow the Laboratory to rehabilitate the existing utilities in the area.

The unusual working hours often required of Laboratory personnel during various phases of spacecraft antenna testing and other activities poses a potential community relations problem since all truck and auto traffic must

flow through the adjoining residential area and enter the government property via an easement. The proposed 1,400-foot extension of the existing roadway to the water tank will diminish this problem as well as promote a more efficient Laboratory operation.

ESTIMATED FUTURE YEAR FUNDING FOR THIS PROJECT: $2,000,000 over the next five years.


JET PROPULSION LABORATORY
FISCAL YEAR 1967 ESTIMATES
UTILITIES
PARKING AREA
ROAD "G"
ROAD "D"
ROAD "H"
ROAD 'C' EXTENSION
SUB. STA. B
SUB. STA. C
SUB. STA. D
SUB STA
SO. CALIF. EDISON CO. SUB. STA.
L.A. COUNTY FLOOD CONTROL DISTRICT
PROPERTY LINE
FY-67
SCALE 1" = 100'
100 0 100 200 300 400 500

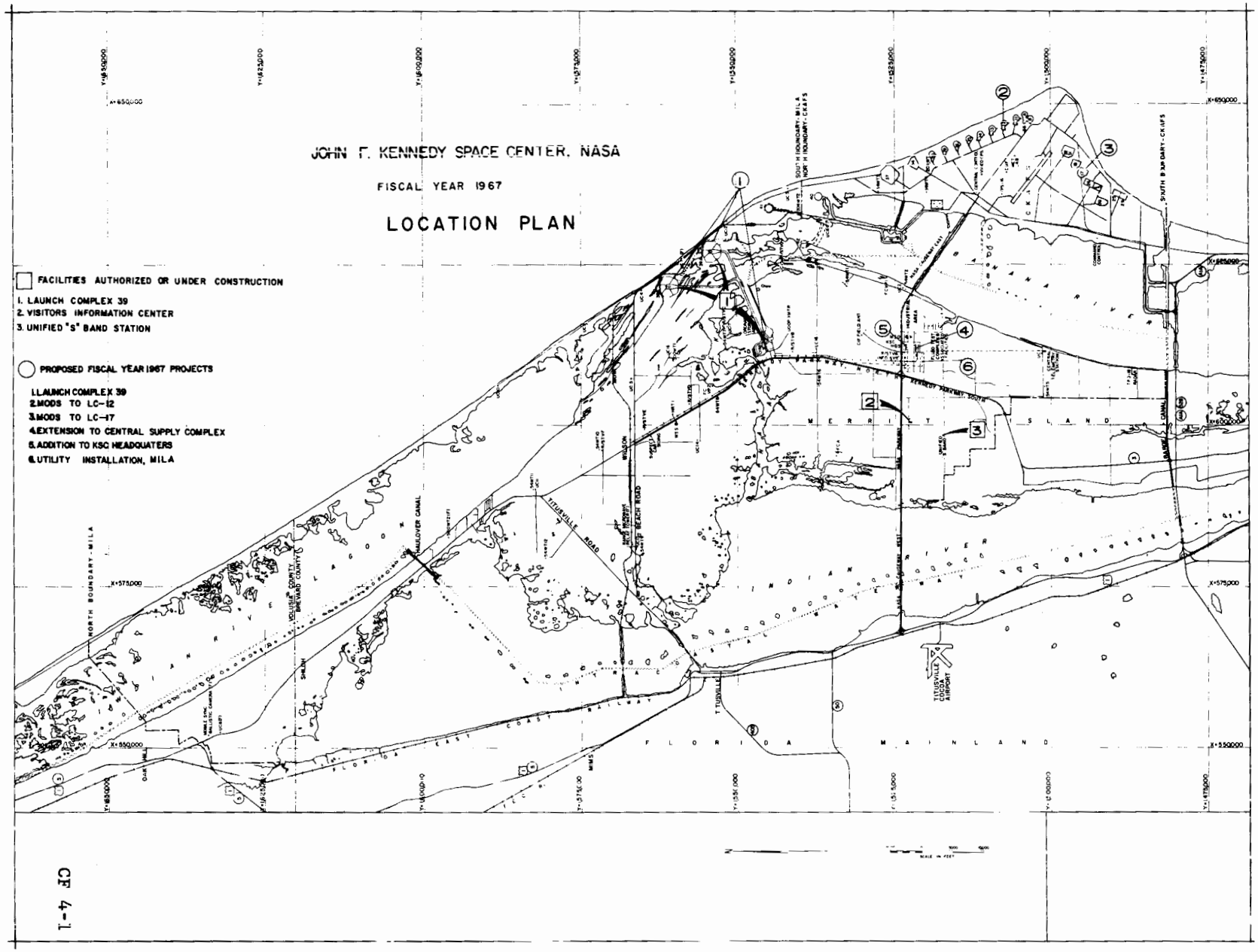

JET PROPULSION LABORATORY
FISCAL YEAR 1967 ESTIMATES
UTILITIES
FY-67
SCALE 1" = 100'
100 0 100 200 300 400 500
PROPERTY LINE
243
REMOTE ANTENNA
RANGE CONTROL
IMPEDANCE
PLATFORM
208
HIGH GAIN
ANTENNA
205
211
MAGNETOMETER
MESA ROAD EXTENSION
PROPERTY LINE
251
GYRO LABORATORY
SPACE SIMULATOR COMPLEX
10' SIMULATOR
25' SIMULATOR
150
248
ROAD "G"
SUB. STA. F

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1967 ESTIMATES

JOHN F. KENNEDY SPACE CENTER, NASA

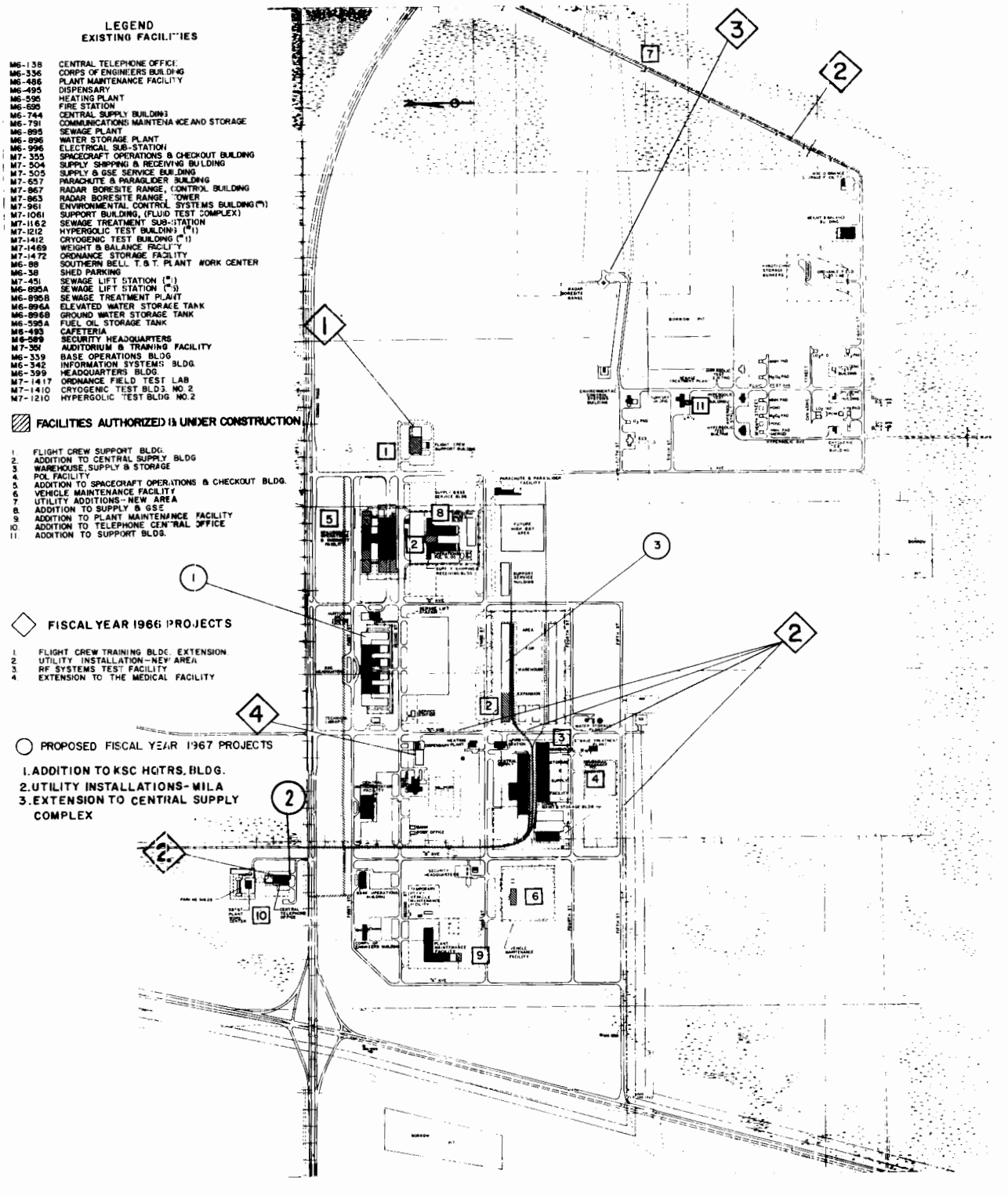

JOHN F. KENNEDY SPACE CENTER, NASA
FISCAL YEAR 1967
LOCATION PLAN
FACILITIES AUTHORIZED OR UNDER CONSTRUCTION
1. LAUNCH COMPLEX 39
2. VISITORS INFORMATION CENTER
3. UNIFIED "S" BAND STATION
PROPOSED FISCAL YEAR 1967 PROJECTS
1. LAUNCH COMPLEX 39
2. MODS TO LC-12
3. MODS TO LC-17
4. EXTENSION TO CENTRAL SUPPLY COMPLEX
5. ADDITION TO KSC HEADQUATERS
6. UTILITY INSTALLATION, MILA
M E R R I T T I S L A N D
F L O R I D A M A I N L A N D
INDIAN RIVER
BANANA RIVER
TITUSVILLE COCOA AIRPORT
FLORIDA EAST COAST RAILWAY
TITUSVILLE ROAD
NORTH BOUNDARY - MILA
SOUTH BOUNDARY - CKAFS

CF 4-1

JOHN F. KENNEDY SPACE CENTER

FISCAL YEAR 1967 ESTIMATES

LOCATION PLAN



CF 4-2

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY
CONSTRUCTION OF FACILITIES
FISCAL YEAR 19 67 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION	COGNIZANT PROGRAM OFFICE FOR INSTALLATION	LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
John F. Kennedy Space Center, NASA	Manned Space Flight	Merritt Island, Florida	Brevard	Cocoa Beach

INSTALLATION MISSION

The Center conducts overall planning and supervision of the integration, test, checkout, and launch of NASA space vehicle systems at the Eastern Test Range (ETR) and Merritt Island, and provides support services for all NASA elements located in the area.

PERSONNEL STRENGTH	FY 1965	FY 1966	FY 1967
NASA PERSONNEL *(End of Year)*	2491	2666	2796
CONTRACTOR AND OTHER PERSONNEL	8192	13847	14535
TOTAL ALL PERSONNEL	10683	16513	17331

LAND	NO. ACRES
NASA-OWNED	84,305
OTHER GOVERNMENT AGENCY-OWNED	121
NON-FEDERAL *(Leases, easements)*	3,351
TOTAL LAND	87,777

TOTAL CAPITAL INVESTMENT* *(Including NASA-Owned Land) (as of June 30, 1965)*	$ 561,762.0

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1961 THRU CURRENT YEAR	FY 1967 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Launch Complex 39	MSF	418,435.9	29,500.0	-	447,935.9
Extension to Central Supply Complex	MSF	5,857.0	600.0	-	6,457.0
Addition to KSC Headquarters Building	MSF	9,097.5	3,500.0	-	12,597.5
Utility Installations - MILA	MSF	179.0	2,897.0	-	3,076.0
Modifications to Launch Complex 17	SSA	1,921.0	740.0	6,000.0	8,661.0
Modifications to Launch Complex 12	SSA	1,283.0	639.0	5,000.0	6,922.0
ALL OTHER PROJECTS		388,359.6			
TOTALS		825,133.0	37,876.0		

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* *Includes work in process.*

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1967 ESTIMATES

MODIFICATIONS TO LAUNCH COMPLEX 17

AUTHORIZATION LINE ITEM: John F. Kennedy Space Center

PROGRAM OFFICE FOR THE PROJECT: Office of Space Science and Applications

LOCATION OF PROJECT: Cape Kennedy, Brevard County, Florida

COGNIZANT NASA INSTALLATION: John F. Kennedy Space Center

TYPE OF CONSTRUCTION PROJECT: Alteration

FUNDING:

FY 1966 and Prior Years	$1,921,000
FY 1967 Estimate	740,000
Total Funding Through FY 1967	$2,661,000

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$235,000
Blockhouse modifications	LS	---	$135,000	135,000
Guided platform hoist	Each	2	50,000	100,000
Equipment				$505,000
Long-line cable replacement	LS	---	315,000	315,000
Pneumatic consoles replacement	LS	---	190,000	190,000
Design	---	---	---	---
Fallout Shelter	---	---	---	-0-
		TOTAL		$740,000

PROJECT PURPOSE:

To upgrade the present launch complex to provide the continuing support necessary for the multi-stage Delta Launch Vehicle and spacecraft.

PROJECT DESCRIPTION:

The Blockhouse will be structurally modified to be completely blast-resistant in accordance with Air Force Eastern Test Range requirements. The effective usable floor space during a launch operation will be increased by 650 square feet, to a 2,700 square foot area. The dividing wall in the central operations area will be removed to allow non-restrictive viewing in this area. Ground Support Equipment will be arranged for better and more effective space utilization.

The long-line instrumentation, power and control cables routed between the Blockhouse terminal board and the launcher terminal board at each of the two pads will be replaced with molded moisture-resistant multiconductor cables.

The four pneumatic consoles located near the base of each of the launchers and numerous secondary panels on the vehicle service towers will be replaced by one central console at each launch pad for the operational control of all nitrogen and helium purging, pressurization and checkout of the attitude control systems. These central consoles will be weatherproofed and equipped with controls that may be operated remotely from the Blockhouse.

One guided platform hoist, to operate between the ground and tenth level, will be attached to the exterior of each of the two launch vehicle service towers. The hoists will be used to lift spacecraft and support equipment to the upper platform levels.

PROJECT JUSTIFICATION:

Launch Complex 17 at Cape Kennedy was constructed in 1957 for the THOR missile program. The service structures have been modified by the Air Force and NASA to accommodate various upper stage and spacecraft configurations since the first application of the THOR booster to space mission use in 1959. To date 102 launchings have been conducted from this complex. Present and future spacecraft missions including communications satellites, weather satellites, Explorers, Pioneer, Orbiting Solar Observatories, Biosatellites, and other scientific and applications spacecraft will require continued usage of this complex for at least a minimum of seven years with an annual launch rate of ten to twelve missions.

The requirements for additional instrumentation equipment and associate operating personnel make it mandatory that the blast-resistant area of the blockhouse be expanded to meet launch and hazardous operation requirements. Removal of the dividing wall and rearrangement of the Ground Support Equipment will allow maximum operational flexibility.

Most of the long line cables between the blockhouse and the launch pad were installed in 1958. Prolonged exposure to the atmosphere, constant usage and blast damage effects have caused deterioration to such an extent that leakage resistance is at an unacceptable low level. Further, numerous splices and repairs have made the long line cables unreliable for critical circuits. If the reliability of the instrumentation circuitry is to be maintained, it is mandatory that the long line cables be replaced.

Existing pneumatic consoles have been in service since 1958 and are badly worn and corroded. These consoles, which play a major functional role in checkout and launch of the Delta Vehicle, have had an abnormally high rate of forty to fifty failures per year. The installation of a single console on each launch pad will provide a central unit of much higher reliability, eliminating associated panels located on the vehicle service towers and thereby reducing the present complement of operating personnel.

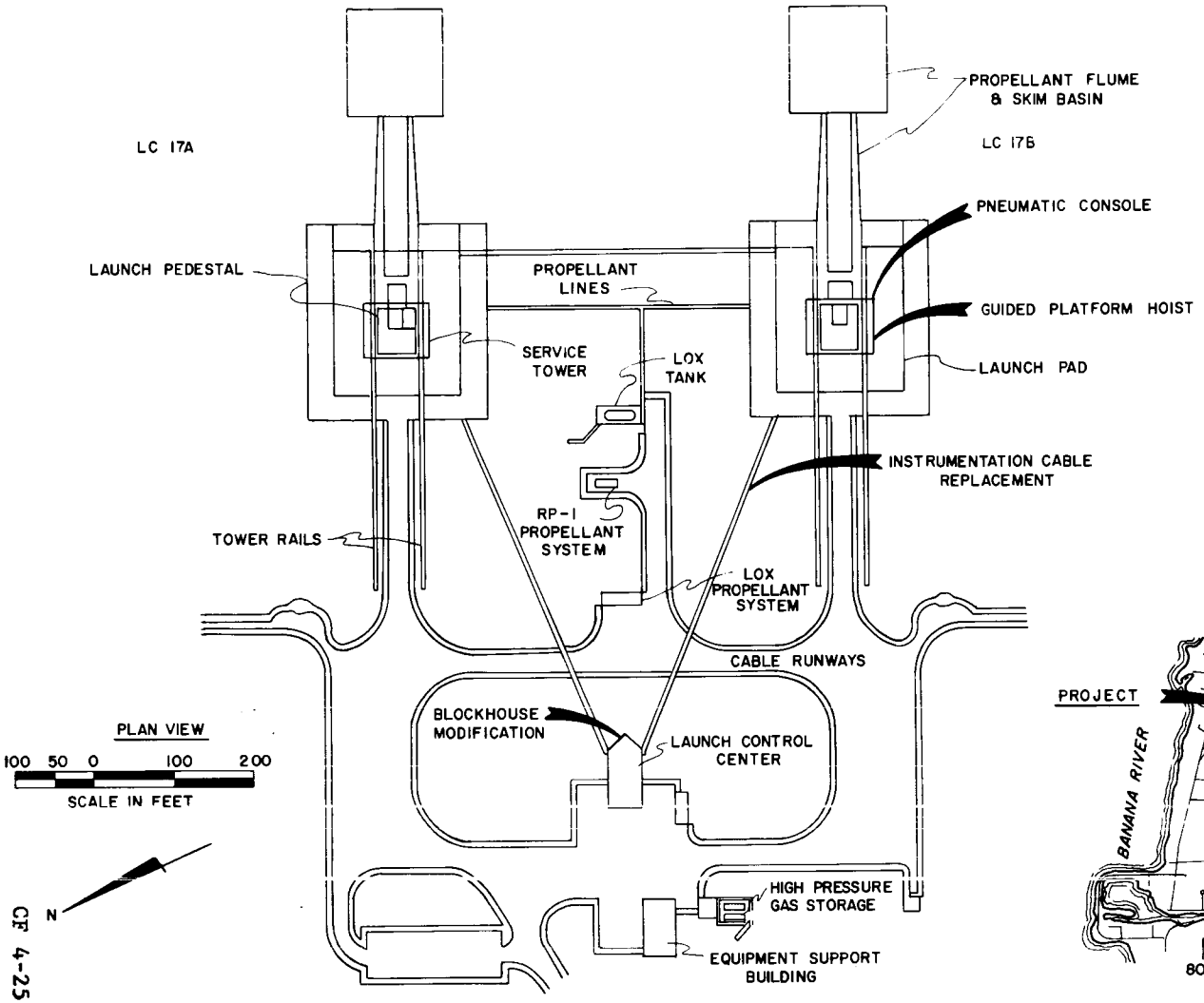
The present hoist system on the launch vehicle service towers is primarily a free fall system restricted by hand-operated guide lines. This system does not provide a positive means to control the motion of equipment which is in transit; the equipment is subject to damage from striking against the tower. This hoist system can not be operated under wind conditions in excess of 15 knots. The proposed hoist system will be operable under much greater winds and will provide a controlled mode for hoisting equipment and spacecraft to the various platform levels. Greater safety to spacecraft and equipment components will be provided.

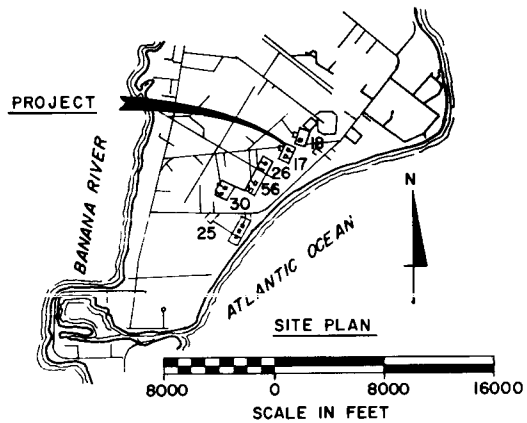
ESTIMATED FUTURE YEAR FUNDING FOR THIS PROJECT: $6,000,000

JOHN F. KENNEDY SPACE CENTER, NASA

FISCAL YEAR 1967 ESTIMATES

MODIFICATIONS TO LAUNCH COMPLEX NO. 17





CONSTRUCTION OF FACILITIES

FISCAL YEAR 1967 ESTIMATES

MODIFICATIONS TO LAUNCH COMPLEX 12

AUTHORIZATION LINE ITEM: John F. Kennedy Space Center

PROGRAM OFFICE FOR THE PROJECT: Office of Space Science and Applications

LOCATION OF PROJECT: Cape Kennedy, Brevard County, Florida

COGNIZANT NASA INSTALLATION: John F. Kennedy Space Center

TYPE OF CONSTRUCTION PROJECT: Alteration

FUNDING:

FY 1966 and Prior Years	$1,283,000
FY 1967 Estimate	639,000
Total Funding Through FY 1967	$1,922,000

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$220,000
Blockhouse modifications	LS	---	$143,285	143,285
Vehicle and transfer room air-conditioning	LS	---	76,715	76,715
Equipment				$419,000
Operational communication	LS	---	11,345	11,345
Operational television	LS	---	90,000	90,000
Long-line cable replacement	LS	---	317,655	317,655
Design	---	---	---	---
Fallout Shelter	---	---	---	-0-
		TOTAL		$639,000

PROJECT PURPOSE:

This project will provide needed improvements to the launch complex for the multi-stage Atlas Agena Launch Vehicle and Spacecraft.

PROJECT DESCRIPTION:

In the Blockhouse Area, the interior will be modified to permit the relocation and rearrangement of ground support equipment (GSE) within the control areas; the observation area will be enlarged for complete separation from the mission operating area; and, an emergency source of air will be installed.

At the Launch Pad, the existing air-conditioning units supporting the launch vehicle airborne electronic pod cooling system, the transfer room, and the instrumentation compressor, brine chiller, heat exchanger, and condenser unit which make up the launch vehicle airborne electronic pod cooling system are to be replaced with a self-contained, weatherproof, corrosion resistant unit. The existing marginal capacity 15 ton and 10 ton air-conditioning units now used in the transfer and instrumentation rooms are to be replaced with modern and efficient package units. These units will be designed to meet the required demands and will utilize existing duct work.

The existing Operational Television System consisting of four cameras and four monitors is to be supplemented to provide a more efficient system consisting of:

Seven television camera installations with pan, tilt and zoomer system capabilities to be located at the present camera mounts; and north of the LO_2 Storage Area and at the spacecraft levels on the Umbilical Tower and on the Launch Service Tower.

Seven 21-inch monitors located in the blockhouse.
A central control console in the blockhouse.
Associate interconnecting cables.

Existing intercommunication stations are to be modified by the addition of an off on switch plus connecting cables to include the capability of side tone transmission.

The existing long-line instrumentation, power, and control cables between the terminal boards in the blockhouse and the terminal board at the launch pad are to be removed and replaced with molded, moisture-resistant, multi-conductor cables. One hundred fifty cables will be involved.

PROJECT JUSTIFICATION:

Launch Complex 12, constructed in 1957 to support the Air Force development of the single-stage Atlas Weapons system, has undergone extensive modifications as the multi-stage Atlas Agena vehicle developed. The following modifications are needed to provide continuing support.

The proposed observation area, while permitting better viewing, will restrict the movement of personnel and limit interference with launch operations.

The present control system was designed for operational modes connected with the Atlas weapons system with additional consoles and equipment to support increasing operational requirements located in any available space in the control area. The advance of the Atlas Agena programs makes it necessary that the existing equipment be relocated to permit maximum utilization of space and increased efficiency during launch operations.

The installation of a more reliable emergency air system in the blockhouse is part of a plan for preparedness in the event of a disaster. No method is available to predict the maximum duration of a possible disaster. At present, emergency air is provided by portable air packs, which have a limited capacity and are considered inadequate. The proposed system will insure that a source of air will be available for long duration and will provide a means for gauging low capacity due to prolonged use or leaks.

The eight-year-old air-conditioning systems at the launcher have only marginal capacity to meet present system demands. Equipment components have been corroded by atmospheric elements, with annual maintenance costs averaging $15,000 to $20,000. Component obsolescence has made it both difficult and expensive to obtain replacement parts. Installation of the new air-conditioning systems will permit more efficient and economical operations and will fulfill present and projected system requirements.

The present operational television system, designed and installed in 1956, is inadequate to monitor multi-stage Atlas Agena operations and does not provide surveillance of either spacecraft or liquid oxygen loading operations. The proposed system will provide the coverage needed for multi-stage vehicle operations and permit monitoring of spacecraft level operations.

The present intercommunication system permits dual reception, but only single transmission. The console operator now has to leave his main line of communications with the test conductor to transmit with another panel monitor. During the critical countdown period, the possibility of missing a command or report from the test conductor could have a serious effect on a launch. By modifying the present system to permit side-tone transmission, the operators will not have to change stations to transmit.

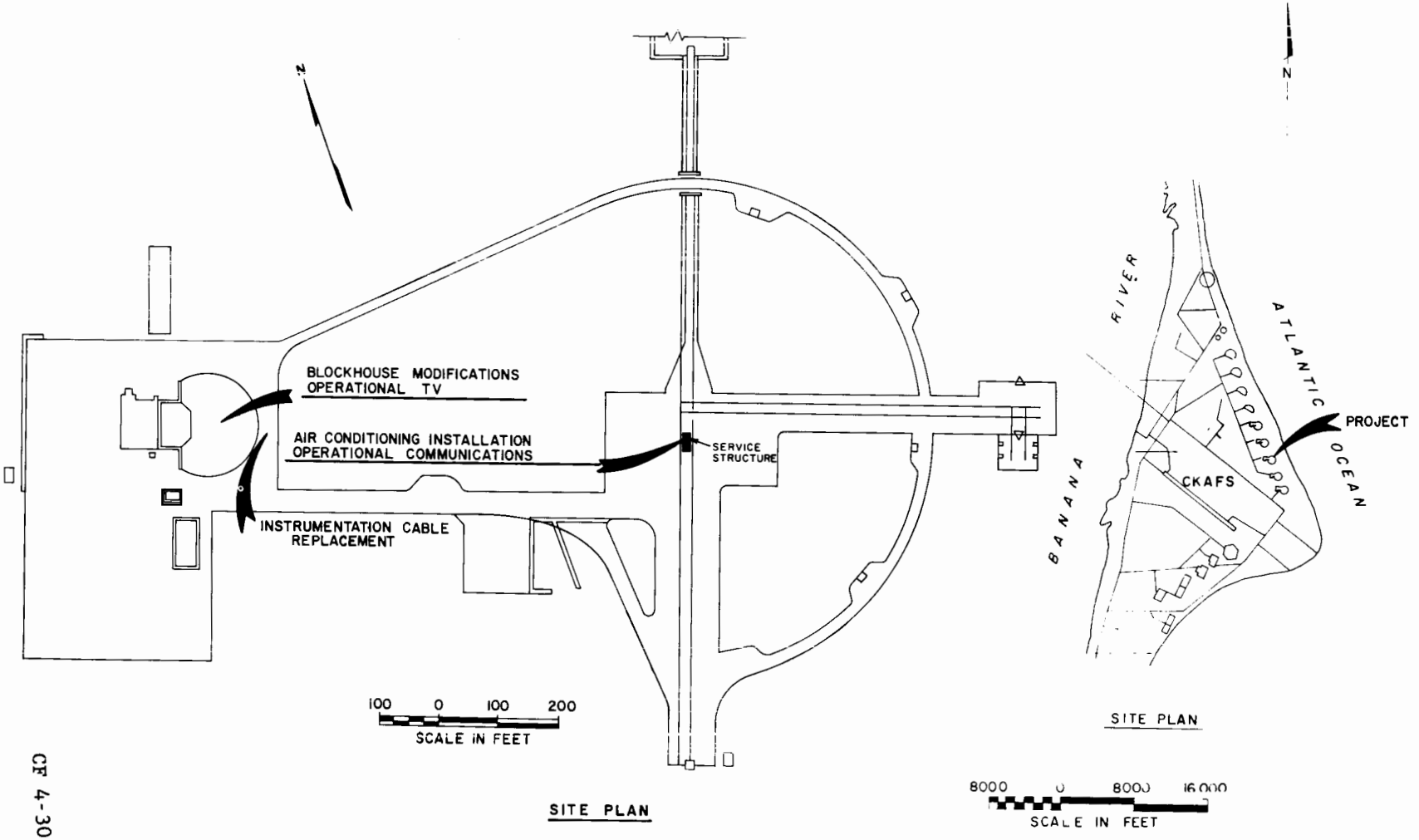
Existing long-line cables were severely damaged by a 1958 pad missile explosion and were made operational by extensive splicing. Leakage resistance, due to atmospheric exposure, insulation deterioration and the numerous splices, has limited the use of the majority of the cables to less reliable instrumentation circuits. Existing cable configurations make it more feasible to replace the entire cable installation. Based on known complex usage and the severe limitations of the present system, a new cable installation to maintain instrumentation reliability is mandatory.

ESTIMATED FUTURE YEAR FUNDING FOR THIS PROJECT: $5,000,000

JOHN F. KENNEDY SPACE CENTER, NASA

FISCAL YEAR 1967 ESTIMATES

MODIFICATIONS TO LAUNCH COMPLEX 12



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

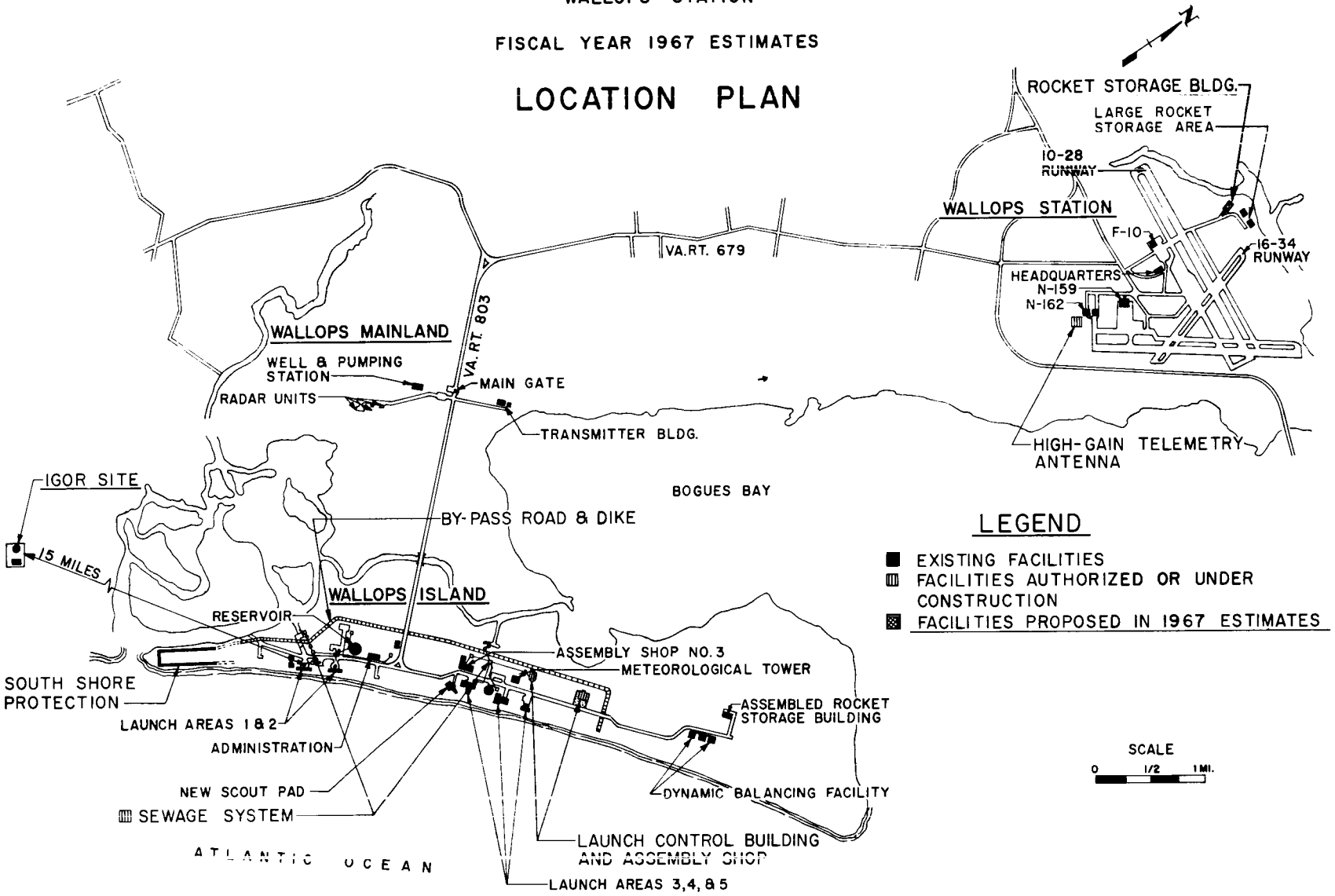
FISCAL YEAR 1967 ESTIMATES

WALLOPS STATION

WALLOPS STATION

FISCAL YEAR 1967 ESTIMATES

LOCATION PLAN



LEGEND

- EXISTING FACILITIES
- FACILITIES AUTHORIZED OR UNDER CONSTRUCTION
- FACILITIES PROPOSED IN 1967 ESTIMATES

SCALE 0 1/2 1 MI.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY
CONSTRUCTION OF FACILITIES
FISCAL YEAR 1967 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION	COGNIZANT PROGRAM OFFICE FOR INSTALLATION	LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Wallops Station	Space Science and Applications	Eastern Shore of Virginia	Accomack	Salisbury, Maryland

INSTALLATION MISSION

The basic mission of the Station is to prepare, assemble, and launch scientific experiments, achieve the desired position, and velocity in space, track and acquire and record the data sought. These data are processed, analyzed, and reduced to meaningful form.

PERSONNEL STRENGTH	FY 1965	FY 1966	FY 1967
NASA PERSONNEL *(End of Year)*	555	530	530
CONTRACTOR AND OTHER PERSONNEL	254	355	430
TOTAL ALL PERSONNEL	809	885	960

LAND	NO. ACRES
NASA-OWNED	6,561
OTHER GOVERNMENT AGENCY-OWNED	-
NON-FEDERAL *(Leases, easements)*	9
TOTAL LAND	6,570

TOTAL CAPITAL INVESTMENT* *(Including NASA-Owned Land) (as of June 30, 1965)*	$ 75,323

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YEAR	FY 1967 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Rocket Storage Magazine	SSA	10	205	-	215
ALL OTHER PROJECTS		37,083			
TOTALS		37,093	205		

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* *Includes work in process.*

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1967 ESTIMATES

ROCKET STORAGE MAGAZINE

AUTHORIZATION LINE ITEM: Wallops Station

PROGRAM OFFICE FOR THE PROJECT: Office of Space Science and Applications

LOCATION OF PROJECT: Wallops Station, Accomack County, Virginia

COGNIZANT NASA INSTALLATION: Wallops Station

TYPE OF CONSTRUCTION PROJECT: New

FUNDING:

FY 1966 and Prior Years	$10,000
FY 1967 Estimate	205,000
Total Funding Through FY 1967	$215,000

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$205,000
Site improvement	LS	---	$30,590	30,590
Utilities	LS	---	28,910	28,910
Building	Sq. Ft.	12,000	12.13	145,500
Equipment	---	---	---	---
Design	---	---	---	---
Fallout Shelter (Not feasible)	---	---	---	None
		TOTAL		$205,000

PROJECT PURPOSE:

This facility will provide approximately 12,000 square feet of additional enclosed magazine space for the storage of solid-propellant rocket motors, increasing the Wallops Station storage capability from 20,000 to 32,000 square feet.

PROJECT DESCRIPTION:

This 12,000 square foot storage building will be located in the Wallops Station main base magazine area north of the landing strip suitably isolated from existing magazines and population in accordance with the quantity-distance criteria for explosive storage. Convenient access to the Wallops Station airport will be provided to accommodate air delivery and shipping of boosters and assembled vehicle systems such as Scout. Provision of heat, insulation and forced ventilation will be included in order to maintain the storage temperature environment between 50° and 90° Fahrenheit. Suitable doors, access road, lighting, alarm systems and lightning arrestors will be incorporated.

PROJECT JUSTIFICATION:

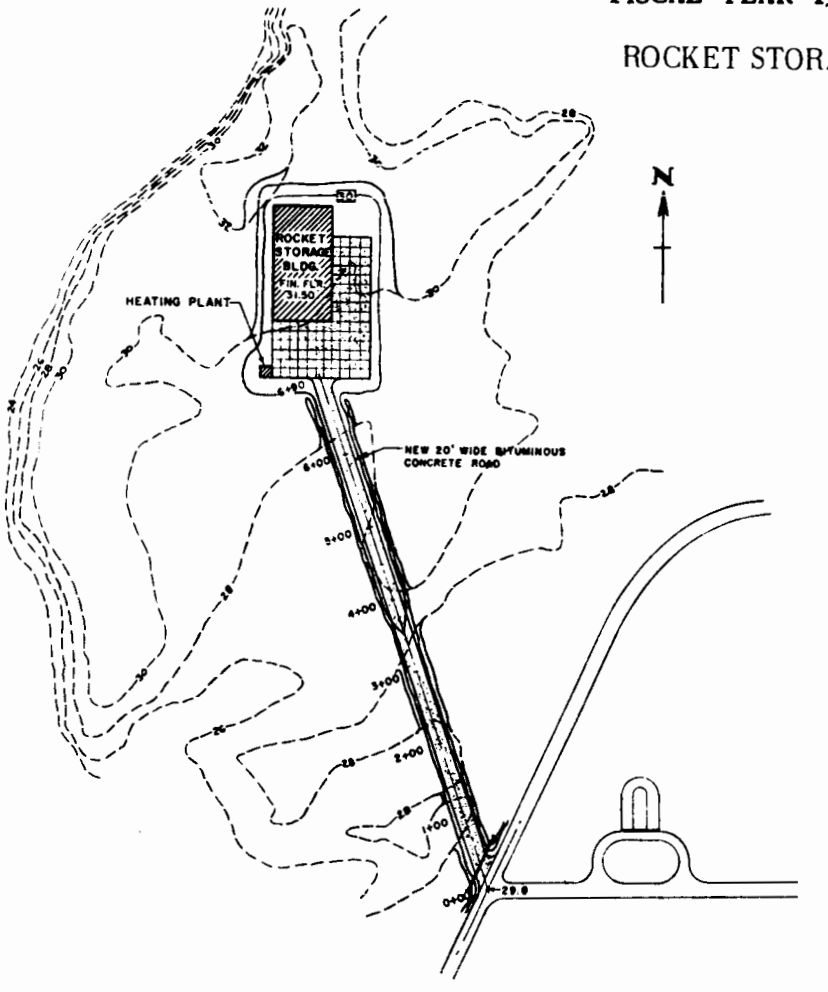
High performance solid propellant formulations used in sounding rockets and Scout Launch Vehicle stages such as the Algol, Castor I and II, the X-254, X-258, X-259, Lance, Aerojet Jr., and Alcor motors require storage between 50° and 90° Fahrenheit in order to guarantee their reliability and repeatability of performance.

The original environmentally controlled storage magazine constructed in 1962 and the adjoining storage shed totaling 20,000 square feet of storage space are no longer capable of meeting the full storage requirements because of the increased use of the higher performance rocket motors which must be maintained at a fairly constant temperature. This, coupled with the single point assembly and checkout of the Scout Launch Vehicle, has increased the Rocket Storage Magazine area requirement to approximately 32,000 square feet. An inventory level of approximately 85 boosters and several assembled Scout Launch Vehicles on transporters are involved.

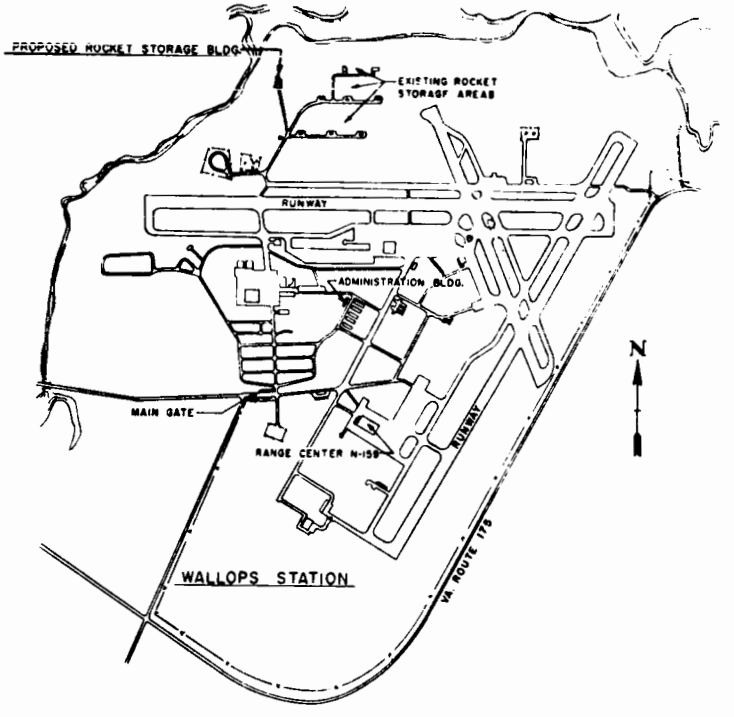
ESTIMATED FUTURE YEAR FUNDING FOR THIS PROJECT: None

WALLOPS STATION
FISCAL YEAR 1967 ESTIMATES

ROCKET STORAGE MAGAZINE



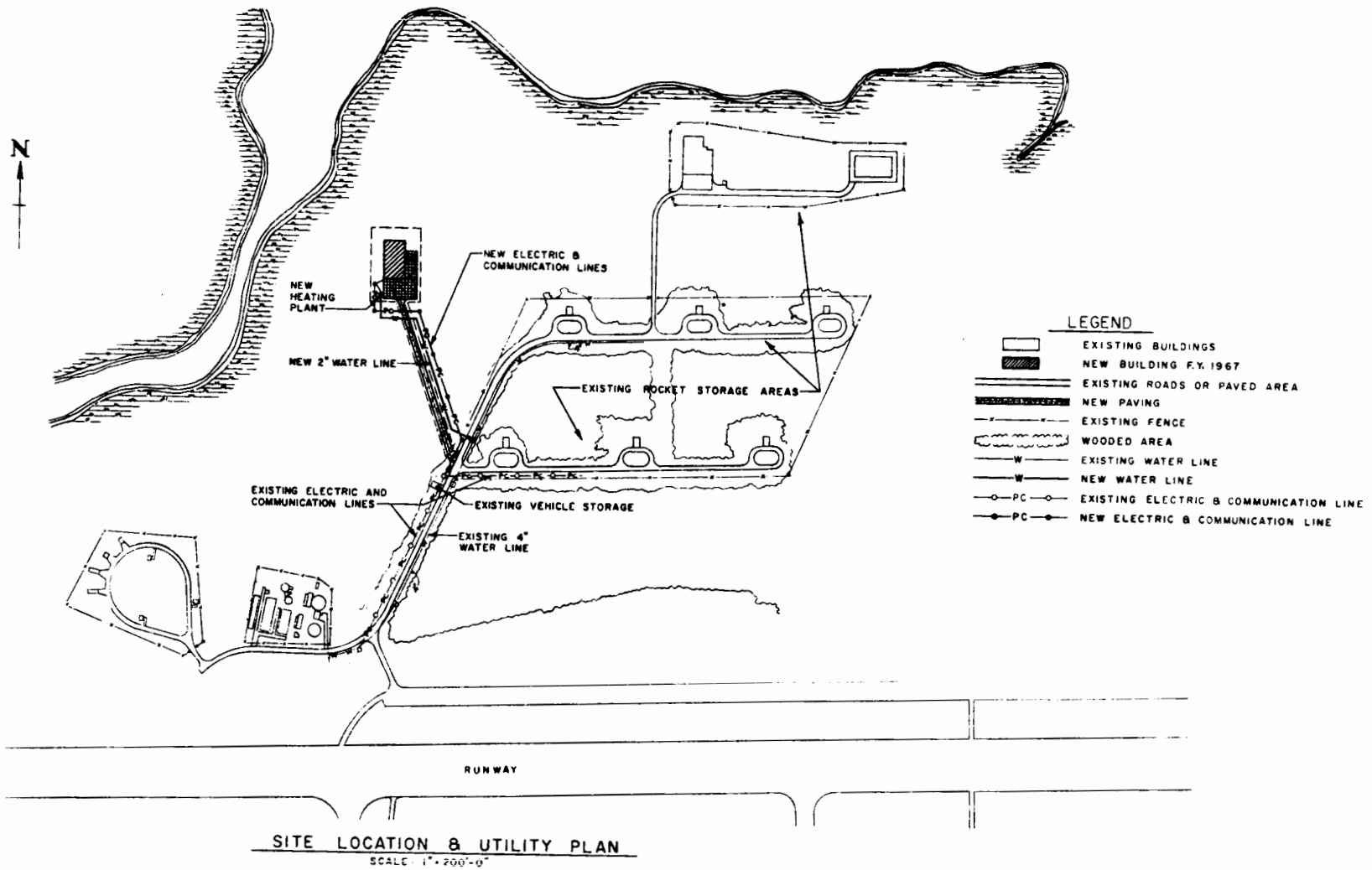
SITE PLAN
SCALE: 1"=80'-0"



LOCATION MAP
NO SCALE

WALLOPS STATION
FISCAL YEAR 1967 ESTIMATES

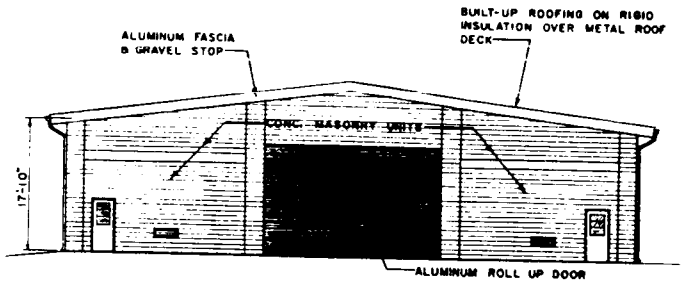
ROCKET STORAGE MAGAZINE



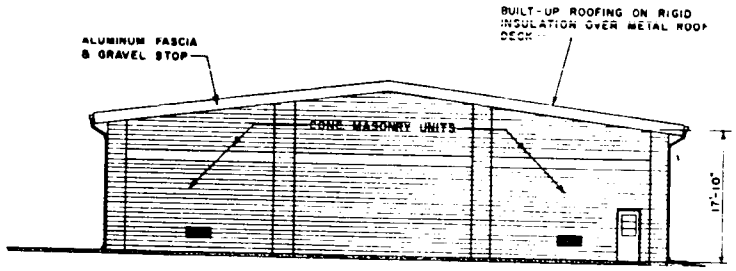
SITE LOCATION & UTILITY PLAN
SCALE: 1" = 200'-0"

WALLOPS STATION
FISCAL YEAR 1967 ESTIMATES

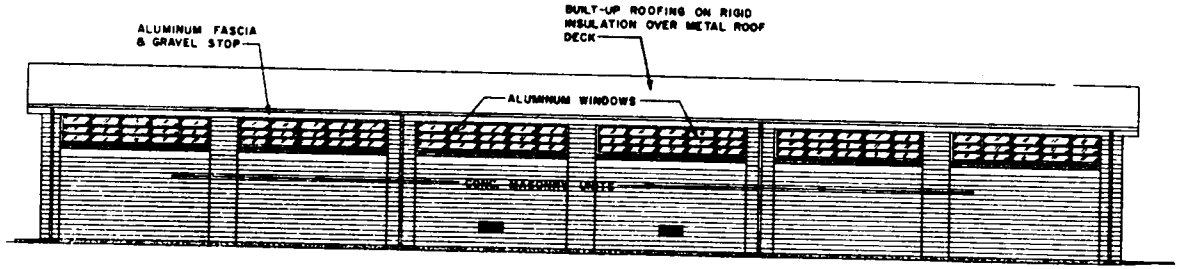
ROCKET STORAGE MAGAZINE



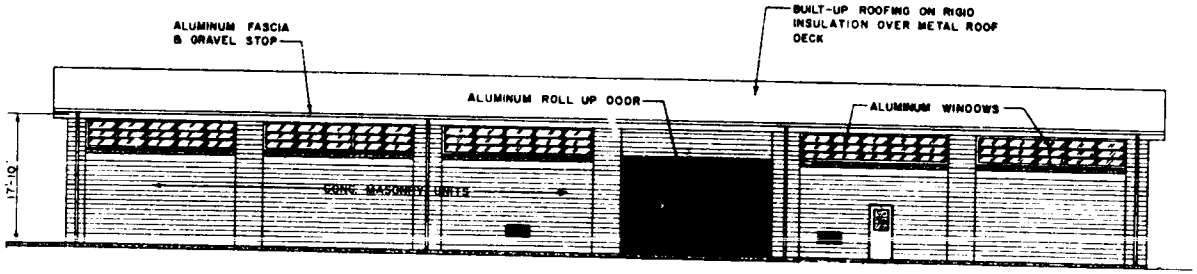
SOUTH ELEVATION
SCALE: 1/8"=1'-0"



NORTH ELEVATION
SCALE: 1/8"=1'-0"



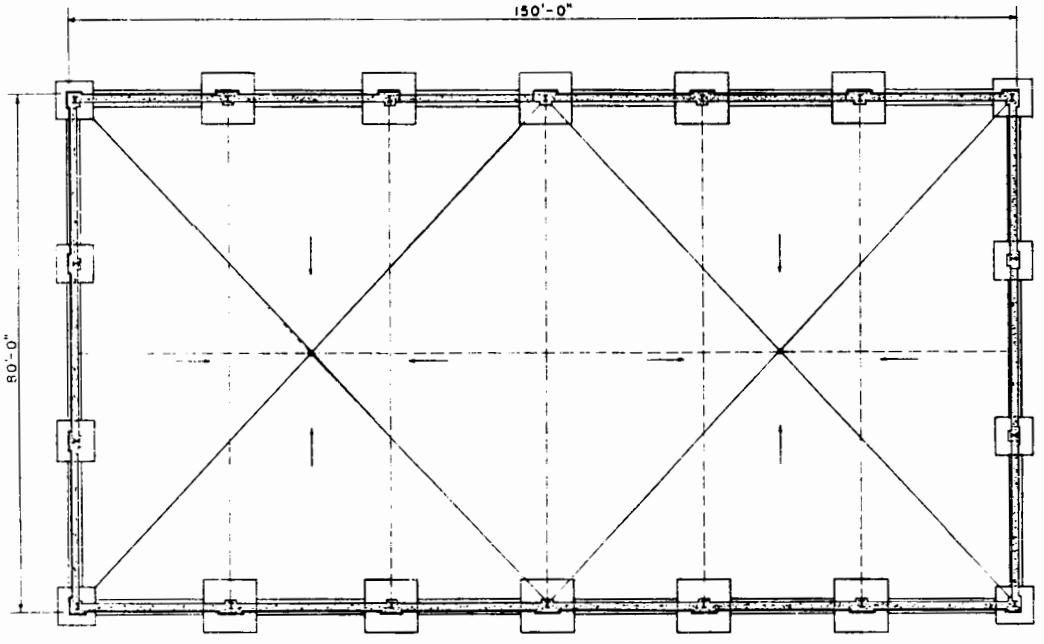
WEST ELEVATION
SCALE: 1/8"=1'-0"



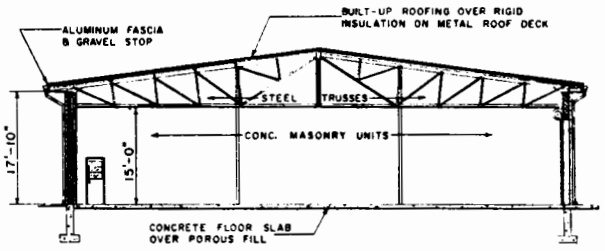
EAST ELEVATION
SCALE: 1/8"=1'-0"

WALLOPS STATION
FISCAL YEAR 1967 ESTIMATES

ROCKET STORAGE MAGAZINE



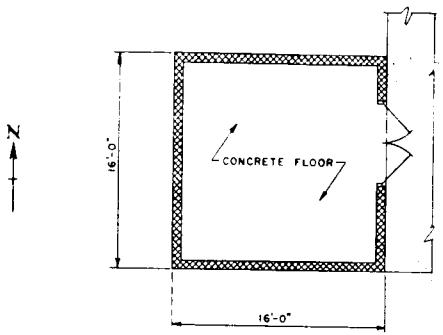
FOUNDATION PLAN
SCALE: 1/8" = 1'-0"



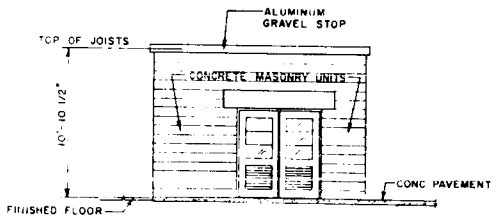
SECTION "A - A"
SCALE: 1/8" = 1'-0"

WALLOPS STATION
FISCAL YEAR 1967 ESTIMATES

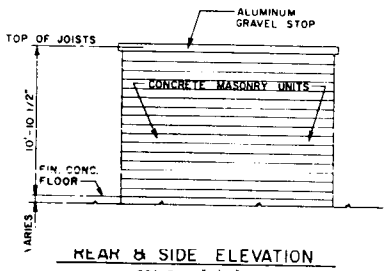
ROCKET STORAGE MAGAZINE
HEATING PLANT



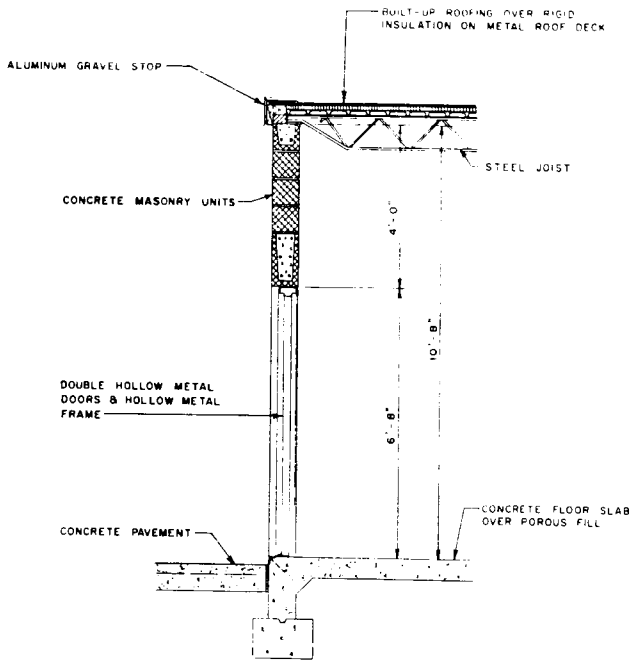
FLOOR PLAN
SCALE: 1/4"=1'-0"



FRONT ELEVATION
SCALE: 1/4"=1'-0"



REAR & SIDE ELEVATION
SCALE: 1/4"=1'-0"



TYPICAL WALL & DOOR SECTION
SCALE: 3/4"=1'-0"

CF 11-9

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1967 ESTIMATES

VARIOUS LOCATIONS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY
CONSTRUCTION OF FACILITIES
FISCAL YEAR 19 67 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION	COGNIZANT PROGRAM OFFICE FOR INSTALLATION	LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Various Locations	Various	Not Applicable	Not Applicable	Not Applicable

INSTALLATION MISSION

PERSONNEL STRENGTH	FY 1965	FY 1966	FY 1967
NASA PERSONNEL *(End of Year)*			
CONTRACTOR AND OTHER PERSONNEL			
TOTAL ALL PERSONNEL	Not Applicable		

LAND	NO. ACRES
NASA-OWNED	
OTHER GOVERNMENT AGENCY-OWNED	
NON-FEDERAL *(Leases, easements)*	Not
TOTAL LAND	Applicable

TOTAL CAPITAL INVESTMENT* *(Including NASA-Owned Land) (as of June 30, 1965)*	Not $ Applicable

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1962 THRU CURRENT YEAR	FY 1967 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Facilities for S-IVB Stage Program	MSF	11,496.2	1,100.0	-	12,596.2
Launch Vehicle Service Tower	SSA	145.0	2,443.0	-	2,588.0
Aerobee 350 Launch Facility	SSA	60.0	1,200.0	-	1,260.0
Spin Test Facility	SSA	38.0	745.0	-	783.0
Water Distribution and Sewage Disposal Systems	TDA	146.0	990.0	-	1,136.0
ALL OTHER PROJECTS		608,010.5			
TOTALS		619,895.7	6,478.0		

NASA FORM 1029 (REV. JUN 65) PREVIOUS EDITIONS ARE OBSOLETE.

* *Includes work in process.*

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1967 ESTIMATES

LAUNCH VEHICLE SERVICE TOWER

AUTHORIZATION LINE ITEM: Various Locations

PROGRAM OFFICE FOR THE PROJECT: Office of Space Science and Applications

LOCATION OF PROJECT: Western Test Range, California

COGNIZANT NASA INSTALLATION: John F. Kennedy Space Center

TYPE OF CONSTRUCTION PROJECT: New

FUNDING:

FY 1966 and Prior Years	$145,000
FY 1967 Estimate	2,443,000
Total Funding Through FY 1967	$2,588,000

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$1,971,000
Foundation and structure	LS	---	$1,490,000	1,490,000
Elevator	Each	1	52,000	52,000
Crane	Each	1	69,000	69,000
Site preparation	LS	---	175,600	175,600
High pressure gas storage shelter	Sq. Ft.	800	33.00	26,400
Concrete safety barricades	Each	2	4,000	8,000
Utilities	LS	---	150,000	150,000
Equipment				$472,000
Instrumentation	LS	---	72,000	72,000
Pneumatic system - 1st stage	LS	---	85,000	85,000

	Unit of Measure	Quantity	Unit Cost	Total Cost
Pneumatic system - 2nd stage	LS	---	$60,000	$50,000
Hydraulic system test stand	LS	---	65,000	65,000
Electric power distribution system	LS	---	190,000	190,000
Design	---	---	---	---
Fallout Shelter (Not feasible)	---	---	---	None
		TOTAL		$2,443,000

PROJECT PURPOSE:

This project will provide a Vehicle Service Tower and associated equipment for launching the Delta and Thor-Agena Vehicles.

PROJECT DESCRIPTION:

This project will provide for the construction of a Launch Vehicle Service Tower at Launch Complex 75-1 on Launch Emplacement 75-1-2 at the Western Test Range, for servicing the improved Delta and the Thor-Agena Vehicles. The structure will be fabricated of concrete and corrosion-resistant metals in order to minimize the high maintenance cost previously experienced from continuous exposure of materials to the salt water atmosphere characteristic of the vicinity. The structure will be used to erect vehicle stages and spacecraft on the launch pad, support equipment and personnel required for vehicle preparation and checkout, provide environmental protection of the vehicle stages on the launch pad, and support the various umbilicals that service the vehicle stages and spacecraft during checkout, propellant loading, and terminal launch operations. The service platforms will be adjustable to meet the specific work level requirements of the Delta, Thor-Agena and Thor-Ablestar Vehicle configurations. The upper levels will be air-conditioned for environmental control of the second-stage guidance section and spacecraft areas. A 40-foot reach, 360-degree, 12½-ton hammerhead crane will be mounted on top of the tower for the erection and mating of all stages, spacecrafts, and solid boosters.

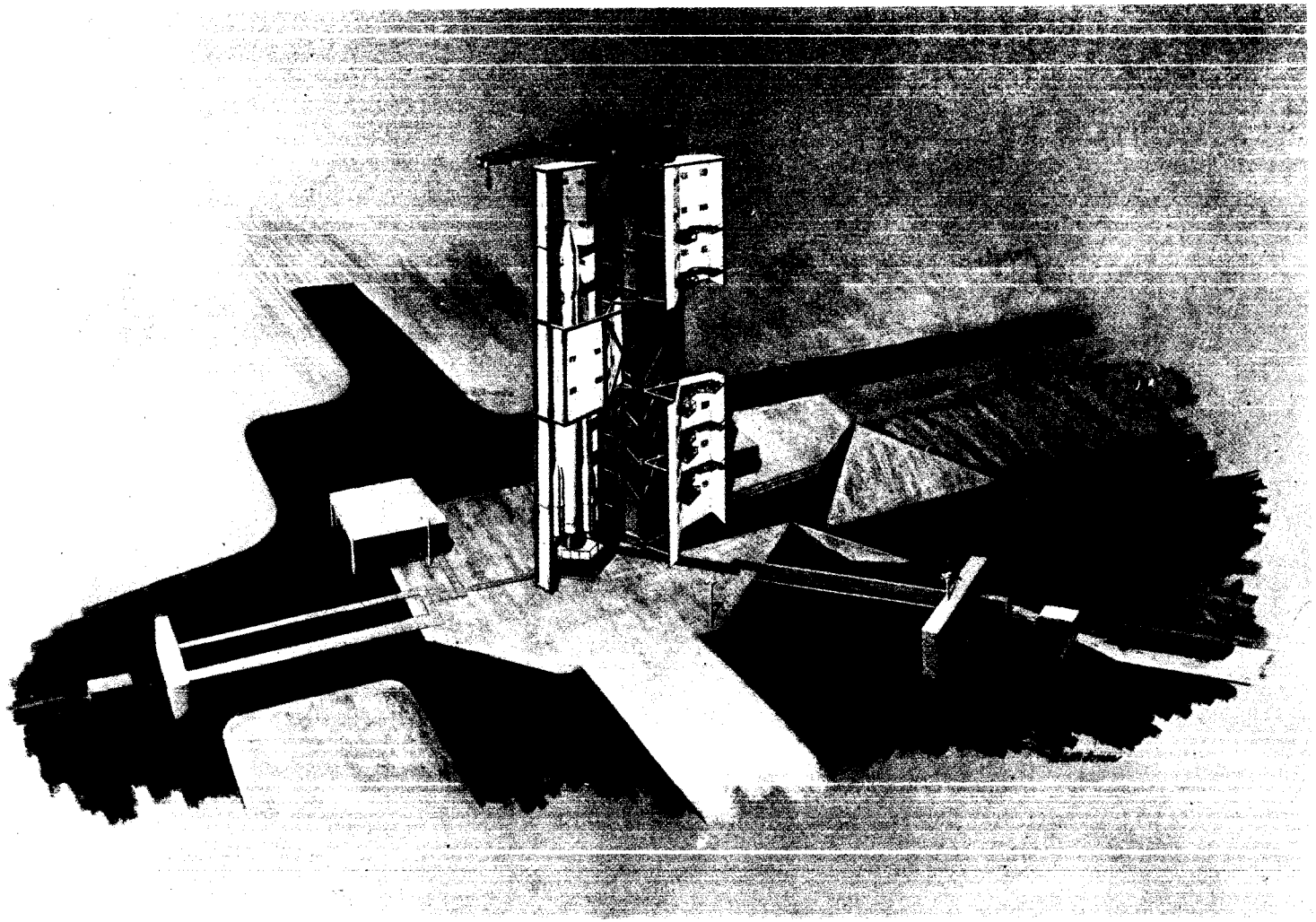
PROJECT JUSTIFICATION:

At present, only Pad 75-1-1 at the Western Test Range is capable of supporting Thor-Agena and Delta launchings of NASA missions. Past experience has shown that the scheduling of more than eight launchings per

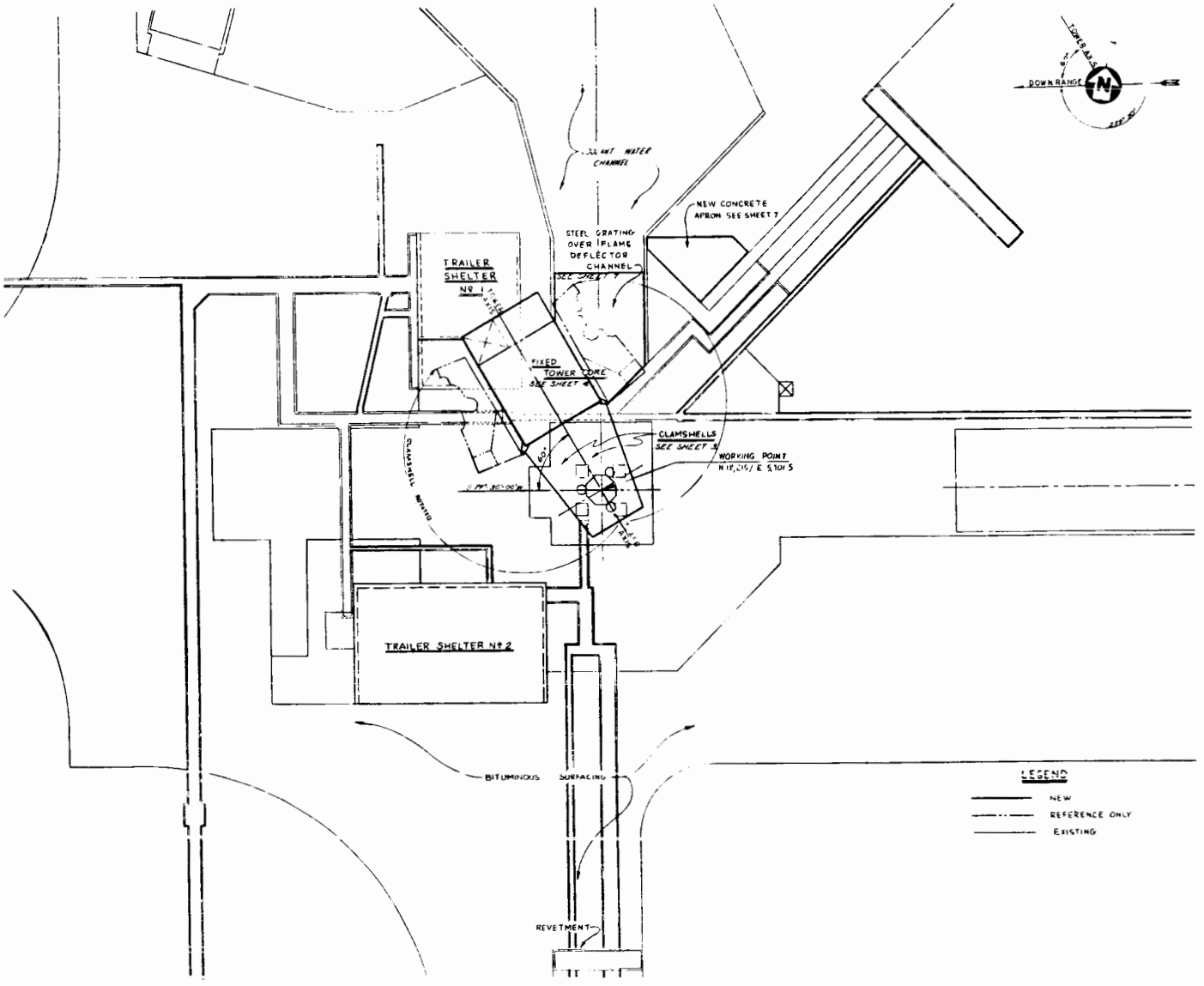
year from one launch pad is excessive. The projected launch schedule for 1967 and subsequent years indicates a combined NASA, DOD, Weather Bureau launch rate of twelve missions per year. A second launch vehicle service structure is required on the adjoining Pad 75-1-2 to meet this schedule as well as provide for scheduling flexibility such as the Weather Bureau rapid call-up missions and to insure continued Polar Orbital operations in the event of a catastrophic accident on one of the launch pads.

ESTIMATED FUTURE YEAR FUNDING FOR THIS PROJECT: None

VARIOUS LOCATIONS
FISCAL YEAR 1967 ESTIMATES
VEHICLE SERVICE TOWER
WESTERN TEST RANGE



VARIOUS LOCATIONS
FISCAL YEAR 1967 ESTIMATES
VEHICLE SERVICE TOWER
WESTERN TEST RANGE



CONSTRUCTION OF FACILITIES

FISCAL YEAR 1967 ESTIMATES

AEROBEE 350 LAUNCH FACILITY

AUTHORIZATION LINE ITEM: Various Locations

PROGRAM OFFICE FOR THE PROJECT: Office of Space Science and Applications

LOCATION OF PROJECT: White Sands, New Mexico

COGNIZANT NASA INSTALLATION: Goddard Space Flight Center

TYPE OF CONSTRUCTION PROJECT: New

FUNDING:

FY 1966 and Prior Years	$60,000
FY 1967 Estimate	1,200,000
Total Funding Through FY 1967	$1,260,000

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$1,059,000
Launch tower structure	LS	---	$304,500	304,500
Boom structure	LS	---	180,600	180,600
Helium servicing building	Sq. Ft.	1,440	20.42	29,400
Propellant building	Sq. Ft.	900	28.78	25,900
Propellant loading system	LS	---	265,000	265,000
Azimuth and guide rail mechanism	LS	---	145,000	145,000
Utilities	LS	---	56,600	56,600
Site preparation	LS	---	52,000	52,000

	Unit of Measure	Quantity	Unit Cost	Total Cost
Equipment				$141,000
Vehicle control console	LS	---	$64,000	64,000
Payload control console	LS	---	77,000	77,000
Design	---	---	---	---
Fallout Shelter (Not feasible)	---	---	---	None
		TOTAL		$1,200,000

PROJECT PURPOSE:

This project will provide a capability for launching Aerobee 350 sounding rockets from White Sands, New Mexico.

PROJECT DESCRIPTION:

An Aerobee 350 Launch Tower will be integrated within the "Little Joe" launch complex making use of the existing blockhouse and Rocket Assembly Building to support the firings of heavy scientific payloads into the atmosphere at this location. The Launch Tower guide rails will be adjustable to accommodate both the 15 inch and the 22 inch diameter Aerobee configurations, and will be capable of remote pointing in firing Azimuth and elevation for timely windage adjustments. The lower half of the Launch Tower will be enclosed to permit all-weather operations.

PROJECT JUSTIFICATION:

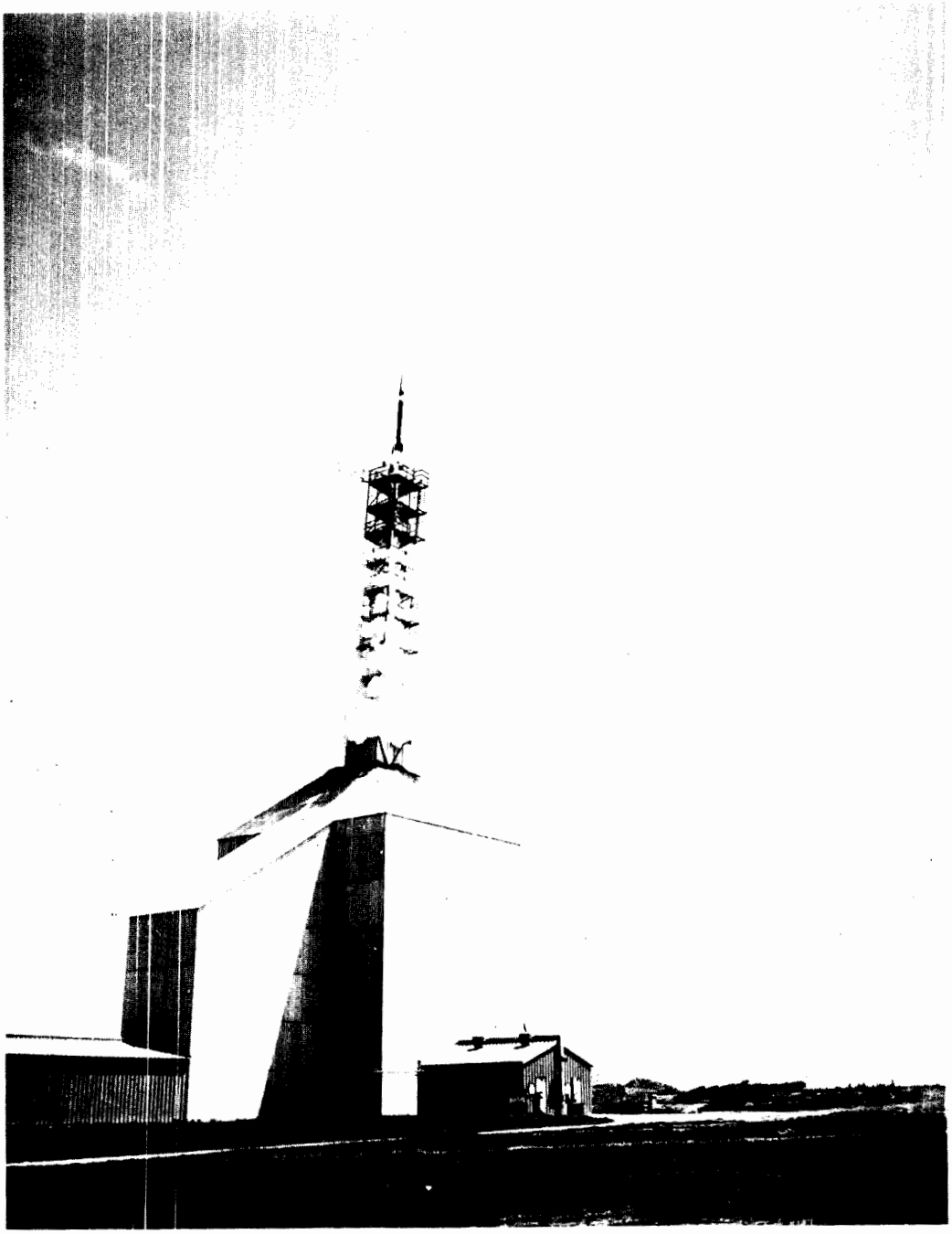
This facility will increase the capability of the NASA Sounding Rocket Program by providing an additional launch site for the Aerobee 350 vehicle. The Aerobee 350 provides the necessary payload capacity and trajectory capability required for many large scientific payloads such as X-ray, optic, and solar astronomy experiments containing large optical and astronomical telescopes of long focal length which will photograph discreet stars and X-ray sources. The payloads consist of the telescope and sensors plus required guidance apparatus and recovery parachutes.

Although the early developmental flights of the Aerobee 350 were conducted from Wallops Island, Virginia, experience to date has shown the structure of the atmosphere above the White Sands to be near optimum for astronomical

observations. Payload recovery is practical at White Sands, thus reuse of the payloads costing up to $250,000 each will be possible. The recovery of cameras, costly experimental equipment and film in processable condition is the only way data can be acquired from many sounding rocket experiments.

ESTIMATED FUTURE YEAR FUNDING FOR THIS PROJECT: None

VARIOUS LOCATIONS
FISCAL YEAR 1967 ESTIMATES
AEROBEE 350 LAUNCH FACILITY
WHITE SANDS, NEW MEXICO



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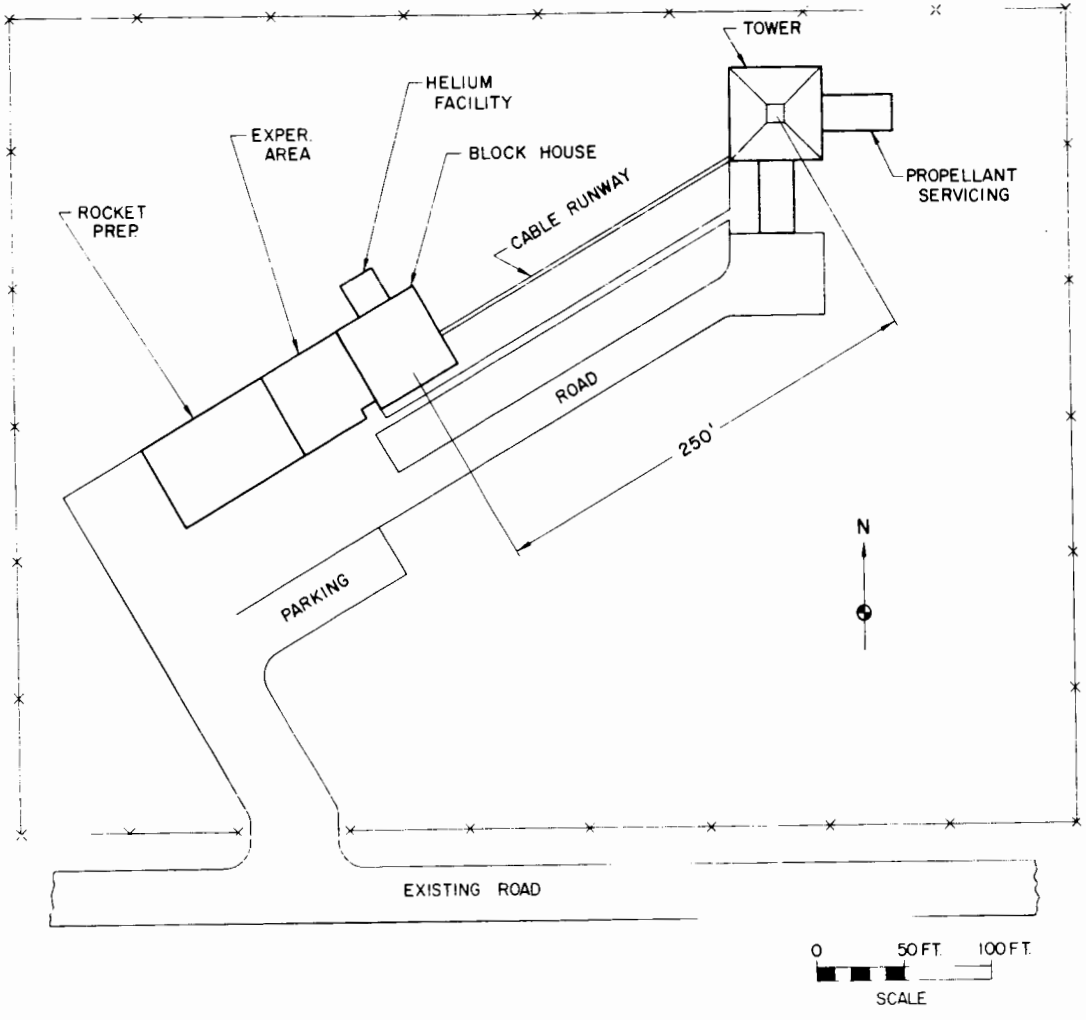
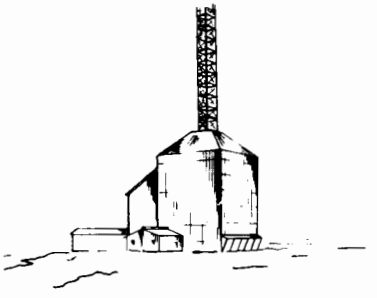
VARIOUS LOCATIONS
FISCAL YEAR 1967 ESTIMATES
AEROBEE 350 LAUNCH FACILITY
WHITE SANDS, NEW MEXICO





CONSTRUCTION OF FACILITIES

FISCAL YEAR 1967 ESTIMATES

SPIN TEST FACILITY

AUTHORIZATION LINE ITEM: Various Locations

PROGRAM OFFICE FOR THE PROJECT: Office of Space Science and Applications

LOCATION OF PROJECT: Western Test Range, California

COGNIZANT NASA INSTALLATION: John F. Kennedy Space Center

TYPE OF CONSTRUCTION PROJECT: New

FUNDING:

FY 1966 and Prior Years	$38,000
FY 1967 Estimate	745,000
Total Funding Through FY 1967	$783,000

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$640,000
Spin test building	Sq. Ft.	2,300	$66.50	153,000
Cranes and monorail	LS	---	25,000	25,000
Control building	Sq. Ft.	2,500	54.00	135,000
Special air-conditioning and compressed air	LS	---	60,000	60,000
Site Preparation	LS	---	115,000	115,000
Utilities	LS	---	97,000	97,000
Communications	LS	---	30,000	30,000
TV monitoring system	LS	---	25,000	25,000

	Unit of Measure	Quantity	Unit Cost	Total Cost
Equipment				$105,000
Dynamic balance machine	LS	---	$105,000	105,000
Design	---	---	---	---
Fallout Shelter (Not feasible)	---	---	---	None
		TOTAL		$745,000

PROJECT PURPOSE:

This facility is required to conduct prelaunch operations on the Delta Launch Vehicle third stage, interstage adapter, spin table and aerodynamic shroud and to conduct final dynamic balancing checks of the third stage solid propellant rocket coupled to the spacecraft in the flight configuration.

PROJECT DESCRIPTION:

This project proposes the construction of a Delta vehicle third stage/spacecraft facility which will consist of two (2) buildings: A Control Building of approximately 2,500 square feet and a Spin Balance Building of approximately 2,300 square feet. The Spin Balance Building will contain a dynamic balance machine.

The Control Building will provide a main control area for housing equipment used for the remote controlled hazardous operations in the Spin Balance Building. Offices, sanitary facilities, stockroom, and an electrical/mechanical laboratory area of 800 sq. ft. equipped with a monorail having a 3-ton capacity hoist with a 30-foot hook height will be contained in this air-conditioned building.

The Spin Balance Building will consist of a main test area for the complete inspection and checkout of the third stage/spacecraft assembly and the testing of these assemblies on the dynamic balance machine. The test area will also contain an overhead bridge crane equipped with two, three (3) ton capacity hoists with a hook height of 30 feet. Since ordnance handling and balance operations will be conducted here, the building will be constructed to meet safety requirements and will contain conductive flooring, explosion-proof electrical utilities, safety shower, and air-conditioning to meet the temperature and humidity constraints.

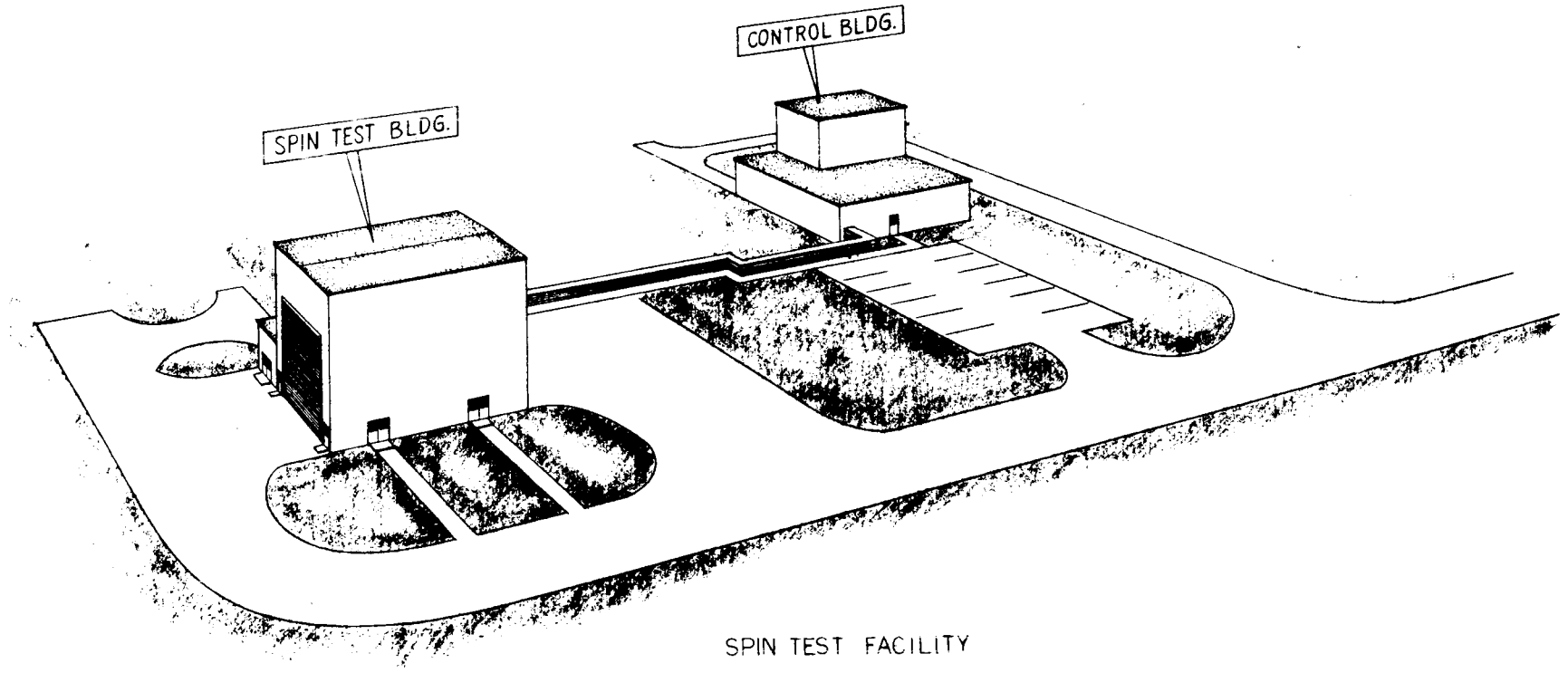
PROJECT JUSTIFICATION:

A Dynamic Balancing Facility is required at the Western Test Range to support Polar Orbit missions scheduled to use the Delta Launch Vehicle. Large spacecraft such as International Satellite for Ionospheric Studies (ISIS), Orbiting Solar Observatory (OSO) or Interplanetary Monitoring Platform (IMP) cannot be dynamically balanced with the third stage solid propellant rocket in the existing Scout Spin Test Facility due to the size of the building and the design limitations of the Scout Balancing Machine. Other prelaunch operations including the receipt and inspection of the third stage rocket motor, spacecraft attach fittings, interstage adapter and aerodynamic shroud will be conducted in this facility. The dynamic balancing of the third stage and spacecraft in the flight configuration is necessary to assure proper spin stabilization during third stage powered flight and in orbit.

ESTIMATED FUTURE YEAR FUNDING FOR THIS PROJECT: None

VARIOUS LOCATIONS

FISCAL YEAR 1967 ESTIMATES
SPIN TEST FACILITY
WESTERN TEST RANGE



SPIN TEST FACILITY

PERSPECTIVE

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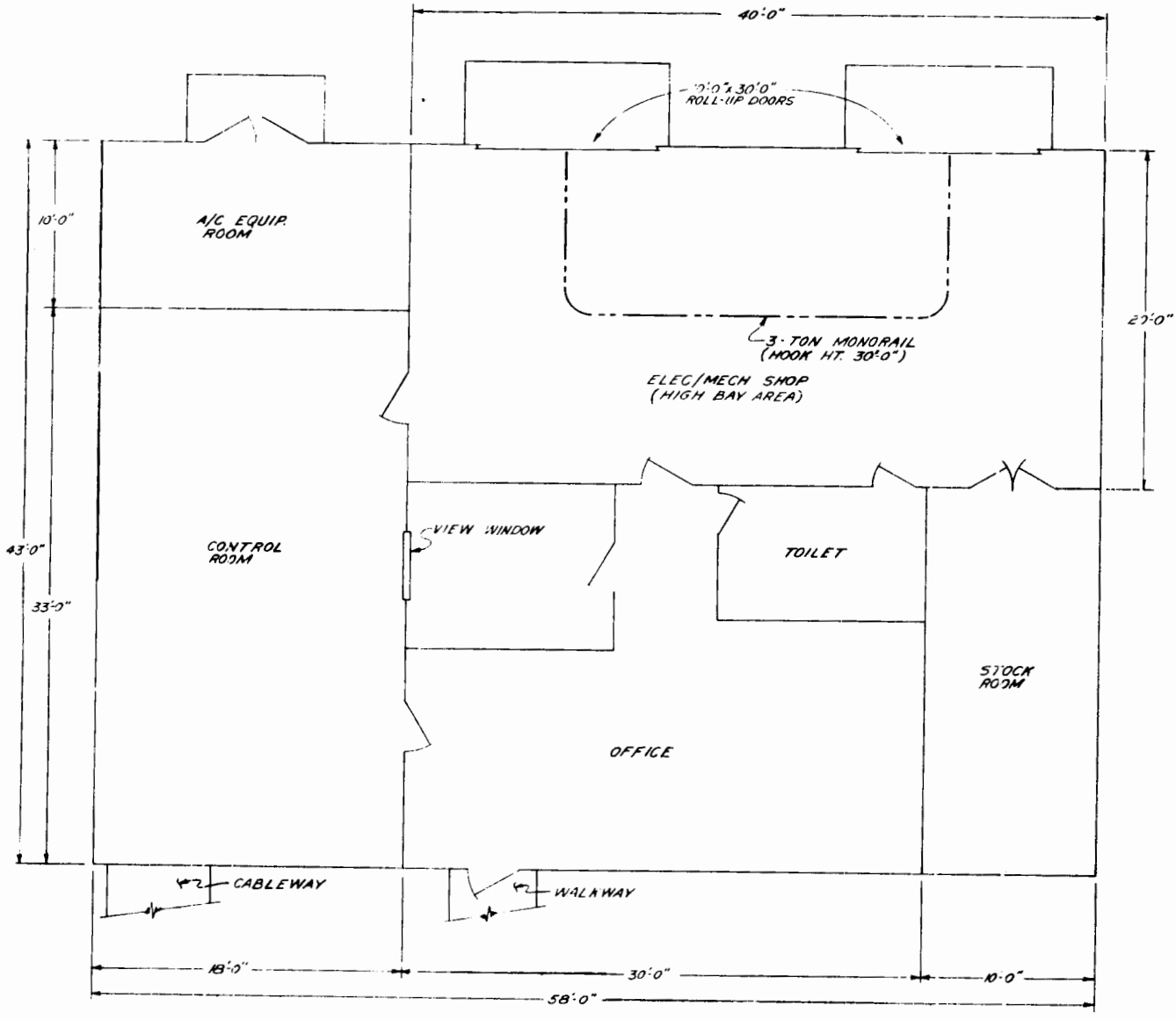
VARIOUS LOCATIONS

FISCAL YEAR 1967 ESTIMATES
SPIN TEST FACILITY
WESTERN TEST RANGE



SPIN TEST FACILITY
CONTROL BUILDING
FLOOR PLAN

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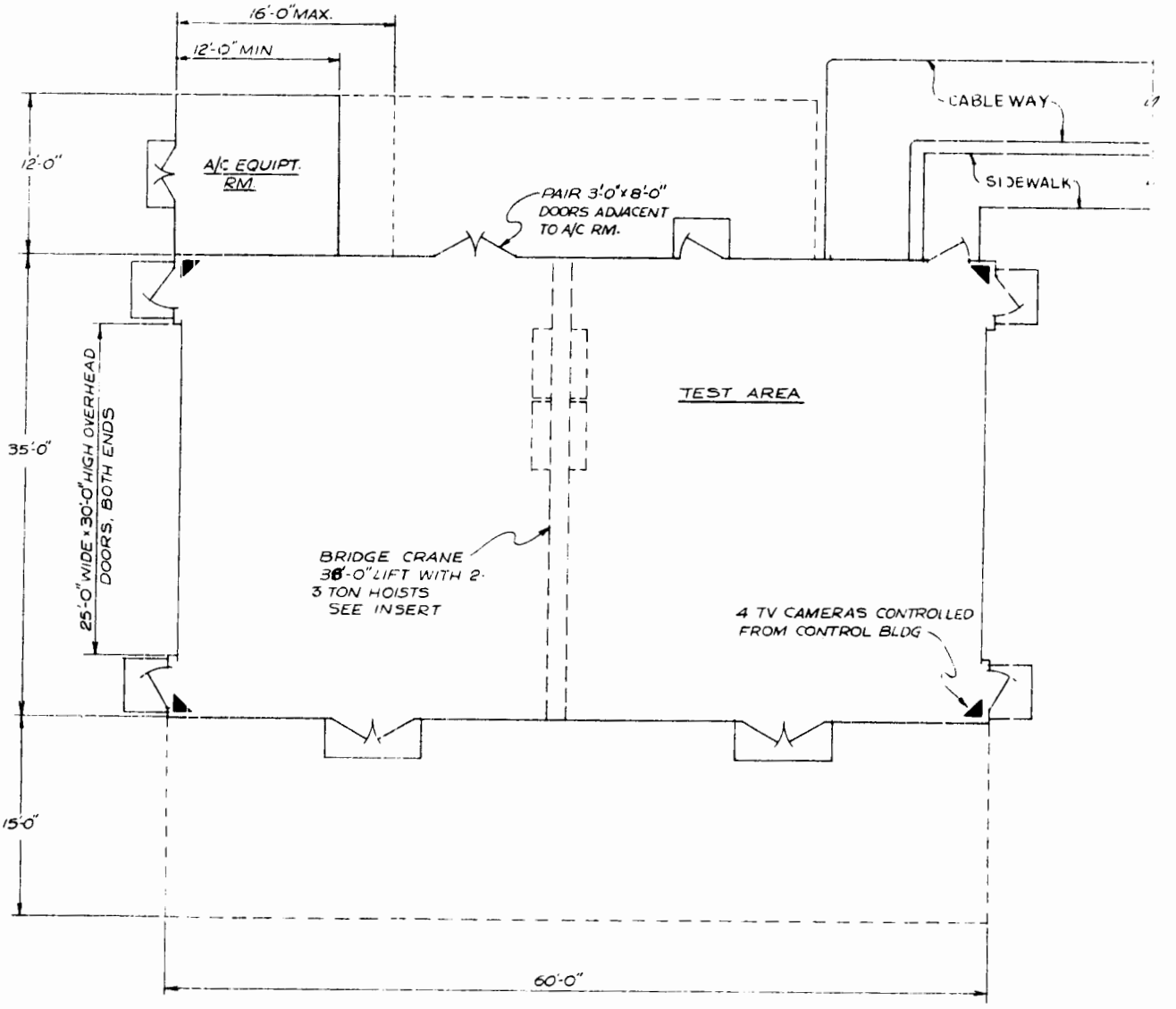
VARIOUS LOCATIONS

FISCAL YEAR 1967 ESTIMATES
SPIN TEST FACILITY
WESTERN TEST RANGE



PLAN
SPIN TEST BLDG.

GROSS AREA: 2300 SQ.FT.

4 0 4 8
SCALE IN FEET

CF 12-22

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1967 ESTIMATES

FACILITY PLANNING AND DESIGN

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY
CONSTRUCTION OF FACILITIES
FISCAL YEAR 1967 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION	COGNIZANT PROGRAM OFFICE FOR INSTALLATION	LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
All	Office of Associate Administrator	---	---	---

INSTALLATION MISSION

See justification.

PERSONNEL STRENGTH	FY 1965	FY 1966	FY 1967
NASA PERSONNEL *(End of Year)*	- -		
CONTRACTOR AND OTHER PERSONNEL			
TOTAL ALL PERSONNEL	Not Applicable		

LAND	NO. ACRES
NASA-OWNED	
OTHER GOVERNMENT AGENCY-OWNED	
NON-FEDERAL *(Leases, easements)*	Not Applicable
TOTAL LAND	
TOTAL CAPITAL INVESTMENT* *(Including NASA-Owned Land) (as of June 30, 1965)*	$ Not Applicable

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1962 THRU CURRENT YEAR	FY 1967 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Facility Planning and Design	AA	46,330	7,000	Not Applicable	Not Applicable
ALL OTHER PROJECTS					
TOTALS		46,330	7,000		

CF 13-1

NASA FORM 1029 (REV. JUN 65) PREVIOUS EDITIONS ARE OBSOLETE.

* *Includes work in process.*

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1967 ESTIMATES

FACILITY PLANNING AND DESIGN

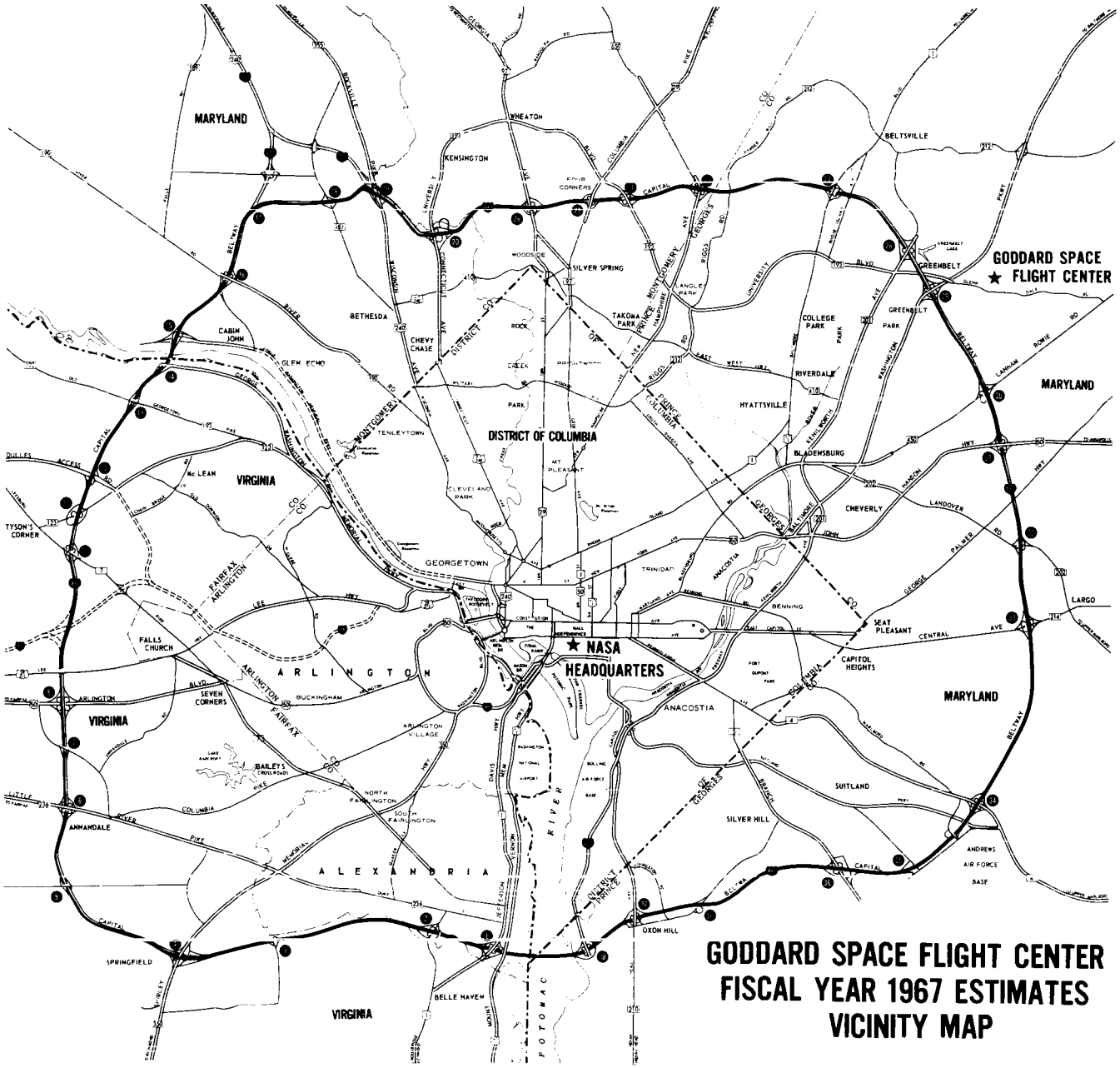
The funds requested are used to conduct advance planning and design activities on projects for which construction funds will be requested in subsequent budgets.

The $7.0 million request covers work in the following three areas: (a) $1.5 million for preliminary designs and other special studies, (b) $3.5 million for the preparation of complete plans and specifications of those projects to be included in the FY 1968 fiscal year construction program, and (c) $2.0 million to complete the detailed design plans and specifications for the highly complex two position engine and stage test stand associated with the NERVA program.

The $1.5 million for the first area covers the preparation and upgrading of master plans for the various NASA centers and other NASA installations, unforeseen construction studies, and the preparation of cost estimates and engineering studies which make up the preliminary designs for an estimated $80 to $100 million fiscal year 1969 construction program.

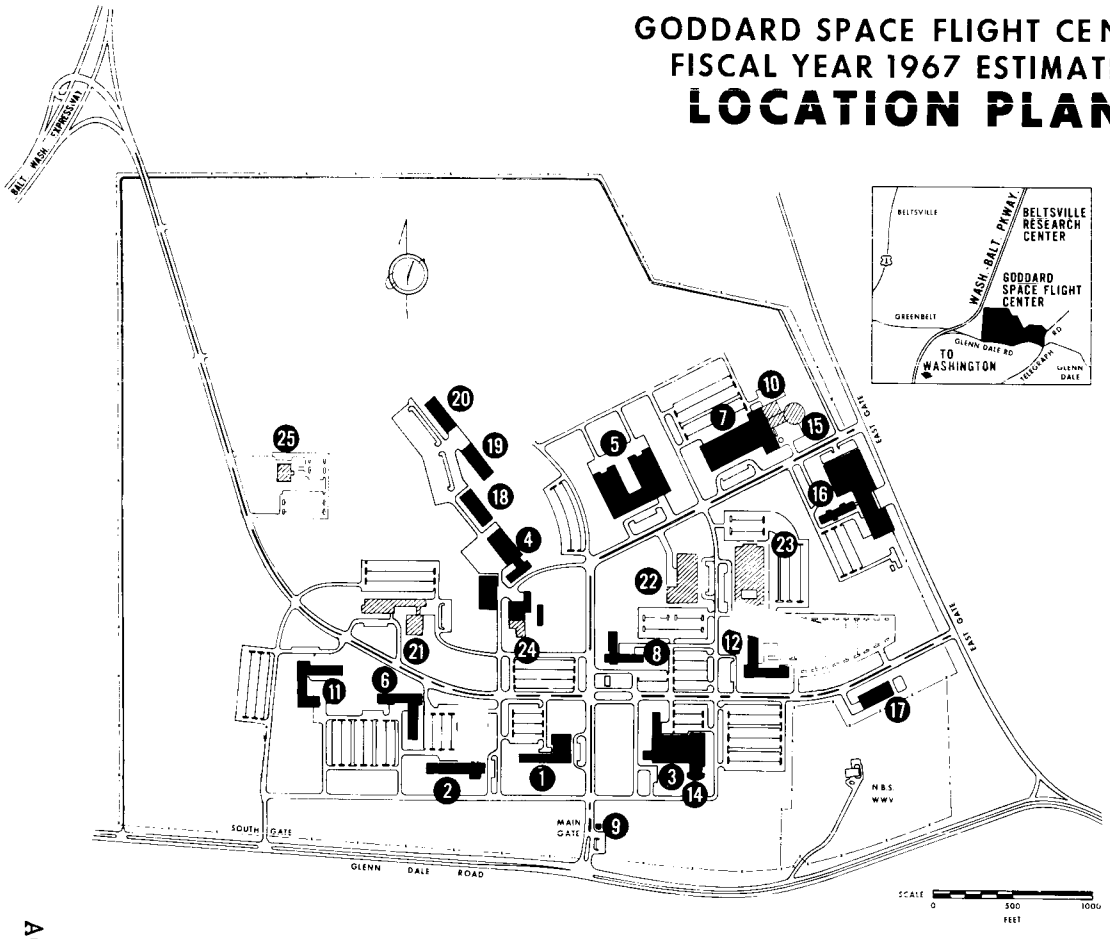
The $3.5 million for the second area covers the preparation of final and complete designs, plans, and specifications for an estimated FY 1968 facility construction activity amounting to a total of $80 to $100 million (excluding the Engine/Stage Test Stand 2-3 facility).

The $2.0 million for the third area covers the engineering and design of the Engine/Stage Test Stand 2-3 test complex which consists of two static test stands, a control center, and ancillary equipment. Each test stand will be capable of testing a nuclear rocket propulsion module in a vertical position during 5000 MW (power) operations. Studies, criteria development and site investigations are in progress and engineering and design will begin shortly. This work has been funded from prior years Facilities Planning and Design funds. $2.0 million are required in fiscal year 1967 to continue the engineering and design of this complex. The $50 million construction costs currently estimated for this test complex are not included in the $80 to $100 million figures shown for the second area requirements.



GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1967 ESTIMATES
VICINITY MAP

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1967 ESTIMATES
LOCATION PLAN

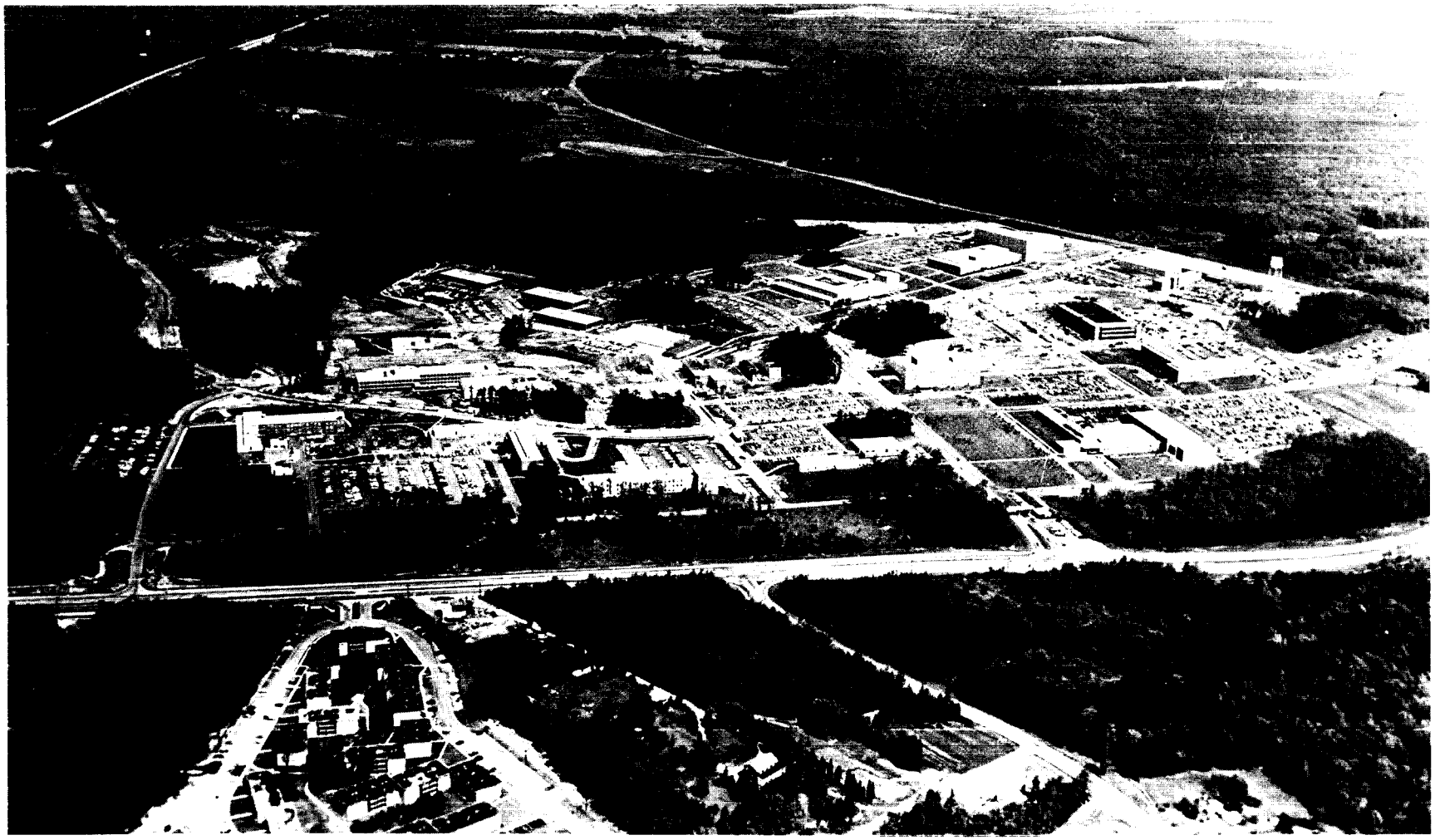


1. SPACE PROJECTS BUILDING
2. RESEARCH PROJECTS LABORATORY
3. CENTRAL FLIGHT CONTROL AND RANGE OPERATIONS LABORATORY
4. BOILER HOUSE AND ELECTRIC SUBSTATION
5. INSTRUMENT CONSTRUCTION AND INSTALLATION LABORATORY
6. SPACE SCIENCES LABORATORY
7. PAYLOAD TESTING FACILITY
8. SATELLITE SYSTEMS LABORATORY
9. GATE HOUSE
10. ENVIRONMENTAL TESTING LABORATORY
11. APPLIED SCIENCES LABORATORY
12. TRACKING AND TELEMETRY LABORATORY
14. SPACECRAFT OPERATIONS FACILITY
15. LAUNCH PHASE SIMULATOR
16. DEVELOPMENT OPERATIONS BUILDING
17. MULTI-PURPOSE BUILDING
18. MULTI-PURPOSE BUILDING
19. MULTI-PURPOSE BUILDING
20. MULTI-PURPOSE BUILDING
21. METEORDLOGICAL SYSTEMS DEVELOPMENT LABORATORY
22. MECHANICAL TEST FACILITY AND QUALITY ASSURANCE LABORATORY
23. DATA INTERPRETATION LABORATORY
24. ADDITION TO CENTRAL HEATING AND REFRIGERATION PLANT
25. NASA SPACE SCIENCE DATA CENTER

EXISTING FACILITIES

FACILITIES UNDER CONSTRUCTION

GODDARD SPACE FLIGHT CENTER



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
ORGANIZATION AND STAFFING CHART

STAFFING SUMMARY

	66	67
Excepted	35	35
GS-16	30	30
GS-15	205	227
GS-14	376	417
All Other GS	2663	2793
Wage Board	268	257
Total Permanent	3577	3759
Temporary	48	48
Total Positions	3625	3807

CHIEF ADVANCED PLANS STAFF

	66	67
Excepted	1	1
GS-16	–	–
GS-15	2	2
GS-14	1	2
All Other GS	4	3
Wage Board	–	–
Total	8	8

OFFICE OF THE DIRECTOR DEPUTY DIRECTOR ASSOCIATE DIRECTOR

	66	67
Excepted	3	3
GS-16	–	–
GS-15	–	–
GS-14	–	–
All Other GS	5	5
Wage Board	–	–
Total	8	8

ASSISTANT DIRECTOR FOR SYSTEMS RELIABILITY

	66	67
Excepted	2	2
GS-16	–	–
GS-15	1	1
GS-14	2	2
All Other GS	5	5
Wage Board	–	–
Total	10	10

TEST AND EVALUATION DIVISION

	66	67
Excepted	1	1
GS-16	–	–
GS-15	9	9
GS-14	28	30
All Other GS	187	183
Wage Board	–	–
Total	225	223

ASSISTANT DIRECTOR FOR ADMINISTRATION AND TECHNICAL SERVICES

	66	67
Excepted	2	2
GS-16	–	–
GS-15	4	4
GS-14	7	9
All Other GS	53	51
Wage Board	–	–
Total	66	66

OFFICE OF TECHNICAL SERVICES

	66	67
Excepted	1	1
GS-16	–	–
GS-15	–	–
GS-14	–	–
All Other GS	1	1
Wage Board	–	–
Total	2	2

FINANCIAL MANAGEMENT DIVISION

	66	67
Excepted	–	–
GS-16	–	–
GS-15	2	2
GS-14	3	4
All Other GS	108	107
Wage Board	–	–
Total	113	113

ORGANIZATION AND PERSONNEL DIVISION

	66	67
Excepted	–	–
GS-16	–	–
GS-15	–	–
GS-14	4	4
All Other GS	56	56
Wage Board	–	–
Total	60	60

MANAGEMENT SERVICES AND SUPPLY DIVISION

	66	67
Excepted	–	–
GS-16	–	–
GS-15	1	1
GS-14	2	2
All Other GS	118	118
Wage Board	9	9
Total	130	130

PROCUREMENT DIVISION

	66	67
Excepted	1	1
GS-16	–	–
GS-15	4	4
GS-14	13	14
All Other GS	266	268
Wage Board	–	–
Total	284	287

TECHNICAL INFORMATION DIVISION

	66	67
Excepted	–	–
GS-16	–	–
GS-15	–	–
GS-14	1	1
All Other GS	63	63
Wage Board	31	31
Total	95	95

PROGRAM SUPPORT DIVISION

	66	67
Excepted	–	–
GS-16	–	–
GS-15	3	3
GS-14	11	12
All Other GS	71	70
Wage Board	–	–
Total	85	85

FACILITIES ENGINEERING DIVISION

	66	67
Excepted	1	1
GS-16	–	–
GS-15	1	1
GS-14	7	7
All Other GS	64	64
Wage Board	101	101
Total	174	174

EXPERIMENTAL FABRICATION AND ENGINEERING DIVISION

	66	67
Excepted	–	–
GS-16	–	–
GS-15	1	1
GS-14	1	1
All Other GS	32	34
Wage Board	127	116
Total	161	162

ASSISTANT DIRECTOR FOR TRACKING AND DATA SYSTEMS

	66	67
Excepted	3	3
GS-16	3	3
GS-15	16	16
GS-14	17	17
All Other GS	53	63
Wage Board	–	–
Total	92	102

NETWORK ENGINEERING AND OPERATIONS DIVISION

	66	67
Excepted	–	–
GS-16	14	17
GS-15	23	25
GS-14	139	136
All Other GS	–	–
Wage Board	177	179
Total		

DATA SYSTEMS DIVISION

	66	67
Excepted	2	2
GS-16	1	1
GS-15	8	10
GS-14	13	15
All Other GS	130	122
Wage Board	–	–
Total	154	150

MANNED FLIGHT OPERATIONS DIVISION

	66	67
Excepted	–	–
GS-16	1	1
GS-15	14	20
GS-14	30	33
All Other GS	154	296
Wage Board	–	–
Total	199	350

ADVANCED DEVELOPMENT DIVISION

	66	67
Excepted	1	1
GS-16	1	1
GS-15	11	12
GS-14	13	14
All Other GS	69	67
Wage Board	–	–
Total	95	95

PROJECT OPERATIONS SUPPORT DIVISION

	66	67
Excepted	–	–
GS-16	1	1
GS-15	4	4
GS-14	10	14
All Other GS	65	60
Wage Board	–	–
Total	80	79

INFORMATION PROCESSING DIVISION

	66	67
Excepted	–	–
GS-16	1	1
GS-15	7	8
GS-14	12	14
All Other GS	123	118
Wage Board	–	–
Total	143	141

NASA COMMUNICATIONS DIVISION

	66	67
Excepted	–	–
GS-16	–	–
GS-15	2	3
GS-14	4	6
All Other GS	51	72
Wage Board	–	–
Total	57	81

ASSISTANT DIRECTOR FOR PROJECTS

	66	67
Excepted	3	3
GS-16	–	–
GS-15	1	1
GS-14	1	1
All Other GS	2	2
Wage Board	–	–
Total	7	7

OAO PROJECT

	66	67
Excepted	–	–
GS-16	1	1
GS-15	6	6
GS-14	4	5
All Other GS	7	6
Wage Board	–	–
Total	18	18

OGO PROJECT

	66	67
Excepted	–	–
GS-16	1	1
GS-15	5	5
GS-14	5	5
All Other GS	10	10
Wage Board	–	–
Total	21	21

OSO AND MSS PROJECT

	66	67
Excepted	–	–
GS 16	–	–
GS-15	3	3
GS-14	9	9
All Other GS	19	19
Wage Board	–	–
Total	31	31

NIMBUS PROJECT

	66	67
Excepted	–	–
GS-16	1	1
GS-15	6	6
GS-14	6	8
All Other GS	8	6
Wage Board	–	–
Total	21	21

ATS PROJECT

	66	67
Excepted	–	–
GS-16	–	–
GS-15	4	4
GS-14	4	5
All Other GS	23	22
Wage Board	–	–
Total	31	31

DELTA PROJECT

	66	67
Excepted	–	–
GS-16	–	–
GS-15	3	2
GS-14	7	6
All Other GS	21	23
Wage Board	–	–
Total	31	31

OPERATIONAL SATELLITES OFFICE

	66	67
Excepted	1	1
GS-16	–	–
GS-15	3	3
GS-14	7	7
All Other GS	7	7
Wage Board	–	–
Total	18	18

ASSISTANT DIRECTOR FOR SPACE SCIENCES

	66	67
Excepted	2	2
GS-16	1	1
GS-15	1	1
GS-14	–	–
All Other GS	7	7
Wage Board	–	–
Total	10	10

LABORATORY FOR SPACE SCIENCES

	66	67
Excepted	3	3
GS-16	4	4
GS-15	12	13
GS-14	26	29
All Other GS	135	131
Wage Board	–	–
Total	180	180

LABORATORY FOR ATMOSPHERIC AND BIOLOGICAL STUDIES

	66	67
Excepted	1	1
GS-16	1	1
GS-15	3	4
GS-14	12	13
All Other GS	80	78
Wage Board	–	–
Total	97	97

GODDARD INSTITUTE FOR SPACE STUDIES

	66	67
Excepted	1	1
GS-16	1	1
GS-15	2	3
GS-14	4	5
All Other GS	29	27
Wage Board	–	–
Total	37	37

LABORATORY FOR THEORETICAL STUDIES

	66	67
Excepted	2	2
GS-16	4	4
GS-15	9	10
GS-14	5	7
All Other GS	77	74
Wage Board	–	–
Total	97	97

ASSISTANT DIRECTOR FOR TECHNOLOGY

	66	67
Excepted	2	2
GS-16	1	1
GS-15	–	–
GS-14	–	–
All Other GS	4	4
Wage Board	–	–
Total	7	7

SPACECRAFT TECHNOLOGY DIVISION

	66	67
Excepted	1	1
GS-16	2	2
GS-15	14	17
GS-14	28	29
All Other GS	129	129
Wage Board	–	–
Total	174	178

SYSTEMS DIVISION

	66	67
Excepted	–	–
GS-16	4	4
GS-15	14	15
GS-14	27	31
All Other GS	117	112
Wage Board	–	–
Total	162	162

SPACECRAFT INTEGRATION AND SOUNDING ROCKET DIVISION

	66	67
Excepted	1	1
GS-16	1	1
GS-15	15	16
GS-14	29	31
All Other GS	171	164
Wage Board	–	–
Total	217	213

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ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1967 ESTIMATES

GODDARD SPACE FLIGHT CENTER

MISSION AND CAPABILITIES:

The Goddard Space Flight Center, the first major United States Laboratory devoted entirely to the investigation and peaceful exploration of space, was established on May 1, 1959.

Although the majority of Goddard's personnel are at the Greenbelt site and at various continental United States installations such as the Goddard Institute for Space Studies in New York City, other personnel are located throughout the world, managing the operation of satellite tracking and communications network stations. One of the Center's major assigned missions is global tracking in support of the United States manned space flight program.

The Center is responsible for development of sounding rockets for scientific investigations; the management of application satellite projects such as Nimbus and the Applications Technology Satellite; and scientific satellite projects such as the Orbiting Solar Observatory, the Orbiting Geophysical Observatory, the Orbiting Astronomical Observatory and Explorers; management and operation of two world-wide tracking and data acquisition networks, the Satellite Tracking and Data Acquisition Network and the Manned Space Flight Network; and project management of NASA's Delta launch vehicle.

The present capabilities of the Center can best be characterized by its diversity. The major portion of Goddard's personnel whose competence and interest are the best measure of the total organizational capabilities, are engaged in scientific studies, in systems engineering, in the development of modern technology for flight spacecraft and for ground systems, and in the technical and administrative management of Goddard's space project responsibilities.

In the space sciences, including the atmospheric sciences, the Center scientists, one of the largest groups in the free world, have been concerned primarily with the near earth measurements in magnetic fields, high and low energy particles, ionospheres, aeronomy, meteorology, micrometeorites, solar physics and astronomy. It is estimated that of all the scientific experiments flown on space vehicles by the United States and selected in open competition from proposals made by university, industry, and other NASA scientists as well as foreign scientists, approximately one-third have been conceived, designed and built by Goddard scientists. At the same time, the Center has had the management responsibility for over 50 percent of the earth

satellites launched by the NASA. Some of these spacecraft have been designed and built by the engineers and technicians at Goddard (e.g., the Interplanetary Explorer); in other projects the Center has gone to industry for the spacecraft, either as prime contractors (as with the Orbiting Geophysical Observatory) or with the Center acting as its own prime contractor (as with Nimbus).

In the area of tracking and data support, Goddard is responsible for the design, implementation, and operation of global tracking, data acquisition and communication networks supporting NASA as well as appropriate portions of the DOD space program.

The first network, the Minitrack Network, conceived and built by the personnel who became the nucleus of the Center's tracking and data systems capability, has provided support from the beginning of this nation's space efforts. Major augmentations have been accomplished to allow this Network to meet the continuously expanding requirements of the space program. Early in the manned flight program, Goddard was made responsible for the management and operation of the Manned Space Flight Network. The Mercury Network has been modified and augmented and is now providing support to the Gemini program concurrent with the major modification and expansion required to meet the Apollo program needs.

Current planning and study effort is directed to the most efficient application of these unique ground support facilities, both manned and unmanned to the nation's future space program such as the Apollo Extended Systems and, where applicable, future space programs of the Department of Defense.

During 1965 Goddard continued its satellite and sounding rocket launch programs and expanded its operations of two world-wide tracking, data acquisition and data reduction networks. Significant achievements of the Goddard program were:

Scientific Satellites - Five satellites were placed into orbit, including the Orbiting Geophysical Observatory. The Orbiting Solar Observatory provided greater insight into solar phenomena and the functioning of the sun; IMP III continued study of the earth's magnetosphere and solar terrestrial relationships; and Explorer XXVII and the International Satellite for Ionosphere Studies-X (ISIS-X) continued study of the ionosphere.

Sounding Rockets - The continued sounding rockets program not only provided additional knowledge about the region into and above the atmosphere, but also provided in-flight development testing of instrumentation and experimental payloads to be incorporated into later satellites.

Communications Satellites - Early Bird, the first satellite project of the Communications Satellite Corporation, was provided launching and associated services from this Center.

Meteorological Satellites - The Tiros IX and Tiros X continued the development of a global meteorological observation system. Tiros IX was configured to provide continuous earth viewing, thus significantly increasing the satellite effectiveness. Tiros X was the first operational Tiros weather satellite and provided additional operational data for the Weather Bureau.

In its operation of the Manned Space Flight Network, Goddard provided communication and tracking coverage for the successful Gemini-Titan missions three through seven.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Authorized Positions, end of year.	3,782	3,625	3,807
Average Number of All Employees...	3,595	3,526	3,704
Administrative Operations.....	$92,570,000	$64,040,000	$71,637,000

INSTALLATION DESCRIPTION:

The Goddard Space Flight Center, located 15 miles northeast of Washington, D. C. and one mile east of the Baltimore-Washington Parkway, Greenbelt, Maryland exit, is situated on a 554-acre main site. Three additional areas, totaling 650 acres, are located within two miles of the Center's main site and comprise the Goddard Antenna Test Range, the Magnetic Fields Component Test Facility, the Attitude Control Test Facility, the Manned Space Flight Training Facility and the STADAN Engineering and Real Time Station. Total capital investment as of June 30, 1965 was $197,236,000.

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION:

		1965	1966	1967
11.	Personnel Compensation.....	$37,512,000	$38,455,000	$41,563,000
12.	Personnel Benefits.....	2,671,000	2,737,000	2,974,000
	Total, personnel costs.....	$40,183,000	$41,192,000	$44,537,000
21.	Travel and Transportation of Persons.....	2,553,000	2,636,000	2,633,000
22.	Transportation of Things.....	1,162,000	1,264,000	1,325,000
23.	Rent, Communications, and Utilities.....	7,245,000	8,000,000	9,721,000

		1965	1966	1967
24.	Printing and Reproduction....	$398,000	$240,000	$250,000
25.	Other Services.....	5,092,000	7,102,000	8,360,000
	Services of other agencies.	399,000	188,000	170,000
26.	Supplies and Materials.....	1,927,000	1,928,000	1,929,000
31.	Equipment.....	32,840,000	1,040,000	2,312,000
32.	Lands and Structures.....	771,000	450,000	450,000
42.	Insurance Claims and Indemnities.....	---	---	---
	Total.....	$92,570,000	$64,040,000	$71,687,000

JUSTIFICATION BY OBJECT CLASSIFICATION:

Personnel Distribution

	1965	1966	1967
Direct Personnel by Program			
Space Science and Applications			
Physics and astronomy.....	1,065	1,039	1,029
Lunar and planetary.....	20	17	20
Launch vehicle procurement.....	121	36	36
Bioscience.....	9	13	16
Meteorological satellites.....	236	203	200
Communication and applications technology satellites.....	122	127	123
Advanced Research and Technology			
Basic research.....	11	8	8
Space vehicle systems.....	40	47	52
Electronics systems.....	74	67	69
Space power and electric propulsion systems.....	12	13	13
Nuclear rockets.....	24	23	23
Chemical propulsion.....	2	7	6
Tracking and Data Acquisition	625	667	789
Technology Utilization	3	3	3
Sub-total, direct positions.....	2,364	2,270	2,392

	1965	1966	1967
Support personnel			
Director and Staff	6	8	8
Administration	755	749	743
Research and development support	579	550	616
Sub-total, support positions	1,340	1,307	1,367
Total, permanent positions	3,704	3,577	3,759
Other positions:			
Positions under cooperative training agreements	36	36	36
Other temporary positions	42	12	12
Total, all positions	3,782	3,625	3,807

Personnel requirements:

As the program emphasis shifts from scientific investigations in space to increased support of the Manned Space Flight Network, personnel are reassigned from areas of declining workload such as Interplanetary Monitoring Platforms and Advanced Orbiting Solar Observatory to those areas where the workload is increasing as in the Tracking and Data Acquisition effort. The requirement for additional personnel to provide global tracking support of the United States manned space flight program is immediate and critical. Personnel shifts have been made to the extent practicable to meet the most immediate needs. The increased complexity of the Apollo program and the compressed Gemini flight schedule create an urgent need for an additional 182 positions for the Manned Space Flight Network in FY 1967 which cannot be met by the internal reassignment of personnel.

Personnel Costs

	1965	1966	1967
Total Positions	3,782	3,625	3,807
Permanent	3,704	3,577	3,759
Other	78	48	48
Personnel Compensation:			
Annual cost of permanent positions	$37,965,000	$38,559,000	$41,163,000
Pay above the stated annual rate	146,000	148,000	158,000

	1965	1966	1967
Lapses (deduct)	$-2,100,000	$-1,408,000	$-1,100,000
Net cost of permanent positions	36,011,000	37,299,000	40,221,000
Other personnel compensation	2,046,000	1,788,000	1,907,000
Total compensation	38,057,000	39,087,000	42,128,000
NASA funded	37,512,000	38,455,000	41,563,000
Reimbursable	545,000	632,000	565,000
Personnel benefits	2,716,000	2,784,000	3,016,000
NASA funded	2,671,000	2,737,000	2,974,000
Reimbursable	45,000	47,000	42,000
Total personnel costs	$40,773,000	$41,871,000	$45,144,000
NASA funded	40,183,000	41,192,000	44,537,000
Reimbursable	590,000	679,000	607,000
Average Number of All Employees (Man Years)	3,595	3,526	3,704

Personnel Costs - $44,537,000

Personnel costs for FY 1967 are estimated to increase by $3,345,000 due to the addition of 182 personnel required by the Manned Space Flight Network, higher average employment, and the full years effect of the Federal Employees Salary Act of 1965.

Travel and Transportation of Persons - $2,633,000

The FY 1967 requirement is estimated at approximately the same level as FY 1966.

The coordination and direction of program activities at various locations, including contractor's plants, educational institutions, launch sites and other field centers, requires substantial travel of Goddard personnel. This travel is essential to effectively monitor, supervise, and evaluate the contractual effort expended as well as the resolving of numerous technical problems which occur in the development process.

Transportation of Things - $1,325,000

The increase of $61,000 is primarily attributable to additional man-years of effort required for the local transportation contract.

Rent, Communications and Utilities - $9,721,000

The increase of $1,721,000 is due primarily to the following:

Rent $7,527,000 - With the introduction of the new generation equipment, the IBM 7094 systems will be phased out by the end of FY 1968. It is necessary, however, to continue the lease of peripheral equipment to the 7094 computers along with the added lease costs of peripheral equipment to the super-speed IBM 360 series of computers, purchased in FY 1965. These costs are necessary to meet current requirements and concurrently ensure the orderly updating of existing computer facilities to a totally integrated super-speed configuration needed to meet known future requirements. During this transition period, rental requirements are increasing by a net of $1,415,000, as the increased cost of computer equipment rentals is partially offset by a decrease in rental of structures as new buildings on-site become available for occupancy.

Communications $1,100,000 - Communication requirements increase by $62,000 to provide for a facsimile terminal and associated circuit costs, increased FTS costs and various installation costs connected with relocation moves.

Utilities $1,094,000 - The completion of on-site buildings and facilities in 1967 and off-site facilities together with increased computer usage account for the $244,000 increase in electrical utilities costs in FY 1967.

Printing and Reproduction - $250,000

Contract printing requirements are estimated to increase by $10,000 due to expanded workload.

Other Services - $8,360,000

The net increase of $1,258,000 in service contracts is primarily to provide for full year funding of the computer services contract for operating an IBM 360 super-speed computer system at the Goddard Institute for Space Studies. This contractual cost includes personnel, peripheral equipment, supplies and maintenance of a government-owned computer.

Maintenance and repair costs are decreased by $77,000 reflecting a reduction in building alteration activity.

The cost for security guard services and janitorial services are expected to increase by $187,000 to extend coverage to the on-site and off-site facilities being completed in FY 1967, and to provide the full year costs of services to those facilities completed during FY 1966.

Supplies and Materials - $1,929,000

The estimate for this object classification is consistent with the FY 1966 level. There is a shift, however, from electronic materials to fuels and lubricants directly attributable to the growth of the physical plant.

Equipment - $2,312,000

The increase of $1,272,000 is required for purchase of a large-scale computer to be used for telemetry data processing; shop equipment and machinery, test equipment, and library books.

Lands and Structures - $450,000

The estimate for minor construction, modifications and alterations are planned at the FY 1966 level.

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1967 ESTIMATES

PACIFIC LAUNCH OPERATIONS OFFICE

MISSION AND CAPABILITIES:

The Pacific Launch Operations Office was consolidated under the John F. Kennedy Space Center, NASA, effective October 1, 1965. The FY 1966 and FY 1967 requirements of this Office are included with the estimates for the John F. Kennedy Space Center.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Authorized Positions, end of year.....	22	---	---
Average Number of All Employees.....	22	---	---
Administrative Operations.....	$844,000	---	---

INSTALLATION DESCRIPTION:

The Pacific Launch Operations Office is located at Vandenberg Air Force Base, California, approximately 150 miles northwest of Los Angeles.

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION:

		1965	1966	1967
11.	Personnel Compensation.....	$213,000	---	---
12.	Personnel Benefits.....	15,000	---	---
	Total, personnel costs.....	$228,000	---	---
21.	Travel and Transportation of Persons.....	38,000	---	---
22.	Transportation of Things.....	6,000	---	---
23.	Rent, Communications, and Utilities.....	41,000	---	---
24.	Printing and Reproduction.....	6,000	---	---
25.	Other Services.....	42,000	---	---
	Services of other agencies.....	164,000	---	---
26.	Supplies and Materials.....	91,000	---	---
31.	Equipment.....	44,000	---	---
32.	Lands and Structures.....	184,000	---	---
42.	Insurance Claims and Indemnities.	---	---	---
	Total.....	$844,000	---	---

JUSTIFICATION BY OBJECT CLASSIFICATION:

Personnel Distribution

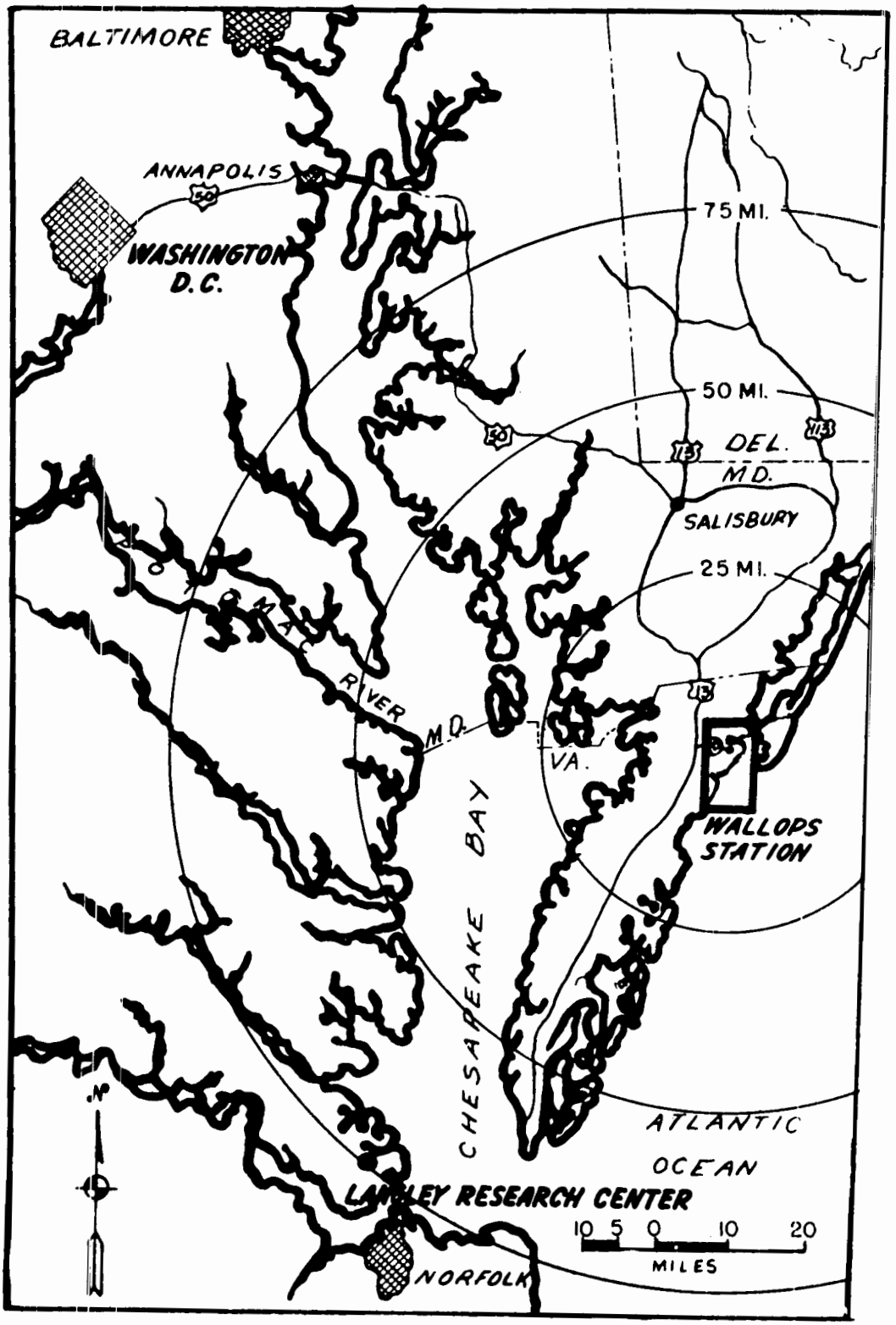
	1965	1966	1967
Direct Personnel by Program			
Support Personnel			
Director and Staff	4	---	---
Administration	8	---	---
Research and development support	7	---	---
Sub-total, support positions	19	---	---
Total, permanent positions	19	---	---
Other positions:			
Positions under cooperative training agreements	---	---	---
Other temporary positions	3	---	---
Total, all positions	22	---	---

Personnel Costs

	1965	1966	1967
Total Positions	22	---	---
Permanent	19	---	---
Other	3	---	---
Personnel Compensation:			
Annual cost of permanent positions	$194,000	---	---
Pay above the stated annual rate	1,000	---	---
Lapses (deduct)	-4,000	---	---
Net cost of permanent positions	191,000	---	---
Other personnel compensation	22,000	---	---
Total compensation	213,000	---	---
NASA funded	213,000	---	---
Reimbursable	---	---	---
Personnel benefits	15,000	---	---
NASA funded	15,000	---	---
Reimbursable	---	---	---

	1965	1966	1967
Total personnel costs.....	$228,000	---	---
NASA funded.....	228,000	---	---
Reimbursable.....	---	---	---
Average Number of All Employees (Man Years).....	22	---	---

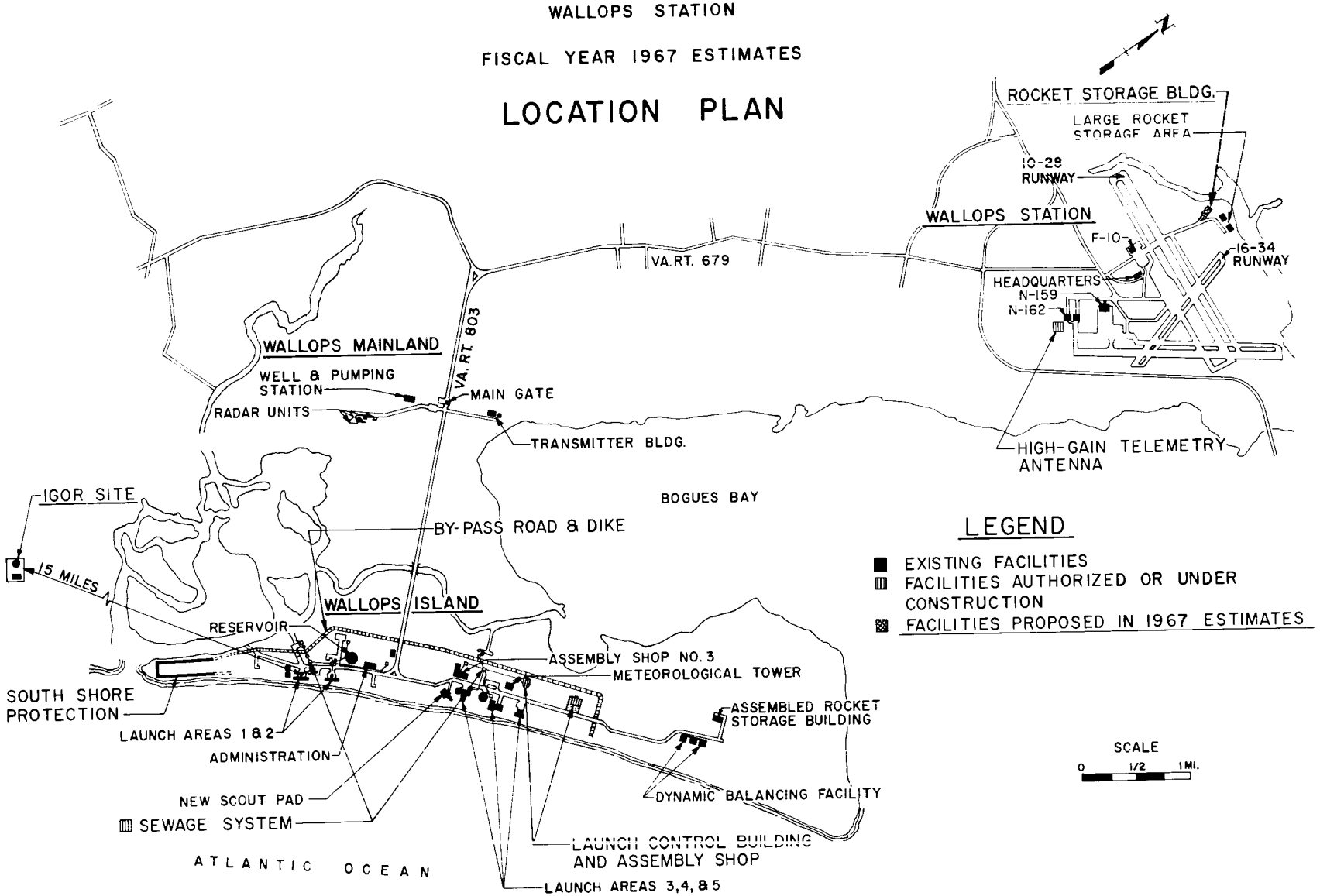
WALLOPS STATION LOCATION



WALLOPS STATION

FISCAL YEAR 1967 ESTIMATES

LOCATION PLAN



LEGEND

- ■ EXISTING FACILITIES
- ▥ FACILITIES AUTHORIZED OR UNDER CONSTRUCTION
- ▩ FACILITIES PROPOSED IN 1967 ESTIMATES

SCALE

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AO 2-17

Toms Cove and Wallops Station

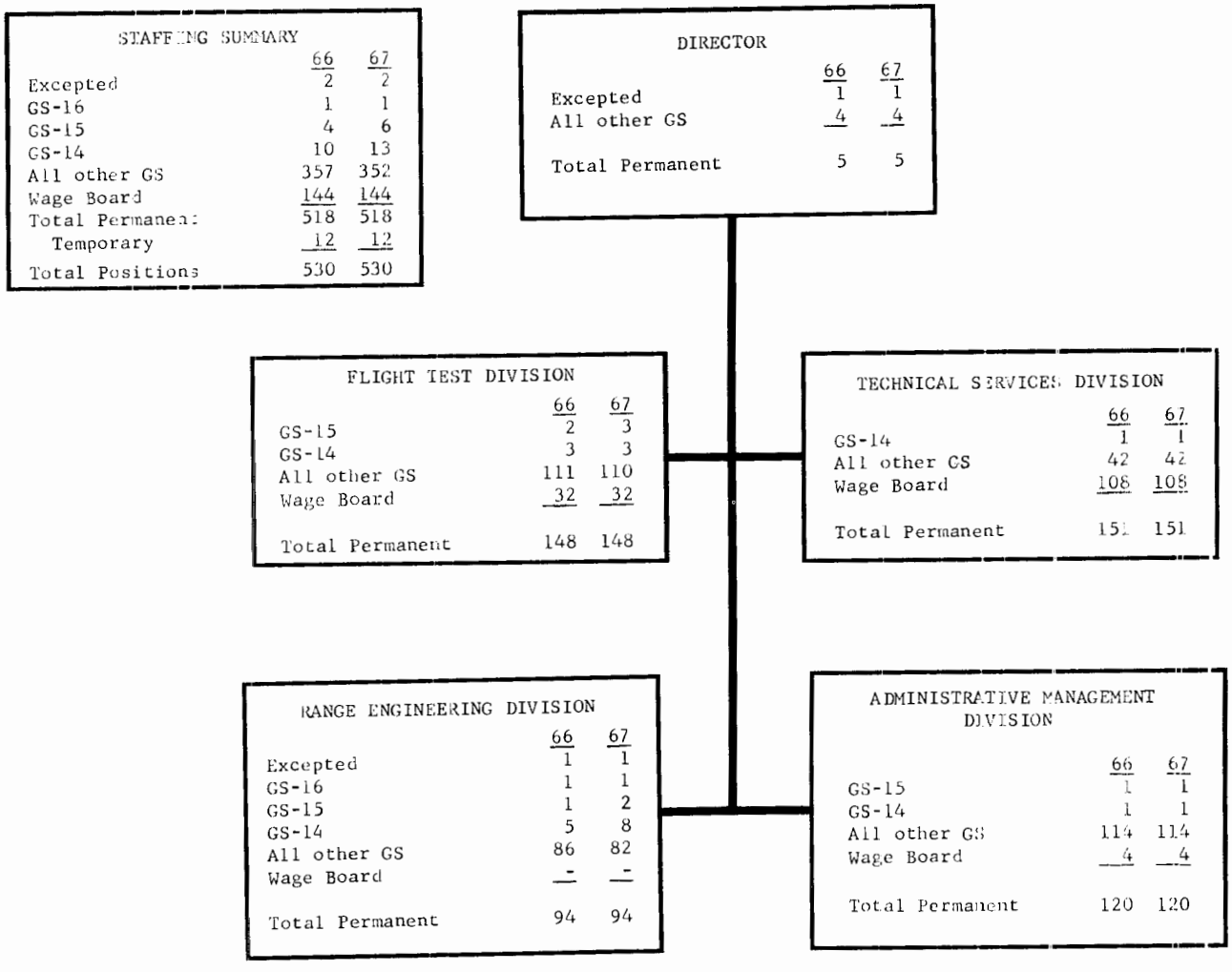
Runways 34, 28, 16, and 22 at Wallops Station

South End of Wallops Island Looking North

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ORGANIZATION AND STAFFING CHART

WALLOPS STATION



ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1967 ESTIMATES

WALLOPS STATION

MISSION AND CAPABILITIES:

Wallops Island was established as the Pilotless Aircraft Research Station of the National Advisory Committee for Aeronautics (NACA) in 1945. This installation's early mission included wind tunnel and laboratory investigations of a variety of aerodynamic problems of flight, as well as serving as a launch site for meteorological and sounding rockets. When the resources and facilities of NACA were transferred to the newly established National Aeronautics and Space Administration (NASA) in 1958, this facility was renamed Wallops Station.

Under NASA, the present mission of Wallops Station is to plan and conduct the integration, test, checkout and launch of space probes, as well as to track, acquire, record, reduce and analyze the data obtained from these activities. In addition, Wallops is responsible for conducting recovery operations for sub-orbital launches, assisting and training foreign nationals in launch techniques, assisting in tracking and acquiring data on spacecraft launched from other facilities, and providing administrative and management support for certain programs and projects. Wallops has recently been assigned project management responsibilities for the University Explorer (OWL) which will investigate auroral and airglow phenomena as well as study solar-terrestrial relationships, and is expected to undertake in the near future project management of the X-Ray Explorer which will gather data on stellar X-ray sources discovered by sounding rockets.

Wallops Station is this country's most active launch site. Nearly 6,000 launches have taken place from there since 1945. Vehicles launched from Wallops Station range in size from the small Hasp meteorological rocket to the four-stage Scout, which is capable of placing a 240 pound payload in a 300 mile orbit. A variety of scientific and experimental re-entry spacecraft launched from Wallops have provided scientific and technical data ranging from information on the flight characteristics of aircraft, launch vehicles and spacecraft to data on the upper atmosphere and space environment.

Although the major portion of these launchings are in support of NASA projects, launchings are also conducted for the armed forces, the Atomic Energy Commission and other government organizations, as well as non-government scientific organizations. Wallops Station is also the launching site for numerous projects undertaken in cooperation with foreign nations under NASA's program of international cooperation. Among the station's achievements of the past calendar year are: the launching of 487 sounding rockets, Explorer XXVII (NASA Beacon Explorer), Explorer XXX (Naval Research Laboratory IQSY), SECOR

(U. S. Army geodetic), and the first Aerobee 350 sounding rocket, the only liquied fuel vehicle fired from Wallops. Also, Wallops Station managed the construction of a new launch facility at Point Barrow, Alaska from which 11 sounding rockets were successfully launched. The Mobile Range Expedition aboard the U. S. N. S. Coratan successfully launched 90 sounding rockets off the coast of South America between February and April.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Authorized Positions end of year...	555	530	530
Average Number of All Employees....	530	523	523
Administrative Operations.....	$10,931,000	$9,446,000	$10,166,000

INSTALLATION DESCRIPTION:

Wallops Station consists of three separate areas on the Atlantic Coast of Virginia's eastern shore: The main base (formerly Chincoteague Naval Air Station), the Wallops Island launching site and the Wallops mainland. The administrative offices, the range control center, support shops and the main telemetry building are located on the main base. Wallops Island is about seven miles south east of the main base and is connected to the mainland by a causeway and bridge. The Island is about five miles long and its widest point is only one-half mile. Located on the Island are rocket storage buildings, blockhouses, assembly shops and the launch sites. The Wallops mainland is a one-half mile strip west of the Island and houses the radar and optical tracking sites.

Wallops Station, totalling 6,561 government owned acres, consists of 2,313 acres on the main base, 108 acres on the mainland area, 3,000 acres on the island, and 1,140 acres of unusable marsh land. The total capital investment as of June 30, 1965, was $75,323,000. New construction completed during the past calendar year included a new Scout launching facility, a new telemetry building, a dynamic balancing facility, and an addition to the assembly shop.

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION:

		1965	1966	1967
11.	Personnel Compensation.....	$4,437,000	$4,692,000	$4,865,000
12.	Personnel Benefits.....	305,000	333,000	345,000
	Total, personnel costs.....	$4,742,000	$5,025,000	$5,210,000
21.	Travel and Transportation of Persons.....	166,000	185,000	185,000
22.	Transportation of Things....	113,000	153,000	124,000
23.	Rent, Communications, and Utilities.....	625,000	430,000	442,000

		1965	1966	1967
24.	Printing and Reproduction.	$32,000	$35,000	$35,000
25.	Other Services.....	1,001,000	1,390,000	1,729,000
	Services of other agencies	77,000	53,000	65,000
26.	Supplies and Materials....	1,450,000	1,250,000	1,451,000
31.	Equipment.....	2,207,000	480,000	480,000
32.	Lands and Structures.....	518,000	445,000	445,000
42.	Insurance Claims and Indemnities.....	---	---	---
	Total.....	$10,931,000	$9,446,000	$10,166,000

JUSTIFICATION BY OBJECT CLASSIFICATION:

Personnel Distribution

	1965	1966	1967
Direct Personnel by Program			
Space Science and Applications			
Physics and astronomy.....	68	74	69
Bioscience.....	6	6	6
Meteorological satellites.....	6	6	3
Advanced Research and Technology			
Space vehicle systems.....	45	45	45
Electronics systems.....	1	1	1
Space power and electric propulsion systems.....	5	-	-
Chemical propulsion.....	-	5	5
Aeronautics.....	15	15	15
Tracking and Data Acquisition	32	39	39
Sub-total, direct positions.....	178	191	183
Support personnel			
Director and Staff.....	5	5	5
Administration.....	208	205	205
Research and development support.....	127	117	125
Sub-total, support positions.....	340	327	335
Total, permanent positions.....	518	518	518

	1965	1966	1967
Other Positions:			
Positions under cooperative training agreements	12	12	12
Other temporary positions	25	---	---
Total, all positions	555	530	530

Personnel Costs

	1965	1966	1967
Total Positions	555	530	530
Permanent	518	518	518
Other	37	12	12
Personnel Compensation:			
Annual cost of permanent positions	$3,862,000	$4,211,000	$4,315,000
Pay above the stated annual rate	38,000	16,000	17,000
Lapses (deduct)	-112,000	-106,000	-47,000
Net cost of permanent positions	3,788,000	4,121,000	4,285,000
Other personnel compensation	649,000	571,000	580,000
Total Compensation	4,437,000	4,692,000	4,865,000
NASA Funded	4,437,000	4,692,000	4,865,000
Reimbursable	---	---	---
Personnel benefits	305,000	333,000	345,000
NASA funded	305,000	333,000	345,000
Reimbursable	---	---	---
Total personnel costs	4,742,000	5,025,000	5,210,000
NASA funded	4,742,000	5,025,000	5,210,000
Reimbursable	---	---	---
Average Number of All Employees (Man Years)	530	523	523

Personnel Costs - $5,210,000

Increased personnel costs are estimated to be $185,000 higher than 1966 as a result of the cost of the Federal Employees Salary Act of 1965 for a full year; within-grade step increase; career development and for retirement contributions and other benefits.

Transportation of Things - $124,000

Anticipated requirements for transportation of things are $29,000 less than

FY 1966 due to reduced requirements for transportation of equipment to the launch facility at Point Barrow, Alaska.

Rent, Communications, and Utilities - $442,000

Estimated requirements are $12,000 above FY 1966 due to increased communications and electricity costs necessary to accommodate greatly increased use of Wallops Station airfield, the experimental radar and tracking equipment turned over to NASA by the Massachusetts Institute of Technology, and the Coquina Beach, North Carolina, tracking site.

Other Services - $1,794,000

Increased anticipated costs of $351,000 above the FY 1966 level reflects the increased requirement for maintenance, repairs and alterations to the aging facilities of the main base, and the continuous maintenance and repair of the station's equipment. Also included is the cost of the addition of four men and increased overtime demands on the fire fighting crew necessitated by increased airport activity, and the first full year of service provided by technical documentation and supply management contracts which were initiated in FY 1966.

Supplies and Materials - $1,451,000

The increase of $201,000 is primarily the result of recently acquired administrative support responsibility for the joint Air Force-NASA Radar Facility at Wallops Station, as well as remotely located facilities at Coquina Beach, North Carolina, and Fort Churchill, Canada. Also, the increased activity which is expected in FY 1967 at the recently completed launch facility at Point Barrow, Alaska, will require additional expenditures for supplies and materials.

All other object classifications - $1,145,000

Other requirements include the cost of travel, printing and reproduction, purchase of equipment, and minor construction, all of which are expected to remain at the FY 1966 level.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ORGANIZATION AND STAFFING CHART

NASA HEADQUARTERS

STAFFING SUMMARY	66	67
Excepted	191	191
GS-16	65	65
GS-15	377	399
GS-14	300	321
All other GS	1,211	1,141
Wage Board	18	18
Total Permanent	2,162	2,135
Temporary	65	65
Total Positions	2,227	2,200

ADMINISTRATOR

	66	67
Excepted	11	11
GS-16	-	-
GS-15	1	1
GS-14	2	2
All other GS	5	5
Wage Board	-	-
Total Permanent	19	19

EXECUTIVE SECRETARY

	66	67
Excepted	1	1
GS-16	-	-
GS-15	3	3
GS-14	3	3
All other GS	55	55
Wage Board	2	2
Total Permanent	64	64

ADMINISTRATION NASA-Wide

	66	67
Excepted	16	16
GS-16	1	1
GS-15	42	42
GS-14	47	48
All other GS	142	137
Wage Board	-	-
Total Permanent	248	244

HEADQUARTERS OPERATIONS

	66	67
Excepted	1	1
GS-16	-	-
GS-15	4	4
GS-14	6	6
All other GS	227	225
Wage Board	15	15
Total Permanent	253	251

DEFENSE AFFAIRS

	66	67
Excepted	3	3
GS-16	-	-
GS-15	1	2
GS-14	1	-
All other GS	5	5
Wage Board	-	-
Total Permanent	10	10

GENERAL COUNSEL

	66	67
Excepted	6	6
GS-16	-	-
GS-15	11	11
GS-14	6	6
All other GS	29	28
Wage Board	-	-
Total Permanent	52	51

INDUSTRY AFFAIRS

	66	67
Excepted	10	10
GS-16	1	1
GS-15	17	18
GS-14	36	37
All other GS	84	80
Wage Board	-	-
Total Permanent	148	146

INTERNATIONAL AFFAIRS

	66	67
Excepted	2	2
GS-16	1	1
GS-15	3	3
GS-14	-	-
All other GS	21	21
Wage Board	-	-
Total Permanent	27	27

LEGISLATIVE AFFAIRS

	66	67
Excepted	2	2
GS-16	-	-
GS-15	4	4
GS-14	2	2
All other GS	20	20
Wage Board	1	1
Total Permanent	29	29

POLICY ANALYSIS

	66	67
Excepted	3	3
GS-16	-	-
GS-15	2	2
GS-14	2	2
All other GS	10	10
Wage Board	-	-
Total Permanent	17	17

PROGRAMMING

	66	67
Excepted	7	7
GS-16	-	-
GS-15	13	14
GS-14	12	12
All other GS	39	37
Wage Board	-	-
Total Permanent	71	70

PUBLIC AFFAIRS

	66	67
Excepted	4	4
GS-16	-	-
GS-15	14	14
GS-14	20	20
All other GS	80	78
Wage Board	-	-
Total Permanent	118	116

TECHNOLOGY UTILIZATION

	66	67
Excepted	6	6
GS-16	-	-
GS-15	8	8
GS-14	13	13
All other GS	51	50
Wage Board	-	-
Total Permanent	78	77

MANNED SPACE FLIGHT

	66	67
Excepted	39	39
GS-16	12	12
GS-15	116	124
GS-14	88	97
All other GS	198	175
Wage Board	-	-
Total Permanent	453	447

SPACE SCIENCE AND APPLICATIONS

	66	67
Excepted	38	38
GS-16	23	23
GS-15	60	68
GS-14	28	38
All other GS	147	125
Wage Board	-	-
Total Permanent	296	292

TRACKING AND DATA ACQUISITION

	66	67
Excepted	6	6
GS-16	5	5
GS-15	19	20
GS-14	10	10
All other GS	22	20
Wage Board	-	-
Total Permanent	62	61

ADVANCED RESEARCH AND TECHNOLOGY

	66	67
Excepted	36	36
GS-16	22	22
GS-15	59	61
GS-14	24	25
All other GS	76	70
Wage Board	-	-
Total Permanent	217	214

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ORGANIZATION AND STAFFING CHART

NASA HEADQUARTERS

STAFFING SUMMARY

	66	67
Excepted	191	191
GS-16	65	65
GS-15	377	399
GS-14	300	321
All other GS	1,211	1,141
Wage Board	18	18
Total Permanent	2,162	2,135
Temporary	65	65
Total Positions	2,227	2,200

ADMINISTRATOR

	66	67
Excepted	11	11
GS-16	-	-
GS-15	1	1
GS-14	2	2
All other GS	5	5
Wage Board	-	-
Total Permanent	19	19

EXECUTIVE SECRETARY

	66	67
Excepted	1	1
GS-16	-	-
GS-15	3	3
GS-14	3	3
All other GS	55	55
Wage Board	2	2
Total Permanent	64	64

ADMINISTRATION
NASA-Wide

	66	67
Excepted	16	16
GS-16	1	1
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	66	67
Excepted	1	1
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	66	67
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	66	67
Excepted	7	7
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GS-15	13	14
GS-14	12	12
All other GS	39	37
Wage Board	-	-
Total Permanent	71	70

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Excepted	4	4
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GS-14	20	20
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ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1967 ESTIMATES

NASA HEADQUARTERS

MISSION AND CAPABILITIES:

The mission of the Headquarters of the National Aeronautics and Space Administration is to plan and provide executive direction for the programs authorized by the Congress, and to implement the national objectives stated in the National Aeronautics and Space Act of 1958, as amended. The principal statutory functions are:

1. To conduct research into, and for the solution of, problems of flight within and outside the earth's atmosphere and to develop, construct, test, and operate aeronautical and space vehicles for research purposes.

2. To conduct activities required for the exploration of space with manned and unmanned vehicles.

3. To arrange for participation by the scientific community in planning scientific measurements and observations to be made through use of aeronautical and space vehicles, and conduct or arrange for the conduct of such measurements and observations.

4. To provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof.

The following offices at Headquarters assist management in carrying out the technical aspects of this mission:

The Office of Manned Space Flight - Responsible for all NASA activities directly involving manned space flight missions. Programs include Gemini - to develop an operational capability to fly a two-man spacecraft in near-earth orbit for periods up to fourteen days and to learn new techniques, including rendezvous, docking and extravehicular activity; Apollo - to provide a broad national capability for manned space exploration, including earth-orbital, lunar orbital, and lunar surface operations and to achieve the specific objective of manned lunar landing and return within this decade; and Advanced Missions - to plan a broad program of exploration which will achieve and maintain a position of space leadership for the United States. The Office of Manned Space Flight has launch responsibility for all major manned and unmanned missions utilizing NASA launch vehicles. This Office also has over-all institutional responsibility for the three

installations primarily concerned with the manned space flight programs. These installations are: the George C. Marshall Space Flight Center, including Mississippi Test Facility, Michoud Assembly Facility, and Slidell where a computer facility is located; the Manned Spacecraft Center, including NASA activities at the White Sands Test Facility; and the John F. Kennedy Space Center, NASA, including NASA activities at the Eastern and Western Test Ranges.

The Office of Space Science and Applications - Responsible for NASA programs involving the unmanned scientific investigation of the space environment including the moon, planets, and interplanetary space utilizing ground-based, airborne, and space techniques such as sounding rockets, earth satellites, and deep space probes (e.g., Voyager); for scientific experiments to be conducted by man in space and selection and training of astronaut-scientists; for the research and development of space flight applications in such areas as meteorology, communications, navigation, geodesy, and economic geographic surveys, and for the support of operational systems using these developments; for the development, procurement, and use of light and medium class launch vehicles, such as Centaur; and for the sustaining university program.

The Office of Space Science and Applications has an over-all institutional responsibility for those NASA installations primarily involved in space science and applications programs. These are the Goddard Space Flight Center, Wallops Station, and the Jet Propulsion Laboratory, including the NASA Resident Office which administers the contract with the California Institute of Technology for the operation of the Jet Propulsion Laboratory.

The Office of Advanced Research and Technology - Responsible for the planning, direction, execution, evaluation, documentation, and dissemination of the results of all NASA research and technology programs which are conducted primarily to demonstrate the feasibility of a concept, structure, component, or system which may have specific general application to the nation's aeronautical and space objectives. This Office is also responsible for coordinating NASA's total program of supporting research and technology, which is related to carrying out the specific flight missions in order to avoid unnecessary duplication and to insure that the agency has an integrated and balanced research program.

In addition, this office has over-all institutional responsibility for the research centers primarily involved in carrying out NASA's advanced research programs. These installations are: the Ames Research Center, the Electronics Research Center, the Flight Research Center, the Langley Research Center, the Lewis Research Center, and the Space Nuclear Propulsion Office.

The Office of Tracking and Data Acquisition - Responsible for the development, implementation, and operation of tracking, data acquisition, communications, and data processing facilities, systems, and services required for NASA flight programs. In addition, the Office is responsible for agency-wide coordination of the management of automatic data processing systems and services.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Authorized Positions, end of year.	2,263	2,227	2,200
Average Number of All Employees...	1,989	2,063	2,043
Administrative Operations.....	$51,516,000	$56,286,000	$58,667,000

INSTALLATION DESCRIPTION:

The NASA Headquarters is located at 400 Maryland Avenue, S. W., Washington, D. C., and also occupies two other buildings in the southwest area of the District of Columbia, as well as storage facilities in nearby Arlington, Virginia. With the exception of the space leased in the Reporter's Building and the warehousing space, personnel occupy government-owned buildings.

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION:

		1965	1966	1967
11.	Personnel Compensation.....	$25,311,000	$27,281,000	$27,946,000
12.	Personnel Benefits.....	1,959,000	2,167,000	2,373,000
	Total, personnel costs....	$27,270,000	$29,448,000	$30,319,000
21.	Travel and Transportation of Persons.....	2,550,000	2,642,000	2,642,000
22.	Transportation of Things....	341,000	295,000	295,000
23.	Rent, Communications, and Utilities.....	1,899,000	2,341,000	2,390,000
24.	Printing and Reproduction...	1,580,000	1,925,000	2,075,000
25.	Other Services.....	12,654,000	15,048,000	16,024,000
	Services of other agencies	2,778,000	2,472,000	2,807,000
26.	Supplies and Materials.....	500,000	555,000	555,000
31.	Equipment.....	1,936,000	1,550,000	1,550,000
32.	Lands and Structures.....	---	---	---
42.	Insurance Claims and Indemnities.....	8,000	10,000	10,000
	Total.....	$51,516,000	$56,286,000	$58,667,000

The above estimates for FY 1966 and FY 1967 are distributed between NASA-wide support functions, conducted or administered centrally, which provide service to all centers; and for Headquarters operations which are for the support of the day-to-day operations of all Headquarters offices. The following table shows this comparison by object classification:

Analysis of Funding for NASA-wide Support and Headquarters Operations

Object Classification	FY 1966 Total	FY 1966 NASA-wide Support	FY 1966 Hdqtrs. Operat.	FY 1967 Total	FY 1967 NASA-wide Support	FY 1967 Hdqtrs. Operat.
			(In thousands of dollars)			
11. Personnel Comp...	$27,281	$25,004	$2,277	$27,946	$25,563	$2,383
12. Personnel Benef..	2,167	2,012	155	2,373	2,209	164
21. Travel and Trans of Persons.....	2,642	2,588	54	2,642	2,588	54
22. Trans. of Things.....	295	234	61	295	234	61
23. Rent, Communic. & Utilities....	2,341	1,261	1,080	2,390	1,319	1,071
24. Printing & Repro	1,925	1,772	153	2,075	1,922	153
25. Other Services...	17,520	15,638	1,882	18,831	16,818	2,013
26. Supplies & Mat...	555	15	540	555	15	540
31. Equipment.....	1,550	1,345	205	1,550	1,345	205
32. Land & Structures	---	---	---	---	---	---
42. Ins. Claims and Indemnities....	10	---	10	10	---	10
Total.....	$56,286	$49,869	$6,417	$58,667	$52,013	$6,654

JUSTIFICATION BY OBJECT CLASSIFICATION:

Personnel Distribution

	1965	1966	1967
Direct Personnel by Program			
Manned Space Flight			
Gemini.....	103	75	43
Apollo.....	249	291	321
Advanced missions.....	101	87	83

	1965	1966	1967
Space Science and Applications			
Physics and astronomy	57	57	56
Lunar and planetary exploration	76	76	74
Sustaining university program	71	71	71
Launch vehicle development	10	6	4
Launch vehicle procurement	15	19	20
Bioscience	26	26	26
Meteorological satellites	20	20	20
Communication and applications technology satellites	21	21	21
Advanced Research and Technology			
Basic research	31	31	31
Space vehicle systems	44	44	43
Electronics systems	37	37	37
Human factor systems	22	22	22
Space power and electric propulsion systems	31	31	30
Nuclear rockets	3	3	3
Chemical propulsion	22	22	22
Aeronautics	27	27	26
Tracking and Data Acquisition	60	62	61
Technology Utilization	14	14	14
Sub-total, direct positions	1,040	1,042	1,028
Support personnel			
*Director and Staff	617	618	611
Administration (Headquarters)	258	253	251
*Research and development support	248	249	245
Sub-total, support positions	1,123	1,120	1,107
Total, permanent positions	2,163	2,162	2,135
Other positions:			
Positions under cooperative training agreements	---	---	---
Other temporary positions	100	65	65
Total, all positions	2,263	2,227	2,200
*NASA-wide support.	(865)	(867)	(856)

Personnel requirements

The FY 1967 budget request includes a total of 2,200 civilian positions for NASA Headquarters, a reduction of 27 positions below the current fiscal year.

Of the 2,135 permanent positions shown in the above table, 1,028 are directly related to the staffing of the scientific and technical program areas in the Office of Manned Space Flight, the Office of Space Science and Applications, the Office of Advanced Research and Technology, the Office of Tracking and Data Acquisition, and the Office of Technology Utilization. Of the remaining 1,107 permanent positions, 856 are for NASA-wide support functions relating to the review, coordination, direction and planning of activities such as procurement, financial management, audit, acquisition and dissemination of scientific and technical information, and the balance of 251 are for Headquarters operations concerned with administrative services, personnel, security, accounts and reports, and contracts.

Personnel Costs

	1965	1966	1967
Total Positions	2,263	2,227	2,200
Permanent	2,163	2,162	2,135
Other	100	65	65
Personnel Compensation:			
Annual cost of permanent positions	$26,308,000	$27,849,000	$27,945,000
Pay above the stated annual rate	101,000	107,000	107,000
Lapses (deduct)	-2,464,000	-2,165,000	-1,538,000
Net cost of permanent positions	23,945,000	25,791,000	26,514,000
Other personnel compensation	1,366,000	1,490,000	1,432,000
Total compensation	25,311,000	27,281,000	27,946,000
NASA funded	25,311,000	27,281,000	27,946,000
Reimbursable	---	---	---
Personnel benefits	1,959,000	2,167,000	2,373,000
NASA funded	1,959,000	2,167,000	2,373,000
Reimbursable	---	---	---
Total personnel costs	27,270,000	29,448,000	30,319,000
NASA funded	27,270,000	29,448,000	30,319,000
Reimbursable	---	---	---
Average Number of All Employees (Man Years)	1,989	2,063	2,043

Personnel Costs - $30,319,000

The personnel costs for FY 1967 are estimated to be $30,319,000 covering 2,043 manyears of employment. Of this amount, $27,946,000 is requested for personnel compensation and $2,373,000 for personnel benefits. The FY 1967 estimate is $871,000 over the amount for the current fiscal year. This increase is required to cover the cost of the Federal Employees Salary Act of 1965 on a full year basis, for within-grade step increases and career development, for retirement contributions and other benefits, and for increased costs payable to the Department of Labor for benefits and other payments made from the Employees' Compensation Fund during FY 1965.

The following table shows the major items which are included in the estimate for personnel costs:

	FY 1967 Estimate	Increase or Decrease from FY 1966
Personnel compensation:		
Net cost of permanent positions.....	$26,514,000	$+723,000
Other personnel compensation.....	1,432,000	-58,000
Sub-total.....	$27,946,000	$+665,000
Personnel benefits:		
Retirement contributions.....	1,749,000	+56,000
Other benefits.....	365,000	+61,000
Employees' Compensation Fund.....	259,000	+89,000
Sub-total.....	2,373,000	+206,000
Total personnel costs.....	$30,319,000	$+871,000

Of the $30,319,000 requested for personnel costs, $27,772,000 is estimated for salaries and benefits of employees engaged in NASA-wide programs and activities which are conducted or administered centrally for the benefit of all centers, and $2,547,000 for personnel engaged in Headquarters operations.

Travel and Transportation of Persons - $2,642,000

The FY 1967 estimate of $2,642,000 for travel and transportation of persons is the same level as FY 1966 requirements. Of this amount, $2,425,000 is for NASA employee travel and transportation and $217,000 for non-NASA employee travel costs of technical and research advisory committees, and for costs of local transportation.

The amount requested includes $2,588,000 in support of NASA-wide programs and activities; and the remainder of $54,000 is related to Headquarters operations.

Transportation of Things - $295,000

The FY 1967 amount of $295,000 requested for transportation of things is the same level required for the current fiscal year. The costs under this object classification include $195,000 for domestic and overseas shipments of exhibits and spacemobiles; $56,000 for transportation of household goods and personal effects; and $44,000 for freight, express, drayage and parcel post costs of shipments to NASA installations, and rental of trucks from the General Services Administration.

Of the $295,000 requested in FY 1967, $234,000 is for support of NASA-wide activities and $61,000 for Headquarters operations.

Rent, Communications, and Utilities - $2,390,000

The FY 1967 estimate of $2,390,000 under this object classification includes: $590,000 for rents, a net increase of $49,000 over FY 1966, which provides for an increase of $58,000 required for rental of space to house the NASA Scientific and Technical Information Facility on a full year basis in FY 1967 and a decrease of $9,000 for rental of ADP equipment; and $1,800,000 for communications costs which are projected at the same level as the current fiscal year requirements.

The following table reflects the items included in the FY 1967 estimates for rents and communications:

	FY 1967 Estimate	Increase or Decrease from FY 1966
Rents:		
Space	$367,000	$+58,000
ADP and EAM equipment	89,000	-9,000
Office duplicating equipment	134,000	---
Total, rents	$590,000	$+49,000
Communications:		
Leased lines	366,000	---
Local telephone & exchange service	451,000	---
Long distance tolls	295,000	---
Postage and TWX	688,000	---
Total, communications	$1,800,000	---
Total, rents and communications	$2,390,000	$+49,000

Of the $2,390,000 requested for FY 1967 for rents and communications, $1,319,000 is estimated for NASA-wide support and $1,071,000 for Headquarters operations.

Printing and Reproduction - $2,075,000

The FY 1967 estimate for these services is $2,075,000, an increase of $150,000 above the FY 1966 level. Over 90 per cent, or $1,915,000 of the FY 1967 estimate is for printing and related services which will be performed through government sources. The remaining $160,000 is for printing and photostating to be done by commercial sources. The major activities funded under this object classification are as follows:

	FY 1967 Estimate	Increase over FY 1966
Scientific and technical information publications	$1,100,000	$+150,000
Educational and information publications	350,000	---
Printing and reproduction of administrative issuances, forms, etc.	625,000	---
Total, printing and reproduction	$2,075,000	$+150,000

The increase of $150,000 requested in FY 1967 in the scientific and technical information activity includes $50,000 for NASA's abstracting and indexing journal "Scientific and Technical Aerospace Reports," $60,000 for printing of technical reviews, monographs, handbooks and data compliations, and $40,000 for special publications on selected aerospace topics.

Of the $2,075,000 requested in FY 1967, $1,922,000 is for printing and reproduction services for NASA-wide support activities and $153,000 for Headquarters operations.

Other Services - $18,831,000

The FY 1967 request for other services is $18,831,000, a net increase of $1,311,000 above the FY 1966 level. Listed in the following table are the major items which are funded under this object classification:

	FY 1967 Estimate	Increase or Decrease over FY 1966
Scientific and technical information facility	$5,308,000	$+341,000
Documentation journal literature	1,810,000	+300,000
Translation services	350,000	+75,000

	FY 1967 Estimate	Increase or Decrease over FY 1966
Scientific information systems development	$355,000	---
Technical publications preparation	885,000	$+288,000
Dissemination of information through educational institutions and other channels	1,305,000	---
Educational and information media services	1,725,000	---
Educational exhibit services	745,000	---
Security investigations	1,300,000	---
Reliability and quality assurance studies	500,000	+60,000
Incentive contracting study	197,000	+197,000
Training programs	400,000	+50,000
Miscellaneous studies and services	1,938,000	-131,000
Headquarters operations	2,013,000	+131,000
Total, other services	$18,831,000	$+1,311,000

Of the net increase of $1,311,000 for other services, over 75%, or $1,004,000, is requested for the NASA-wide scientific and technical information program. This includes:

1. $341,000 to provide increased support for operation of NASA's contractor operated Scientific and Technical Information Facility. The workload of the facility has been increasing between 20 and 30% each year over the past several years. It is anticipated that this trend will continue in FY 1967. The increased workload is caused by the additional number of scientific and technical reports which are becoming available from NASA supported research and development programs, and from interagency agreements and exchange arrangements with domestic and foreign organizations.

2. $300,000 for documentation of world-wide journal literature to process the increased volume of significant foreign aerospace literature for immediate use in the U. S. aerospace programs.

3. $75,000 for additional translation services required to handle the rise in world-wide journal activity in the aerospace sciences and the availability of a continually increasing volume of material originally published in foreign languages.

4. $288,000 for preparation of manuscript material for specialized scientific and technical publications. This includes $163,000 for handbook and data compilations on selected aerospace subjects, and $125,000 increased support of the Langley Research Center printing plant operations for specialized services such as editing, verification of references, and preparation of graphs and tables.

The remaining increase of $307,000 is required for the other NASA-wide support functions and for Headquarters operations, as follows:

For other NASA-wide requirements, a net increase of $176,000 consisting of increases of: (1) $60,000 for reliability and quality assurance studies relating to subjects such as systems design trade-off studies, quality assurance methodology and development of publications on special topics; (2) $197,000 for initiation of an incentive contracting effectiveness study; and (3) $50,000 for agency-wide training of personnel in technical management, supervisory and administrative areas common to several NASA centers with emphasis on training programs relating to supervisory management, incentive contracting, financial management, and contract administration. The foregoing increases are partially offset by decreases amounting to $131,000 in a variety of miscellaneous studies and services.

For Headquarters operations, an increase of $131,000 consisting of: (1) $110,000 for computer operation, programming and systems design services; and (2) $21,000 for contract administration and security guard services.

Supplies and Materials - $555,000

The FY 1967 estimate of $555,000 for supplies and materials is the same level required for FY 1966. The items under this object classification primarily include the purchase of pamphlets and documents for the scientific and technical information program, office and photographic supplies and materials, and subscriptions and technical books for the law and technical libraries.

Of the amount estimated for FY 1967, $15,000 is for NASA-wide support and $540,000 for Headquarters operations.

Equipment - $1,550,000

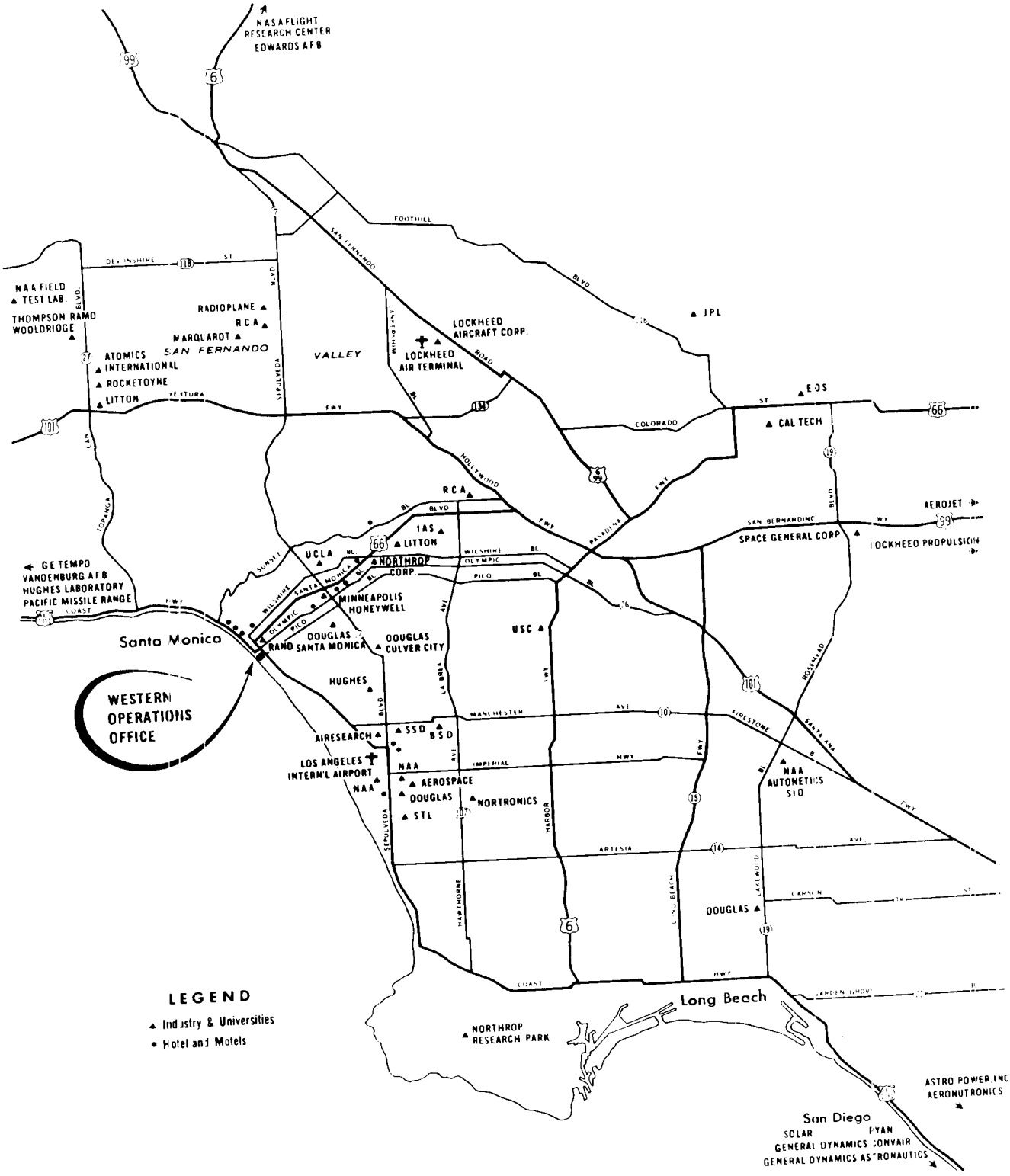
The FY 1967 estimate for equipment is the same level required for the current fiscal year. The items for FY 1966 and FY 1967 under this object classification include $205,000 for purchase of mechanical, photographic and miscellaneous office equipment; $155,000 for procurement of replacement vehicles for the existing spacemobile fleet which will exceed the 80,000 mile mark in FY 1966 and will become uneconomical to maintain and repair, and for updating of model inventory and equipment to be placed in these spacemobiles;

$80,000 for purchase of miscellaneous equipment for the Scientific and Technical Information Facility; and $1,110,000 for procurement of educational exhibits and materials which will provide up-to-date coverage of NASA programs in the manned and unmanned exploration of space, and to up-date the exhibit inventory to keep abreast of technical programs. These exhibits are designed for use in educational institutions, teachers and students fairs and workshops, professional and technical organizations and display before the general public, both domestic and foreign.

Of the $1,550,000 required in FY 1967 for equipment described above $1,345,000 is for support of NASA-wide activities and $205,000 for Headquarters operations.

Insurance Claims and Indemnities - $10,000

The FY 1967 requirement is estimated at the same level as for the current fiscal year. These funds cover payment of claims of $2,500 or less under the provisions of 28 U.S.C. 2672 for injury, death, or loss of property caused by the negligent or wrongful act or omission of any employee of NASA while acting within the scope of the responsibility of his office or employment.


NASA FLIGHT RESEARCH CENTER EDWARDS AFB
FOOTHILL BLVD
SAN FERNANDO VALLEY
NAA FIELD
TEST LAB.
THOMPSON RAMO WOOLDRIDGE
RADIOPLANE
RCA
MARQUARDT
ATOMICS INTERNATIONAL
ROCKETDYNE
LITTON
LOCKHEED AIRCRAFT CORP.
LOCKHEED AIR TERMINAL
JPL
EDS
CAL TECH
COLORADO
HOLLYWOOD FWY
RCA
IAS
LITTON
UCLA
NORTHROP CORP.
MINNEAPOLIS HONEYWELL
DOUGLAS RAND SANTA MONICA
DOUGLAS CULVER CITY
USC
HUGHES
AIRESEARCH
SSD
BSD
LOS ANGELES INTERN'L AIRPORT
NAA
AEROSPACE
DOUGLAS
NORTRONICS
STL
NAA AUTONETICS SID
DOUGLAS
AEROJET
SPACE GENERAL CORP.
LOCKHEED PROPULSION
GE TEMPO
VANDENBURG AFB
HUGHES LABORATORY
PACIFIC MISSILE RANGE
Santa Monica
WESTERN OPERATIONS OFFICE
NORTHROP RESEARCH PARK
Long Beach
ASTRO POWER INC
AERONUTRONICS
San Diego
SOLAR
RYAN
GENERAL DYNAMICS CONVAIR
GENERAL DYNAMICS ASTRONAUTICS
LEGEND
▲ Industry & Universities
• Hotel and Motels

AO 4-14

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ORGANIZATION AND STAFFING CHART

WESTERN OPERATIONS OFFICE

STAFFING SUMMARY

	66	67
Excepted	4	4
GS-16	1	1
GS-15	12	12
GS-14	47	47
All other GS	322	317
Total Permanent	386	381
Temporary	5	5
Total Positions	391	386

DIRECTOR

	66	67
Excepted	2	2
All other GS	3	3
Total Permanent	5	5

NASA RESIDENCY OFFICE - JPL

	66	67
GS-15	2	2
GS-14	6	6
All other GS	13	13
Total Permanent	21	21

LEGAL DIVISION

	66	67
GS-15	2	2
GS-14	3	3
All other GS	6	5
Total Permanent	11	10

ADMINISTRATIVE SERVICES DIVISION

	66	67
All other GS	36	35
Total Permanent	36	35

PUBLIC AFFAIRS DIVISION

	66	67
All other GS	8	8
Total Permanent	8	8

PERSONNEL DIVISION

	66	67
All other GS	9	9
Total Permanent	9	9

NASA-O DOWNEY

	66	67
Excepted	1	1
GS-15	1	1
GS-14	6	6
All other GS	125	124
Total Permanent	133	132

TECHNICAL DIVISION

	66	67
GS-16	1	1
GS-15	6	6
GS-14	25	25
All other GS	50	49
Total Permanent	82	81

CONTRACTS DIVISION

	66	67
Excepted	1	1
GS-15	1	1
GS-14	6	6
All other GS	47	46
Total Permanent	55	54

FINANCE DIVISION

	66	67
GS-14	1	1
All other GS	25	25
Total Permanent	26	26

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ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1967 ESTIMATES

WESTERN OPERATIONS OFFICE

MISSION AND CAPABILITIES:

The primary mission of the Western Operations Office is to represent NASA in the southwestern area and to provide technical, contractual, and administrative support to NASA field centers and NASA Headquarters for programs and projects located in southern California and other areas west of Denver, Colorado. The Western Operations Office functions as a field support activity in such areas as procurement, technical management, public affairs and educational programs, legal and patent reviews, financial management activities, and other administrative support.

Technical management support, as assigned by NASA Headquarters and field centers, encompasses advanced technology contracts and many research and development hardware contracts. Contract activity includes negotiations for advanced technology, hardware, basic agreements with major contractors, and procurement of pressurants and propellants for NASA and contractors requirements. The Western Operations Office mission also includes operation of an in-plant staff at the North American Aviation plant at Downey, California, to handle over-all contract administration and quality assurance for the Apollo and Saturn projects.

The mission of the Western Operations Office also includes administrative support and services for the NASA Resident Office at the Jet Propulsion Laboratory. The Resident Office, physically located at the Jet Propulsion Laboratory in Pasadena, California, has principal contract administration responsibilities for the NASA contract with the California Institute of Technology which operates the Jet Propulsion Laboratory.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Authorized Positions, end of year	405	391	386
Average Number of All Employees..	377	382	378
Administrative Operations.....	$22,693,000*	$5,987,000	$6,149,000

*Includes $17,034,000 for purchase of computers for JPL.

INSTALLATION DESCRIPTION:

The main Western Operations Office is located at 150 Pico Boulevard, Santa Monica, California. The Office occupies a group of buildings under commercial lease and no government investment in buildings or acreage is involved at this location.

Over one-third of the Western Operations Office staff is located in government owned facilities at Downey, California, which are currently being utilized by the Space Information Systems Division of North American Aviation, Inc., mainly for Apollo and Saturn work. The government owned portion of the North American Aviation Downey complex is located on 166 acres and the land and plant acquisition value is approximately $45 million as of June 30, 1965. The responsibility for management of property and facilities valued at $39.5 million was transferred from the Air Force to NASA on July 1, 1964. A few additional Western Operations Office personnel are assigned to other contractor locations within the Los Angeles area where full time project support is required.

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION:

		1965	1966	1967
11.	Personnel Compensation...	$4,115,000	$4,289,000	$4,426,000
12.	Personnel Benefits.....	289,000	309,000	317,000
	Total, personnel costs.	$4,404,000	$4,598,000	$4,743,000
21.	Travel and Transportation of persons.....	247,000	282,000	282,000
22.	Transportation of Things.	8,000	45,000	50,000
23.	Rent, Communications, and Utilities.....	349,000	402,000	402,000
24.	Printing and Reproduction	15,000	15,000	15,000
25.	Other Services.....	522,000	514,000	517,000
	Services of other agencies.....	12,000	14,000	58,000
26.	Supplies and Materials...	51,000	53,000	53,000
31.	Equipment.....	17,085,000	64,000	29,000
32.	Lands and Structures.....	---	---	---
42.	Insurance Claims and Indemnities.....	---	---	---
	Total.....	$22,693,000	$5,987,000	$6,149,000

JUSTIFICATION BY OBJECT CLASSIFICATION:

Personnel Distribution

	1965	1966	1967
Direct Personnel by Program			
Manned Space Flight			
Gemini	4	2	-
Apollo	161	162	163
Advanced missions	8	10	10
Space Science and Applications			
Physics and astronomy	15	15	14
Lunar and planetary exploration	15	14	14
Launch vehicle procurement	5	4	5
Bioscience	-	2	2
Communication and applications technology satellites	7	7	6
Advanced Research and Technology			
Space vehicle systems	3	3	3
Electronics systems	23	21	20
Space power and electric propulsion systems	2	2	2
Chemical propulsion	4	4	4
Technology Utilization	3	3	3
Sub-total, direct positions	250	249	246
Support personnel			
Director and Staff	9	9	9
Administration	63	63	62
Research and Development support	64	65	64
Sub-total, support positions	136	137	135
Total, permanent positions	386	386	381

	1965	1966	1967
Other positions			
Positions under cooperative training agreements.....	-	-	-
Other temporary positions.....	19	5	5
Total, all positions.....	405	391	386

Personnel Costs

	1965	1966	1967
Total Positions.....	405	391	386
Permanent.....	386	386	381
Other.....	19	5	5
Personnel Compensation:			
Annual cost of permanent positions.....	$3,985,000	$4,193,000	$4,221,000
Pay above the stated annual rate.....	15,000	16,000	16,000
Lapses (deduct).....	- 170,000	- 228,000	- 111,000
Net cost of permanent positions	3,830,000	3,981,000	4,126,000
Other personnel compensation...	285,000	308,000	300,000
Total Compensation.....	4,115,000	4,289,000	4,426,000
NASA funded.....	4,115,000	4,289,000	4,426,000
Reimbursable.....	---	---	---
Personnel benefits			
NASA funded.....	289,000	309,000	317,000
Reimbursable.....	289,000	309,000	317,000
Total personnel costs.....	4,404,000	4,598,000	4,743,000
NASA funded.....	4,404,000	4,598,000	4,743,000
Reimbursable.....	---	---	---
Average Number of All Employees (Man Years).....	377	382	378

Personnel Compensation and Benefits - $4,743,000

Personnel costs in FY 1967 are estimated to be $145,000 higher than in FY 1966, of which $137,000 is for personnel compensation and $8,000 is for personnel benefits. The estimate reflects the additional cost resulting from higher pay scales in effect for a full year, and for within-grade step increases, retirement contributions and other benefits.

Travel and Transportation of Persons - $282,000

Travel and transportation requirements in FY 1967 are expected to remain at the FY 1966 level. The total estimate includes $230,000 needed for employee travel to direct and coordinate technical program and administrative activities; to attend NASA technical meetings and working panels; and for the cost of temporary assignments and transfers. The balance of $52,000 will be used for the expense of local transportation and toll charges, and the rental of passenger motor vehicles from the General Services Administration.

Transportation of Things - $50,000

Transportation of things is estimated to increase $5,000 in FY 1967. This increase is related to the movement of household goods to accommodate the personnel turnover anticipated in FY 1967. The estimate also includes $38,000 for transportation of NASA exhibits in the western area of the United States.

Rent, Communications, and Utilities - $402,000

Fiscal year 1967 requirements in this area are estimated to remain unchanged from FY 1966.

The estimate includes $192,000 required for the commercial lease of real property and the rental of equipment, of which $168,000 is to continue the lease of 46,800 square feet of office space at an average annual cost of $3.60 per square foot. The remaining amount of $24,000 covers the rental of office and other equipment on a term basis.

The FY 1967 requirement of $205,000 for communications services is composed of the following items:

Leased lines	$4,000
Long distance tolls	39,000
Local telephone and exchange	71,000
All other communications	91,000

The balance of the FY 1967 estimate, amounting to $5,000, is required for utilities, primarily electric power.

Printing and Reproduction - $15,000

The FY 1967 cost of printing and reproducing technical and administrative reports, publications and forms is estimated to continue at the FY 1966 level. The estimate includes $3,000 to cover the printing of administrative materials by other government agencies, and $12,000 for the commercial printing of technical documents and related publications.

Other Services - $575,000

Requirements for other services in FY 1967 indicate a net increase of $47,000 over FY 1966. This results from planned expansion of the Reliable Electrical Connections School facilities at an additional cost of $12,000, in order to accelerate quality assurance certification of contractor personnel in time to assure adherence to space hardware production schedules; the augmentation of the technical reference library staff at an increased amount of $8,000 to serve the progressively larger use of these services by industry in the western area; and the assistance of Defense Contracts Administration Services Regions (DCASR) in providing contract administration services, which will require $44,000 of additional funding. These estimated increases are partially offset by the expected reduction of $17,000 in the cost of leasing, maintenance and operation of administrative aircraft at the Jet Propulsion Laboratory because of the disposal of a NASA-owned aircraft.

The following table indicates estimated FY 1967 funding for this area by the major requirements:

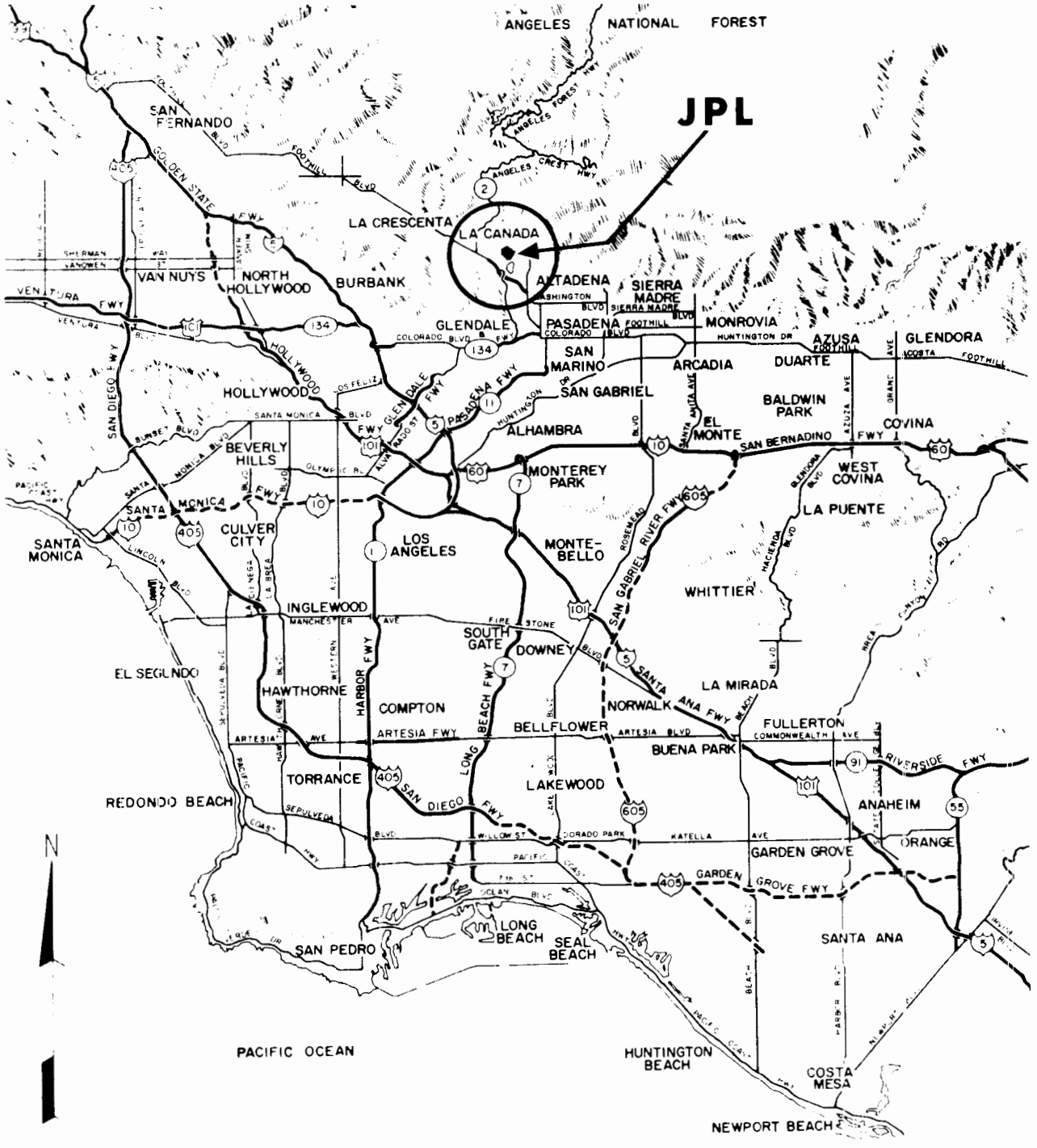
ADP equipment operation	$30,000
Custodial services	18,000
JPL administrative aircraft lease, maintenance and operation	245,000
Technical reference library	80,000
Reliable electrical connections school	120,000
Contract administration services	50,000
Miscellaneous minor services	32,000
Total	$575,000

Supplies and Materials - $53,000

The cost of supplies and materials for FY 1967 is expected to remain at the FY 1966 level. The estimate includes $48,000 for replacement of office supplies and $5,000 for purchase of expendable photographic, maintenance and operating supplies.

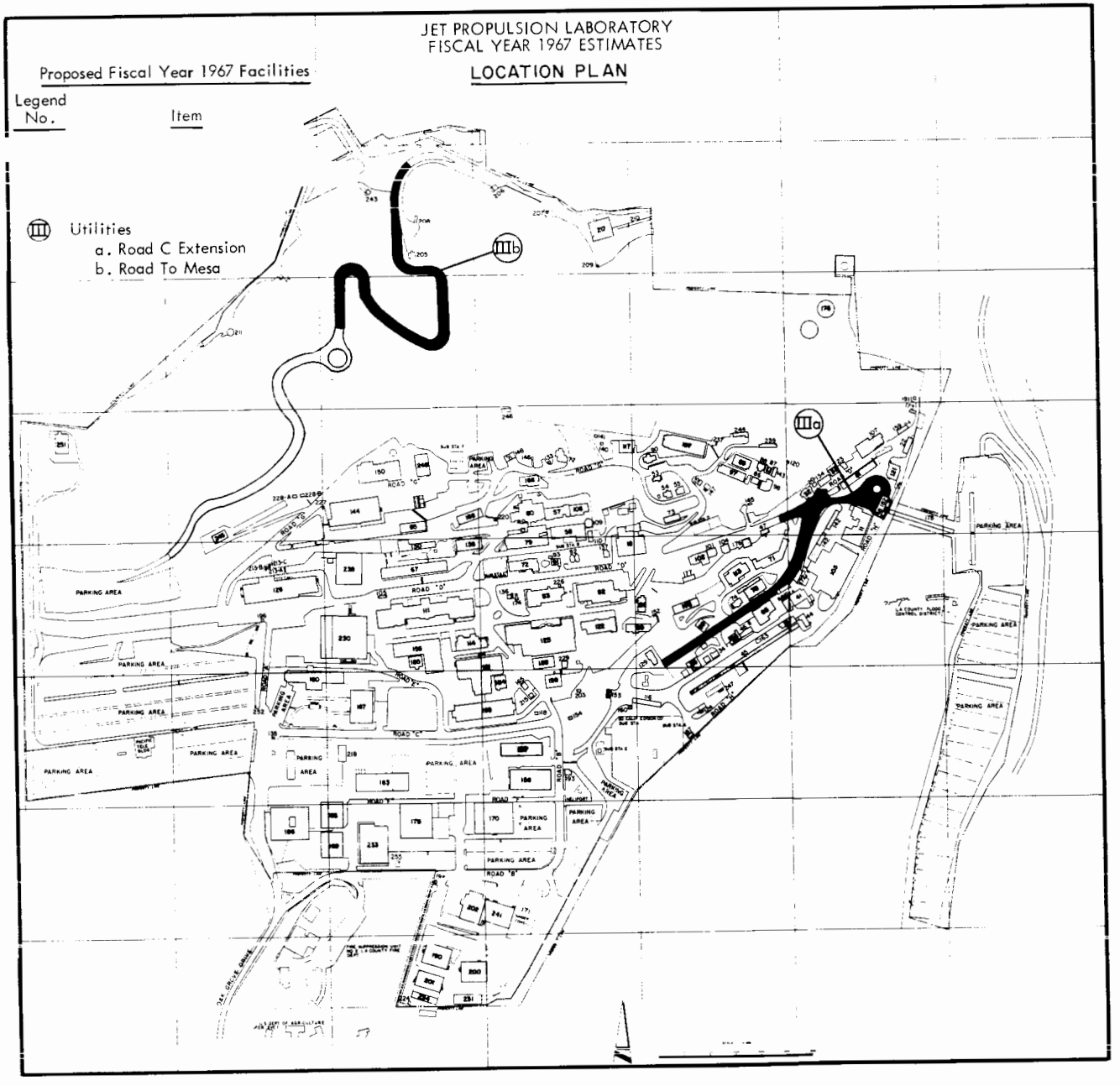
Equipment - $29,000

The FY 1967 estimate of $29,000 is $35,000 below FY 1966. The estimate includes $16,000 for the procurement of two replacement engines for leased administrative aircraft supporting the Jet Propulsion Laboratory; $4,000 to purchase two passenger motor vehicles (for replacement); and $9,000 for acquisition of photographic and non-capitalized equipment, and replacement of office furniture and equipment.



JET PROPULSION LABORATORY
Vicinity Map

AC 5-1


JET PROPULSION LABORATORY
FISCAL YEAR 1967 ESTIMATES
LOCATION PLAN
Proposed Fiscal Year 1967 Facilities
Legend
No.
Item
Utilities
a. Road C Extension
b. Road To Mesa
IIIa
IIIb
PARKING AREA
ROAD "C"
ROAD "D"
ROAD "B"

AC 5-2

AO 5-3

CALIFORNIA INSTITUTE OF TECHNOLOGY

STAFFING SUMMARY	66	67
Direct Positions		
Flight Projects	1,049	1,049
Deep Space Network	343	336
Supporting Research and Technology	651	658
Other	425	425
Total Direct	2,468	2,468
Support Positions	1,782	1,782
Total Positions	4,250	4,250

JET PROPULSION LABORATORY
LABORATORY DIRECTOR

	66	67
Total Positions	22	22

ASSISTANT LABORATORY DIRECTOR
RESEARCH AND ADVANCED DEVELOPMENT

	66	67
Total Positions	662	669

ASSISTANT LABORATORY DIRECTOR
TRACKING AND DATA ACQUISITION

	66	67
Total Positions	354	347

ASSISTANT LABORATORY DIRECTOR
LUNAR AND PLANETARY PROJECTS

	66	67
Total Positions	1,073	1,073

ASSISTANT LABORATORY DIRECTOR
TECHNICAL DIVISION

	66	67
Total Positions	632	632

ADVANCED STUDIES

	66	67
Total Positions	6	6

ARMS CONTROL

	66	67
Total Positions	7	7

QUALITY ASSURANCE AND RELIABILITY

	66	67
Total Positions	75	75

PUBLIC INFORMATION
AND EDUCATION SERVICES

	66	67
Total Positions	8	8

PERSONNEL ADMINISTRATION
AND SUPPORTING SERVICES

	66	67
Total Positions	405	401

FABRICATION SERVICES

	66	67
Total Positions	118	128

FACILITIES

	66	67
Total Positions	17	17

PLANT ENGINEERING

	66	67
Total Positions	273	267

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STAFFING SUMMARY	66	67
rect Positions		
Flight Projects	1,049	1,049
Deep Space Network	343	336
Supporting Research and Technology	651	658
Other	425	425
Total Direct	2,468	2,468
pport Positions	1,782	1,782
tal Positions	4,250	4,250

CALIFORNIA INSTITUTE OF TECHNOLOGY

JET PROPULSION LABORATORY
LABORATORY DIRECTOR

	66	67
Total Positions	22	22

ASSISTANT LABORATORY DIRECTOR
TRACKING AND DATA ACQUISITION

	66	67
Total Positions	354	347

ASSISTANT LABORATORY DIRECTOR
LUNAR AND PLANETARY PROJECTS

	66	67
Total Positions	1,073	1,073

ASSISTANT LABORATORY DIRECTOR
TECHNICAL DIVISION

	66	67
Total Positions	632	632

ASSISTANT LABORATORY DIRECTOR
FINANCIAL MANAGEMENT AND PROCUREMENT

	66	67
Total Positions	23	23

TUDIES

	66	67
	6	6

ROL

	66	67
	7	7

QUALITY ASSURANCE AND RELIABILITY

	66	67
Total Positions	75	75

PUBLIC INFORMATION AND EDUCATION SERVICES

	66	67
Total Positions	8	8

PERSONNEL ADMINISTRATION AND SUPPORTING SERVICES

	66	67
Total Positions	405	401

FABRICATION SERVICES

	66	67
Total Positions	118	128

FACILITIES

	66	67
Total Positions	17	17

PLANT ENGINEERING

	66	67
Total Positions	273	267

PROCUREMENT

	66	67
Total Positions	207	207

FINANCIAL MANAGEMENT

	66	67
Total Positions	127	127

MATERIEL SERVICES

	66	67
Total Positions	241	241

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1967 ESTIMATES

JET PROPULSION LABORATORY

The Jet Propulsion Laboratory (JPL) is a contractor operated facility. Personnel and other costs of operating this Laboratory are funded under the Research and Development appropriation, except for the lease of administrative aircraft and the purchase of passenger motor vehicles. These costs are included elsewhere in the Administrative Operations budget. The administrative operations type costs for JPL are shown in this volume for information purposes only and are not to be considered a part of the NASA Administrative Operations budget for FY 1967.

MISSION AND CAPABILITIES:

The Jet Propulsion Laboratory (JPL) is engaged in research and development activities associated with the exploration of space. It functions as a part of the California Institute of Technology and is operated by the Institute under contractual arrangement for the National Aeronautics and Space Administration (NASA), using facilities primarily owned by the United States Government. The NASA Resident Office - JPL, which is situated at JPL has principal contract administration responsibilities for the contract. Like JPL, the Resident Office is institutionally responsible to the Associate Administrator for Space Science and Applications.

In consonance with the objectives of the National Aeronautics and Space Act, the purpose of the Laboratory is to advance the national interests in the exploration of space, and to increase mankind's knowledge of the constitution and the environment of space.

Functions of the Jet Propulsion Laboratory

Formulate and carry out research programs which are in consonance with the Institute's obligations to support the national space program.

Conceive and perform advanced development and experimental engineering investigations which further the technology required in support of the national space program.

Perform studies and recommend and carry out scientific investigations in space. Make determinations of the feasibility of carrying out various scientific missions in space, determine the significance of such missions, and analyze and interpret data returned from these missions.

Undertake the development and construction of prototypes and flight hardware in support of approved programs.

Provide operational support for certain NASA space programs.

Advise and assist NASA in the formulation and the evaluation of long-range national plans for the space program and, when appropriate, participate in formulating objectives and requirements for major development programs.

Areas of Primary Project Activity

The Jet Propulsion Laboratory is responsible for the following major activities:

Lunar and deep space unmanned scientific missions.

Project management of complete spacecraft systems.

Tracking, data acquisition, data reduction and analysis required by lunar and deep space flights.

Advanced spacecraft guidance and control systems.

Advanced solid propellant and liquid propellant spacecraft engines.

Integration of advanced propulsion systems into spacecraft.

SUMMARY OF RESOURCES REQUIREMENTS:

	1965	1966	1967
Authorized Positions, end of year.	3,998	4,250	4,250
Average Number of All Employees...	4,119	4,125	4,200
Administrative Type Cost.....	$63,151,000	$65,699,000	$71,218,000

INSTALLATION DESCRIPTION:

The Jet Propulsion Laboratory is located in Pasadena, California, approximately 20 miles from downtown Los Angeles. Subsidiary facilities are located at Goldstone, California; Edwards Air Force Base in Muroc, California, and at Table Mountain, California.

At Pasadena, California, the Laboratory occupies 171.7 acres of land, 145.9 of which are owned by NASA and 25.8 leased from the city of Pasadena and commercial sources. At Goldstone, California, facilities are located on 40 acres of land occupied under permit from the Army. At Edwards Air Force Base, Muroc, California, facilities are located on 600 acres of land occupied under permit from the Air Force. The Table Mountain, California, facilities of the Laboratory are located on 10.5 acres of land occupied under permit from the Forest Service of the Department of Agriculture. The capital investment value as of June 30, 1965, was $128,177,167.

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION:

		1965	1966	1967
11.	Personnel Compensation.....	$43,862,000	$44,435,000	$46,516,000
12.	Personnel Benefits.....	2,827,000	3,550,000	4,609,000
	Total, personnel costs....	$46,689,000	$47,985,000	$51,125,000
21.	Travel and Transportation of Persons.....	2,934,000	2,710,000	2,931,000
22.	Transportation of Things....	308,000	375,000	370,000
23.	Rent, Communications, and Utilities.....	7,256,000	8,109,000	10,099,000
24.	Printing and Reproduction...	232,000	266,000	288,000
25.	Other Services.....	2,314,000	2,696,000	2,773,000
26.	Supplies and Materials.....	2,549,000	2,172,000	2,331,000
31.	Equipment.....	671,000	911,000	826,000
32.	Lands and Structures.....	198,000	475,000	475,000
42.	Insurance Claims and Indemnities.....	---	---	---
	Total.....	$63,151,000	$65,699,000	$71,218,000

Personnel Distribution

	1965	1966	1967
Direct Personnel			
Lunar and planetary flight projects.....	985	1,049	1,049
Deep space network.....	276	343	336
Supporting research and technology.....	707	651	658
Other direct manpower.....	336	425	425
Sub-total, direct positions.....	2,304	2,468	2,468
Support Personnel			
Director and Staff.....	108	116	116
Technical divisions.....	369	390	390
Quality assurance and reliability.....	72	75	75
Personnel administration and supporting services	342	359	359
Procurement.....	187	207	207
Financial management.....	128	127	127
Plant engineering.....	209	220	220

	1965	1966	1967
Material services	234	241	241
Fabrication services	45	47	47
Sub-total, support positions	1,694	1,782	1,782
Total, all positions	3,998	4,250	4,250

U.S. GOVERNMENT PRINTING OFFICE : 1966 O—205-834