NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

SUMMARY DATA

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VOLUME I

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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GENERAL STATEMENT

The National Aeronautics and Space Administration was established on October 1, 1958, pursuant to the National Aeronautics and Space Act of 1958, approved on July 29, 1958. The Act states that the policy and purpose of the United States activities in space will be: to conduct space and aeronautical activities for peaceful purposes for the benefit of all mankind. These activities should contribute materially to: the expansion of human knowledge in the atmosphere and space; the improvement and usefulness of aeronautical and space vehicles; the development and operation of space vehicles; the establishment of long-range studies, the preservation of United States leadership in aeronautics and space technology and utilization; the dissemination of pertinent information gained in the program to civil and military agencies; the cooperation with other nations in aeronautics and space activity pursuant to peaceful interests; and the effective utilization of scientific and engineering talents and facilities of the nation.

A total funding program of $4,370,400,000, to be financed by new obligational authority, is requested to support current and proposed programs.

The industrial community, under contracts with the NASA, will continue to carry forward the prime design, development, and fabrication effort of the NASA program. Specific elements of the activity will continue to be pursued within NASA installations, other government agencies, universities, and research contractors which have the necessary level of expertise in special areas of engineering and science. The major elements of the program fall within the following categories:

MANNED SPACE FLIGHT: A program for the continued development and demonstration of a capability for manned space operations and exploration; to maintain progress in manned space flight; and to provide information required for future decisions concerning follow-on space programs.

SPACE SCIENCE AND APPLICATIONS: A program of unmanned space flight involving: (1) scientific investigations of the earth, solar system, stars and space environment; compiling new knowledge in astronomy; planetary and interplanetary studies and experiments on the affects of space environment on living organisms; and (2) the adapting of space technology so acquired for the direct benefit of mankind in areas such as weather, communications, navigation, traffic control, geodesy, meteorology, and earth resources.

ADVANCED RESEARCH AND TECHNOLOGY: A continuing program to provide the technological base for significant future aerospace missions.

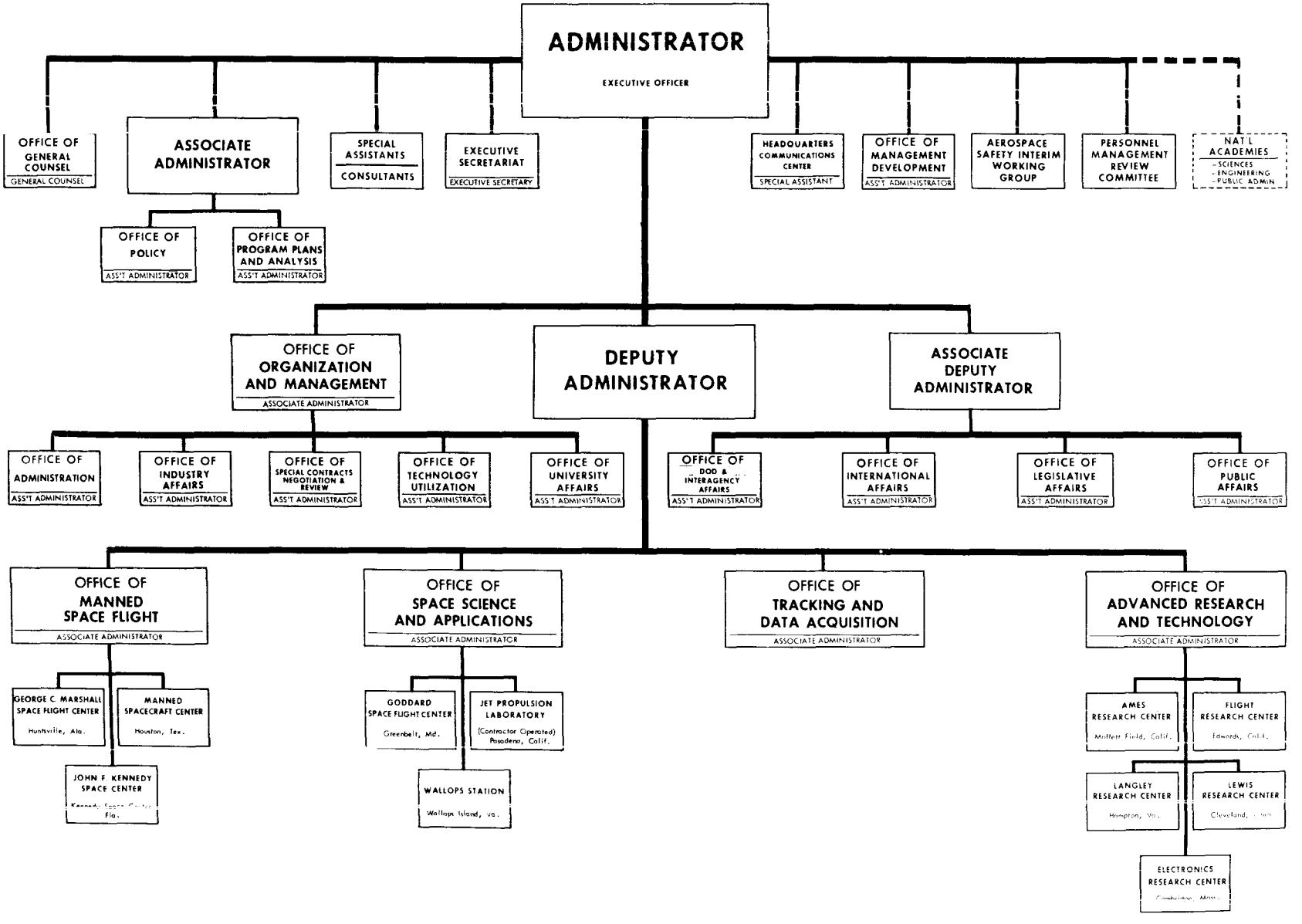
TRACKING AND DATA ACQUISITION: A program for providing the support required by the world-wide NASA manned and unmanned space flight programs.

Detailed justification of the FY 1969 budget estimate for the total program of $4,370,400,000 is provided in the following three volumes:

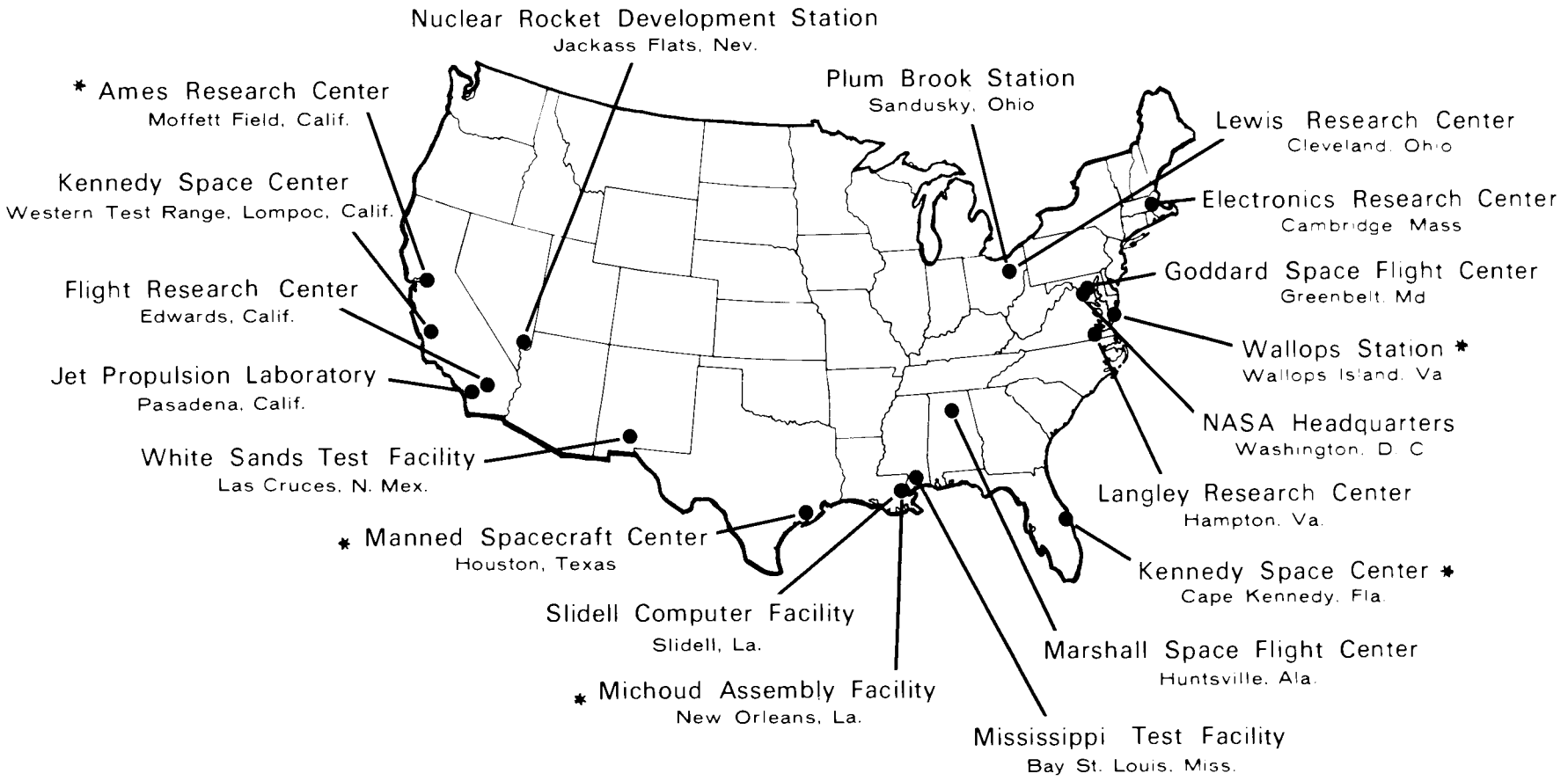
Volume		Amount
II	Research and Development	$3,677,200,000
III	Construction of Facilities	45,000,000
IV	Administrative Operations	648,200,000
	TOTAL	$4,370,400,000

REIMBURSEMENT AT EASTERN TEST RANGE: A new financial arrangement will increase the NASA reimbursement to the Air Force Eastern Test Range from $25.2 million to $51.4 million in FY 1969. This agreement, based on a Bureau of the Budget analysis of Eastern Test Range costs and workload, recognizes the impact of NASA launch support requirements on the cost of the Eastern Test Range support activities and provides for NASA reimbursement for range instrumentation ships and aircraft, mainland and down-range instrumentation sites for tracking and communications, data processing, and mission operations support.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



NASA INSTALLATIONS



* Installations for which construction projects are requested in FY 1969 budget.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

SUMMARY OF APPROPRIATIONS

(In thousands of dollars)

Appropriation	P.L. 89-555 Fiscal Year 1967	P.L. 90-131 Fiscal Year 1968	Fiscal Year 1969
Research and Development.....	$4,245,000	$3,925,000	$3,677,200
Construction of Facilities....	83,000	35,900	45,000
Administrative Operations.....	640,000	628,000	648,200
TOTAL.....	$4,968,000	$4,588,900	$4,370,400

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

SUMMARY OF APPROPRIATIONS (ADJUSTED)

(In thousands of dollars)

	Total	Research and Development	Construction of Facilities	Administrative Operations
FISCAL YEAR 1967				
Independent Offices Appropriation Act, 1967 (80 Stat. 675)	$4,968,000	$4,245,000	$83,000	$640,000
NASA Appropriation Transfers (80 Stat. 676)	---	-9,900	2,000	7,900
Transfer to "Operating expenses, Public Buildings Service," General Services Administration (80 Stat. 674)	-417	---	---	-417
Appropriation (adjusted)	$4,967,583	$4,235,100	$85,000	$647,483
FISCAL YEAR 1968				
National Aeronautics and Space Administration Appropriation Act, 1968 (81 Stat. 384-385)	$4,588,900	$3,925,000	$35,900	$628,000
NASA Appropriation Transfers (81 Stat. 385)	---	-14,400	1,900	12,500
Transfer to "Operating expenses, Public Buildings Service," General Services Administration (81 Stat. 348)	-127	---	---	-127
Appropriation (adjusted)	$4,588,773	$3,910,600	$37,800	$640,373
FISCAL YEAR 1969				
Appropriation request	$4,370,400	$3,677,200	$45,000	$648,200

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

SUMMARY OF BUDGET PLAN BY APPROPRIATION BY BUDGET ACTIVITY

(In thousands of dollars)

APPROPRIATION TITLE	TOTAL	MANNED SPACE FLIGHT	SCIENTIFIC INVESTIGATIONS IN SPACE	SPACE APPLICATIONS	SPACE TECHNOLOGY	AIRCRAFT TECHNOLOGY	SUPPORTING ACTIVITIES
Fiscal Year 1967.....	$4,908,096	$3,393,516	$564,394	$110,205	$387,769	$105,376	$346,836
Research and development..	4,175,100	3,024,000	481,294	91,486	235,570	35,900	306,850
Construction of facilities	86,411	45,057	4,688	---	8,590	21,010	7,066
Administrative operations.	646,585	324,459	78,412	18,719	143,609	48,466	32,920
Fiscal Year 1968.....	$4,648,773*	$3,158,608	$508,695	$134,303	$398,868	$122,681	$325,618
Research and development..	3,970,600*	2,809,200*	433,523	114,337	256,890	66,800	289,850
Construction of facilities	37,800	25,665	3,595	---	2,115	3,170	3,255
Administrative operations.	640,373	323,743	71,577	19,966	139,863	52,711	32,513
Fiscal Year 1969.....	$4,370,400	$2,824,812	$479,530	$147,733	$410,061	$131,435	$376,829
Research and development..	3,677,200	2,483,400	405,522	127,338	265,240	76,900	318,800
Construction of facilities	45,000	18,659	1,200	---	386	---	24,755
Administrative operations.	648,200	322,753	72,808	20,395	144,435	54,535	33,274

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*Includes $60 million of prior year funds applied to FY 1968 budget plan.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

SUMMARY OF BUDGET PLAN

OFFICE OF MANNED SPACE FLIGHT PROGRAMS

	(Thousands of dollars) 1967	1968	1969
Research and Development	$3,024,000	$2,809,200	$2,483,400
Gemini	15,200	---	---
Apollo	2,922,600	2,556,000	2,038,800
Apollo applications	80,000	253,200	439,600
Advanced missions	6,200	---	5,000
Construction of Facilities	45,057	25,665	18,659
Kennedy Space Center	34,157	23,745	13,209
Manned Spacecraft Center	10,200	750	3,100
Marshall Space Flight Center	---	745	---
Michoud Assembly Facility	700	425	400
Various locations	---	---	1,950
Administrative Operations	317,102	312,957	312,984
Kennedy Space Center	92,742	93,831	97,710
Manned Spacecraft Center	95,659	95,908	97,096
Marshall Spaceflight Center	128,701	123,218	118,178
TOTAL, MANNED SPACE FLIGHT	$3,386,159	$3,147,822	$2,815,043

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

SUMMARY OF BUDGET PLAN

OFFICE OF SPACE SCIENCE AND APPLICATIONS PROGRAMS
OFFICE OF UNIVERSITY AFFAIRS PROGRAM

	(Thousands of dollars) 1967	1968	1969
SPACE SCIENCE AND APPLICATIONS PROGRAMS AND PROJECTS			
Research and Development	$576,100	$552,850	$538,200
Physics and astronomy	129,800	142,950	141,900
Lunar and planetary exploration	184,150	141,500	107,300
Launch vehicle development	31,200	---	---
Launch vehicle procurement	117,650	127,100	128,300
Bioscience	42,000	41,800	48,500
Space applications	71,300	99,500	112,200
Construction of Facilities	4,688	3,595	1,200
Goddard Space Flight Center	---	565	---
Jet Propulsion Laboratory	350	---	---
John F. Kennedy Space Center, NASA	1,213	2,290	700
Various locations	2,920	---	---
Wallops Station	205	740	500
Administrative Operations	80,798	77,392	79,502
Goddard Space Flight Center	71,069	68,525	70,594
Wallops Station	9,729	8,867	8,908
TOTAL, SPACE SCIENCE AND APPLICATIONS	$661,586	$633,837	$618,902
UNIVERSITY AFFAIRS PROGRAM			
Research and Development			
Sustaining university program	$31,000	$10,000	$10,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

SUMMARY OF BUDGET PLAN

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY PROGRAMS
OFFICE OF TRACKING AND DATA ACQUISITION PROGRAMS
OFFICE OF TECHNOLOGY UTILIZATION PROGRAM

	(Thousands of dollars) 1967	1968	1969
ADVANCED RESEARCH AND TECHNOLOGY PROGRAMS AND PROJECTS			
Research and Development	$268,150	$318,700	$336,800
Basic research	21,401	21,465	22,000
Space vehicle systems	33,909	35,000	35,300
Electronics systems	33,597	39,200	39,400
Human factor systems	16,265	20,985	21,700
Space power and electric propulsion systems	40,440	44,000	44,800
Nuclear rockets	53,000	54,000	60,000
Chemical propulsion	33,638	37,250	36,700
Aeronautical vehicles	35,900	66,800	76,900
Construction of Facilities	29,600	5,285	386
Ames Research Center	---	3,170	386
Electronics Research Center	7,500	---	---
Langley Research Center	6,100	---	---
Lewis Research Center	16,000	2,115	---
Administrative Operations	188,128	188,882	195,108
Ames Research Center	33,824	33,563	33,975
Electronics Research Center	12,219	15,467	19,079
Flight Research Center	9,488	9,439	9,728
Langley Research Center	64,337	62,095	62,765
Lewis Research Center	66,280	66,220	67,352
Space Nuclear Propulsion Office	1,980	2,098	2,209
TOTAL, ADVANCED RESEARCH AND TECHNOLOGY	$485,878	$512,867	$532,294

	(Thousands of dollars) 1967	1968	1969
TRACKING AND DATA ACQUISITION PROGRAMS AND PROJECTS			
Research and Development			
Tracking and data acquisition.....	$270,850	$275,850	$304,800
Construction of Facilities	1,700	1,900	21,755
Goddard Space Flight Center.....	710	---	---
Jet Propulsion Laboratory.....	---	1,900	---
Various Locations.....	990	---	21,755
TOTAL, TRACKING AND DATA ACQUISITION.....	$272,550	$277,750	$326,555
TECHNOLOGY UTILIZATION - Research and Development	$5,000	$4,000	$4,000

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

NUMBER OF PERSONNEL POSITIONS

	Fiscal Year 1967	Fiscal Year 1968	Fiscal Year 1969
MANNED SPACE FLIGHT			
John F. Kennedy Space Center, NASA	2,720	2,931	2,931
Manned Spacecraft Center	4,704	4,579	4,579
Marshall Space Flight Center	7,086	6,386	6,386
SPACE SCIENCE AND APPLICATIONS			
Goddard Space Flight Center	3,782	3,686	3,841
Wallops Station	518	497	497
ADVANCED RESEARCH AND TECHNOLOGY			
Ames Research Center	2,173	2,092	2,092
Electronics Research Center	700	816	966
Flight Research Center	590	566	566
Langley Research Center	4,161	3,990	3,990
Lewis Research Center	4,676	4,485	4,485
Space Nuclear Propulsion Office	117	115	115
SUPPORTING OPERATIONS			
NASA Headquarters	2,499	2,279	2,279
TOTAL PERMANENT POSITIONS	33,726	32,422	32,727
POSITIONS OTHER THAN PERMANENT	2,182	2,182	2,182
TOTAL POSITIONS	35,908	34,604	34,909

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROPOSED APPROPRIATION BILL

RESEARCH AND DEVELOPMENT

For necessary expenses, not otherwise provided for, including research, development, operations, services, minor construction, supplies, materials, equipment, maintenance, repair, and alteration of real and personal property; and purchase, hire, maintenance, and operation of other than administrative aircraft necessary for the conduct and support of aeronautical and space research and development activities of the National Aeronautics and Space Administration [$3,925,000,000] *$3,677,200,000,* to remain available until expended. *(42 U.S.C. 2451, et seq., 50 U.S.C.* [*151-160*] *511-515; National Aeronautics and Space Administration Appropriation Act, 1968; additional authorizing legislation to be proposed.)*

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

RESEARCH AND DEVELOPMENT

Program and Financing (in thousands of dollars)

	Budget Plan			Costs to this appropriation		
	1967	1968	1969	1967	1968	1969
Program by activities:						
Direct program:						
1. Manned space flight:						
(a) Gemini	15,200	.....	.....	100,383	6,100	.....
(b) Apollo	2,922,600	2,556,000	2,038,800	2,845,089	2,509,700	2,132,700
(c) Apollo applications	80,000	253,200	439,600	62,805	179,800	435,000
(d) Advanced mission studies	6,200	.....	5,000	10,011	6,000	4,300
2. Scientific investigations in space:						
(a) Physics and astronomy	160,837	175,817	175,922	202,071	184,100	176,100
(b) Lunar and planetary exploration	201,005	150,666	113,900	234,081	163,000	118,000
(c) Bioscience	42,000	45,700	54,400	46,031	46,500	52,200
(d) Launch vehicle development	77,452	61,340	61,300	95,069	72,900	62,200
3. Space applications	91,486	114,337	127,338	107,871	112,200	127,100
4. Space technology	235,570	256,890	265,240	246,384	252,200	273,400
5. Aircraft technology	35,900	66,800	76,900	41,089	50,000	67,800
6. Supporting activities:						
(a) Tracking and data acquisition	270,850	275,850	304,800	317,914	306,100	304,400
(b) Sustaining university program	31,000	10,000	10,000	36,184	35,800	27,000
(c) Technology utilization	5,000	4,000	4,000	4,166	4,700	4,200
Total direct program costs, funded	4,175,100	3,970,600	3,677,200	4,349,148	3,929,100	3,784,400

RESEARCH AND DEVELOPMENT

Program and Financing (in thousands of dollars) - Continued

	Budget Plan			Costs to this appropriation		
	1967	1968	1969	1967	1968	1969
Reimbursable program:						
1. Manned space flight:						
(a) Gemini	1,257	.....	.....	1,369	3,946	.....
(b) Apollo	373	175	175	631	607	175
(c) Apollo applications	.....	400	400	.....	273	400
2. Scientific investigations in space:						
(a) Physics and astronomy	12,464	7,477	7,673	6,231	8,177	7,673
3. Space applications	49,415	17,500	31,500	27,179	53,757	31,500
4. Space technology	39,796	40,579	45,252	40,116	40,701	45,252
5. Aircraft technology	2,147	5,750	2,000	2,207	8,463	2,000
6. Supporting activities:						
(a) Tracking and data acquisition	1,000	619	500	1,657	1,031	500
(c) Technology utilization	139	.....	.....	150	1	.....
Total reimbursable program costs	106,591	72,500	87,500	79,540	116,956	87,500
Total program costs, funded	4,281,691	4,043,100	3,764,700	4,428,688	4,046,056	3,871,900
Change in selected resources1/	.....	.....	.....	-99,046	153,159	-107,200
10 Total	4,281,691	4,043,100	3,764,700	4,329,642	4,199,215	3,764,700

Program and Financing (in thousands of dollars) - Continued

		Budget Plan			Costs to this appropriation		
		1967	1968	1969	1967	1968	1969
10	Total	4,281,691	4,043,100	3,764,700	4,329,642	4,199,215	3,764,700
	Financing:						
	Receipts and reimbursements from:						
11	Federal funds	-93,717	-68,425	-75,425	-93,717	-68,425	-75,425
14	Non-Federal sources[2]	-12,874	-4,075	-12,075	-12,874	-4,075	-12,075
21	Unobligated balance available, start of year:						
	For completion of prior year budget plans	.....	.....	.....	-203,665	-156,715	.....
	Available to finance new budget plans	.....	-60,000	.....	.....	-60,000	.....
22	Unobligated balance transferred from other accounts	.....	.....	.....	-1,002	.....	.....
23	Unobligated balance transferred to other accounts	.....	.....	.....	.....	600	.....
24	Unobligated balance available, end of year:						
	For completion of prior year budget plans	.....	.....	.....	156,715	.....	.....
	Available to finance new budget plans	60,000	.....	.....	60,000	.....	.....
	New obligational authority	4,235,100	3,910,600	3,677,200	4,235,100	3,910,600	3,677,200

RESEARCH AND DEVELOPMENT

Program and Financing (in thousands of dollars) - Continued

		Budget Plan			Costs to this appropriation		
		1967	1968	1969	1967	1968	1969
	New obligational authority:						
40	Appropriation	4,245,000	3,925,000	3,677,200	4,245,000	3,925,000	3,677,200
41	Transferred to other accounts	-9,900	-14,400	.....	-9,900	-14,400	.....
43	Appropriation (adjusted)	4,235,100	3,910,600	3,677,200	4,235,100	3,910,600	3,677,200
	Relation of obligations to expenditures:						
10	Total obligations				4,329,642	4,199,215	3,764,700
70	Receipts and other offsets (items 11-17)				-106,591	-72,500	-87,500
71	Obligations affecting expenditures				4,223,052	4,126,715	3,677,200
72	Obligated balance, start of year				1,837,620	1,573,457	1,695,672
74	Obligated balance, end of year				-1,573,457	-1,695,672	-1,521,572
90	Expenditures				4,487,215	4,004,500	3,851,300
	Expenditures are distributed as follows:						
01	Out of current authorizations				2,868,570	2,555,400	2,448,200
02	Out of prior authorizations				1,618,645	1,449,100	1,403,100

Program and Financing (in thousands of dollars) - Continued

	1966	1967 Adjustments	1967	1968	1969
[1]Selected resources as of June 30 are as follows:					
Stores	35,257	2,368	39,097	39,097	39,097
Unpaid undelivered orders	1,147,462	.....	1,043,395	1,196,554	1,089,354
Advances	6,563	.....	10,112	10,112	10,112
Total selected resources	1,189,282	2,368	1,092,604	1,245,763	1,138,563

[2]Reimbursements from non-Federal sources are receipts for services performed on Communications Satellite Corporation projects (42 U.S.C. 2473).

	1967 actual	1968 estimate	1969 estimate
Note.--Reconciliation of budget plan to obligations:			
Total budget plan	4,281,691	4,043,100	3,764,700
Deduct portion of budget plan to be obligated in subsequent years	113,369	.....	.....
Add obligations of prior year budget plans	161,320	156,115	.....
Total obligations	4,329,642	4,199,215	3,764,700

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

SUMMARY OF RESEARCH AND DEVELOPMENT BUDGET PLAN BY PROGRAM BY COGNIZANT OFFICE
(In thousands of dollars)

BUDGET ACTIVITY	OFFICE/PROGRAM	Fiscal Year 1967	Fiscal Year 1968	Fiscal Year 1969
	MANNED SPACE FLIGHT.....	$3,024,000	$2,809,200	$2,483,400
1a	Gemini.....	15,200	---	---
1b	Apollo.....	2,922,600	2,556,000**	2,038,800
1c	Apollo applications.....	80,000	253,200	439,600
1d	Advanced mission studies..	6,200	---	5,000
	SPACE SCIENCE AND APPLICATIONS.....	576,100	552,850	538,200
2a	Physics and astronomy.....	129,800	142,950	141,900
2b	Lunar and planetary exploration.....	184,150	141,500	107,300
2d	Launch vehicle development	31,200	---	---
*	Launch vehicle procurement	117,650	127,100	128,300
2c	Bioscience.....	42,000	41,800	48,500
3	Space applications.....	71,300	99,500	112,200
	UNIVERSITY AFFAIRS			
6b	Sustaining university program.....	31,000	10,000	10,000
	ADVANCED RESEARCH AND TECHNOLOGY.....	268,150	318,700	336,800
4	Basic research.....	21,401	21,465	22,000
4	Space vehicle systems.....	33,909	35,000	35,300
4	Electronics systems.....	33,597	39,200	39,400
4	Human factor systems.....	16,265	20,985	21,700
4	Space power and electric propulsion systems.....	40,440	44,000	44,800
4	Nuclear rockets.....	53,000	54,000	60,000
4	Chemical propulsion.....	33,638	37,250	36,700
5	Aeronautical vehicles.....	35,900	66,800	76,900
6a	TRACKING AND DATA ACQUISITION	270,850	275,850	304,800
6c	TECHNOLOGY UTILIZATION.....	5,000	4,000	4,000
	TOTAL BUDGET PLAN.....	$4,175,100	$3,970,600**	$3,677,200

*Funds for the procurement of launch vehicles are statistically distributed to unmanned flight programs (e.g., Physics and Astronomy, Space Vehicle Systems).
**Includes $60 million of prior year funds applied to FY 1968 budget plan.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

NEW RESEARCH AND DEVELOPMENT PROGRAMS AND PROJECTS

The fiscal year 1969 budget contains $38,000,000 for the following new research and development projects:

Lunar and Planetary Exploration Program

Mariner Mars 1971 ..... $18,000,000

The objectives of the Mariner Mars 1971 project are to place two spacecraft in orbit about Mars to measure the physical, chemical, and thermal properties of its surface and atmosphere and the variations of these properties with the season and time of day. This project will also advance spacecraft technology particularly for orbital missions about the planets. The scientific instruments for the Mariner 1971 missions will be similar to those carried by Mariner 1969. However, the 1971 mission concept is a major advance because it provides for orbital operations to make measurements closer to the surface and for longer periods of time, whereas the Mariner Mars 1969 flyby mission will have a short encounter time at a farther distance from the planet.

The Mariner Mars 1971 spacecraft will be similar to the Mariner Mars 1969 spacecraft and will use the spare components and proof test model from that project. The funds requested for FY 1969 will provide for a detailed system design, procure additional Mariner Mars 1969 subsystems, provide for modification of Mariner Mars 1969 hardware, and develop and test prototypes of critical subsystems.

Titan Mars 1973 ..... $20,000,000

The objectives of the Titan Mars 1973 project are to continue to measure the physical and chemical properties of Mars from orbit, and to send a survivable lander through the atmosphere to the surface of Mars. These measurements will increase the topographic and thermal mapping information; establish the absence or the presence and distribution of water on the surface of Mars; measure the trace constituents of the atmosphere; determine ionosphere properties and distribution; and obtain density, temperature, and composition profiles of the atmosphere by direct measurements. The orbiter

spacecraft developed for this mission will be used for future planetary missions. Critical technologies and sterilization techniques will be developed for systems to be landed on the surface of Mars in later missions. The project will provide for two missions to Mars. Each mission will consist of a small survivable orbiter and a lander launched on a Titan vehicle in 1973. The funds requested for 1969 will provide for the preparation of functional specifications; initiation of detailed system designs; and development, fabrication, and testing of engineering models of critical subsystems for both the orbiters and probes.

SUMMARY

OFFICE OF MANNED SPACE FLIGHT — APOLLO PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of the Apollo program is the creation of a strong manned space flight capability to achieve a position of leadership in space for the United States.

The program, while focused on the accomplishment of manned lunar landing and return, is not solely directed toward this goal. Apollo represents the development of an extensive operational capability, including not only lunar exploration, but also the capability for a variety of other manned operations in space.

The technology that forms the basis of this capability results from the melding of a large complex of development, manufacturing, test, and launch facilities with the knowledge and experience of a unified team of people brought together from the government, industry, and universities. The skills, resources, and technology created, assembled, and developed for Apollo are a versatile and powerful national asset.

The problems and progress of the Apollo program during the past year are mirrored in two events. On January 27, 1967, during a countdown simulation at Cape Kennedy, a flash fire occurred in the Apollo spacecraft, causing the deaths of the astronaut crew. The accident delayed progress toward accomplishing Apollo's objective of a successful manned lunar landing and return before the end of the decade, and forcefully focused full national attention on the ever-present realities of the hazards inherent in the exploration of space. The command module fire has delayed this first manned flight by over one year as design changes and modifications are made to the spacecraft. These modifications represent a concentrated effort to eliminate the possibility of a fire or to preclude its propagation.

Momentum was re-established on November 9, 1967, with the successful all up test of the first Saturn V launch vehicle. This "all up" test produced a substantial number of "firsts" for the Apollo program and this country. It represented the first launch of the S-IC and S-II stages of the vehicle, the first flight of the powerful F-1 engine which produces over 1.5 million pounds of thrust, the heaviest weight (nearly 140 tons) ever placed into orbit, the initial qualification of the Apollo heatshield to withstand the 25,000 mph speed and 4,500°F. temperatures of re-entry from lunar distances, and the recovery of a payload from the greatest distance in space - over

11,000 miles. The test also demonstrated the ability of the S-IVB stage to restart in earth orbit. Each is an essential part of the manned lunar landing mission.

On the lunar mission, the spacecraft, with the Saturn V 3rd (S-IVB) stage still attached, will be inserted into a 100 nautical mile earth-parking orbit. After detailed checkout, the Apollo astronauts will separate the command, service, and lunar modules from the S-IVB stage. Necessary mid-course corrections, using the service module propulsion system, will keep the spacecraft on the correct path to the moon. As the Apollo spacecraft nears the moon, the service module propulsion system will again be fired to inject it into lunar orbit. After a checkout of all systems, two of the three astronauts will transfer from the command module to the lunar module, separate from the command craft, which will remain in lunar orbit, and land on the moon. After a stay of up to one day, during which the two astronauts will conduct observations, implant experiment equipment and instrumentation, and collect lunar samples, the astronauts will return to the orbiting command module and re-enter it. The ascent stage of the lunar module will be left in lunar orbit. The astronauts will then restart the service module propulsion system to escape from lunar orbit. After a coasting period, the service module propulsion system will be restarted for the final time to place the command module into the re-entry corridor. The service module will then be jettisoned and the command module will re-enter the earth's atmosphere.

During 1969, five manned Saturn V launches are scheduled and represent progressive steps toward the manned lunar landing. FY 1969 funding is required to support this flight schedule and the accomplishment of the national goal.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1967	1968	1969
Spacecraft	$1,310,600	$1,095,000	$ 820,100
Saturn IB	225,626	**146,600**	69,100
Saturn V	1,098,154	**998,900**	818,200
Engine development	49,800	**18,700**	—
Mission support	238,420	296,800	331,400
Total	$2,922,600	$2,556,000	$2,038,800

BASIS OF FUND REQUIREMENTS:

Spacecraft

An Apollo spacecraft, launched by a Saturn V, will accomplish the national goal of a manned lunar landing and return. The Apollo spacecraft is composed of three modules: the command module, the service module, and the lunar module. The command module, which is the recoverable portion of

the Apollo spacecraft, houses the three astronauts in a controlled environment. The service module contains the propulsion system used for making trajectory correlations and electrical and other utility systems supporting the command module. The lunar module is a self-contained vehicle consisting of a descent stage with landing legs and an ascent stage with a habitable two-man cabin.

Funding during FY 1969 provides for continued production and test of the command and service modules, launch support, and post-flight analysis. Six command and service modules are scheduled for delivery, and integration and checkout and will proceed on eleven others. A total of nineteen Block II flight command and service modules are included in the Apollo program. **Fiscal year 1969 funding also provides for continued manufacturing, test launch preparation of the lunar module, post-flight analysis, and associated hardware for experiments to be conducted on the lunar surface. Six flight articles will be delivered in FY 1969. The six remaining articles will be in the process of assembly, systems integration, and checkout at Grumman. Funds are also provided for test operations, crew equipment, including space suits, logistics, instrumentation, and scientific equipment.**

Saturn IB

The Saturn IB is a two-stage launch vehicle with a capability of placing approximately 20 tons of payload into a low earth orbit, and is used to demonstrate the initial operational capability of the Apollo spacecraft. The 1st stage, powered by eight H-1 engines, produces about 1.6 million pounds of thrust.

The Apollo program includes twelve Saturn IB vehicles. The vehicle was qualified for manned flight in 1966 after three successful development flights. A Saturn IB was originally scheduled to launch the first Apollo manned spacecraft in early 1967, but the Apollo accident and the subsequent requirements for significant spacecraft modifications delayed this flight until mid 1968. The current plan schedules the next Saturn IB launch, **an unmanned, earth-orbital test of the lunar module, early in 1968. Another launch is planned in 1968 for a second unmanned test of the lunar module. Use of the remaining six Saturn IB vehicles in the Apollo program is contingent on the qualification of the Saturn V for manned flight. To the extent that these vehicles are not required for support of the Apollo program, they will be available for Apollo Applications missions.**

Saturn V

The Saturn V, the most powerful member of the Saturn family of launch vehicles, is composed of three propulsion stages and an instrument unit. The vehicle is designed to boost payloads up to 140 tons into low-earth orbit and to send payloads up to 50 tons on lunar missions.

The Saturn V schedule provides for fifteen launch vehicles for unmanned qualification flights, manned lunar mission simulations, and manned lunar missions. Nine of these vehicles are scheduled to be launched before the end of the decade. Two vehicles were delivered in FY 1967, the first of which was used on November 9, 1967 in the very highly successful demonstration of the "all up" concept of space vehicle development. This unmanned orbital flight tested the vehicle dynamic characteristics, the reliability of the propulsion systems, and the accuracy of the guidance and control sequencing system, as well as a spacecraft heat shield. Two additional unmanned qualification tests and the first manned flight are scheduled for 1968. For 1969, the Apollo schedule includes five manned Saturn V flights, moving toward a manned lunar landing and return by the end of the decade. Major production activity continued over the last year, with the undelivered vehicles in the process of manufacturing, checkout or test.

Mission Support

Mission support funds provide for the critical areas of launch, flight crew, and recovery operations and for the program-wide systems engineering and supporting development necessary for the accomplishment of manned space flight.

There are two centers of operations activity - one at the Kennedy Space Center in Florida, where the launchings take place and the other at the Manned Spacecraft Center in Texas, where crew training and flight and recovery operations are conducted and directed.

Funding for the Kennedy Space Center covers the operation of checkout, launch and instrumentation facilities, including those contractor services and equipment and materials supplied by the Air Force Eastern Test Range for which the National Aeronautics and Space Administration reimburses the Department of Defense.

Funding for effort conducted and directed by the Manned Spacecraft Center includes the operation and maintenance of the very complex mission control center and the training of astronaut crews through the use of mission simulators and high performance aircraft. Manned Spacecraft Center operations activities also include the direction and funding of recovery operations and important mission planning requirements.

Systems engineering provides for integrated technical support, review, and analysis of manned space flight programs.

Supporting development consists of individually selected engineering efforts which back up an on-going mainstream program with alternate or improved hardware or which provide a firm basis for specific hardware decisions which must be made in the relatively near-term future.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1969 ESTIMATES

SUMMARY

OFFICE OF MANNED SPACE FLIGHT — APOLLO APPLICATIONS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Apollo Applications program will increase the effectiveness of manned space flight operations as well as the performance of experiments and other in-flight activities. The program will maintain progress in manned space flight and provide the information required to permit knowledgeable decisions concerning potential future space programs within a severely limited budget.

Missions are built upon a strong base of flight experience, ground facilities, and trained manpower developed in the Gemini and Apollo programs. Maximum economy is achieved by using, modifying, and expanding the capabilities of present Apollo systems rather than moving toward wholly new developments.

Apollo Applications program flight missions planning is separated into two categories: earth orbital missions using both the Saturn IB and the Saturn V, and lunar missions using Saturn V vehicles and spacecraft modified to provide limited extension of Apollo mission staytimes on the lunar surface.

During fiscal years 1968 and 1969 Apollo Applications funding provides for continuation of production of Saturn launch vehicles at a minimum rate and development and fabrication of the equipment and experiments for the orbital workshop, the solar astronomy, and the revisit missions. In addition, definition effort will be underway to determine the equipment and experiments necessary for the most effective exploration of the moon in the post-Apollo period. These activities support the following missions in the Apollo Applications program.

Saturn I Workshop Mission - Initial orbital workshop operations are planned in 1970. The orbital workshop is set-up inside the empty hydrogen tank of a spent S-IVB stage, after the stage is used as a launch vehicle.

The orbital workshop requires the launch of two Saturn IB vehicles to begin operation of a large volume workshop in earth orbit. An unmanned flight, consisting of a Saturn IB with an air-lock module, and a docking adapter, will be launched first. A second Saturn IB launch occurring approximately one day later, will be manned and will rendezvous with the S-IVB stage from the first flight.

The crew will transfer from the command module through the docking adapter and the airlock module into the orbital workshop, and complete preparations for the crew quarters.

The experiments planned on this mission are chiefly devoted to determining and evaluating tank performance of men in space over extended periods of time. The planned mission duration for the crew will be 28 days. After completion of the mission, the equipments in the workshop, airlock and docking adapter will be placed in a standby mode for reuse in future missions.

Workshop Revisit Mission - The first workshop revisit mission uses a single Saturn IB launch of a three man Command and Service Module to rendezvous and dock with the orbital workshop placed in orbit during the previous mission. Its planned duration is 28 to 56 days. The primary in-flight experiment emphasis will be in the medical area. This will be the first mission with a medical doctor as a member of the crew.

Solar Astronomy Mission - The third mission, planned for 1971, uses the orbital workshop as a base of operations for a manned solar observatory. One Saturn IB will launch a three man Command and Service Module configured for a 56 day mission; a second Saturn IB launches the unmanned Apollo Telescope Mount (ATM) with its payload of solar instruments. It is expected that an astronomer astronaut will be a member of the crew.

Workshop/Observatory Revisit Mission - A series of three additional revisits to the orbital workshop is planned in 1971. These will use the same configuration of the Command and Service Module being developed to support the first revisit to the workshop and the Apollo Telescope Mount missions, with a nominal duration of 56 days.

Saturn V Workshop - Over the past several years NASA, with supporting effort from many contractors, has conducted a series of studies of the configuration and utilization of an orbital workshop launched on a Saturn V. The ability of the Saturn V to orbit a workshop outfitted on the ground before launch, significantly enhances the effective use of manned operations in earth orbit.

This Saturn V workshop is a natural progression from the Saturn I workshop, as well as from the Mercury, Gemini, and Apollo programs. It will enable astronaut crews to conduct major scientific and engineering investigations for a period of a year or more.

Effective evolution and utilization of the space program and its capabilities require that the specific approach to the Saturn V workshop be determined within the next year. This definition effort will be directed toward the workshop; its scientific, engineering, and medical payloads; and operations plans.

Lunar Missions - Following the first Apollo landings, we will continue exploring the moon and providing the capability to conduct extended operations on the lunar surface. In analyzing the requirements for the post-Apollo missions three important extensions to the projected Apollo surface mission capability were identified:

1. Extension of staytime for the astronauts.

2. Increase in exploration radius about the landing site.

3. Increase in landed payload for mission support.

Missions in 1971 and 1972 can be planned with a surface staytime for two astronauts of three or more days during which time they will be able to explore within a five to ten kilometer radius of the landing point. This increased capability is brought about by utilizing performance margins which have been identified in the Apollo lunar module.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1967	1968	1969
Space vehicles	$37,700	$86,000	$201,300
Experiments	37,600	139,000	190,300
Mission support	4,700	28,200	48,000
Total	$80,000	$253,200	$439,600

BASIS OF FUND REQUIREMENTS:

Space Vehicles

Funding of space vehicle requirements in support of the Apollo Applications program through FY 1969 is limited to the procurement of Saturn IB and Saturn V launch vehicles and to the design, development, production and installation of Apollo spacecraft systems that require modifications to meet the long duration objectives established for Apollo Applications missions.

To minimize expenditures, delivery of Saturn IB launch vehicles for use in the Apollo Applications program has been rescheduled to two per year beginning in calendar year 1970.

Production of Saturn V launch vehicles for Apollo Applications is also scheduled at two per year with the first delivery of a post-Apollo vehicle planned for 1971.

The long-duration characteristics of the Apollo Applications missions requires that spacecraft systems be modified to support these extensions in flight time. The Apollo spacecraft has been designed and produced to provide a 14 day operational capability and must be modified to accommodate the 56 day missions that are incorporated in the Apollo Applications program.

Funding during FY 1969 provides for the fabrication, checkout, and test of the necessary modifications and their initial installation in the first modified Block II command and service modules.

Feasibility studies directed toward modifying the lunar module to operate on the moon for a staytime of three days were performed during FY 1967, with preliminary design of the modifications being initiated during FY 1968.

FY 1969 funding provides for the continuation of design and preparation of vehicle and test specifications and the initial procurement of long lead hardware.

Experiments

Apollo Applications experiments cover a wide range of objectives in the fields of space medicine, science, applications, technology, and engineering. The definition and development of experiment payloads to meet these objectives will include activity by elements of NASA, other government agencies and the scientific and industrial communities. Unlike preceding manned space flight projects, in which the successful demonstration of the basic systems capability was the principal objective, Apollo Applications must achieve its objectives primarily through the judicious selection and carefully planned accomplishment of specific experiments. The measure of success will be the degree to which these experiments meet the overall objectives of investigating, demonstrating, and utilizing man's effectiveness in space, extending his useful staytime, and contributing to this basic understanding of natural phenomena. Each of the experiments currently included in the program will contribute substantially to one or more of these objectives.

Contractor development effort is currently in process on the systems and components required for most of the major experiments. The basic pieces of hardware required for the workshop are well into their development phase at present. The airlock module is currently under development. Initial fabrication has begun on the first flight article, which will be ready for delivery to Cape Kennedy in late 1969.

The multiple docking adapter is being developed and fabricated in-house by NASA at the Marshall Space Flight Center. Manufacture of the initial flight unit will begin in 1969 and will be completed early in FY 1970.

Work is also in process on the ATM at the Marshall Space Flight Center, with major subsystem development having been underway for a year. Five specific experiments comprised of thirteen major instruments have been selected for the ATM and are currently in the process of fabrication.

Mission Support

Funds in this category will support the payload integration activity and requirements for actual flight operations. Payload integration includes mission payload analysis and engineering aspects of integrating experiment payloads into spacecraft. It also provides support equipment hardware definition and design; performance and design test specifications; experiment interface specifications; and development of requirements, plans, and program data for accomplishing payload integration. Operations include efforts at the Kennedy Space Center and the Manned Spacecraft Center that are directly concerned with pre-launch, launch, flight, crew and recovery activity.

SUMMARY

OFFICE OF MANNED SPACE FLIGHT — ADVANCED MISSIONS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of the Advanced Missions program is to examine advanced manned space flight mission concepts in support of timely decisions with regard to future programs. Included are: logical extensions of the NASA space program through analysis of present hardware systems for growth potential; development of requirements for future systems; guidance for research and technology activities; provision of technical information and cost data upon which future program decisions can be based; and initiation of the definition, preliminary design and specification of probable future missions.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1967	1968	1969
Advanced missions studies.....	$6,200	---	$5,000
Total.....	$6,200	---	$5,000

BASIS OF FUND REQUIREMENTS:

Advanced Missions Studies

Advanced studies have in past years encompassed a wide spectrum of missions and related hardware. They were grouped into the categories of Earth Orbital Studies, Planetary Mission Studies, and Flight Vehicle Studies. The advanced missions program office in the Office of Manned Space Flight was organized along lines that reflected this categorization. Recently, however, the Advanced Manned Missions program office was realigned to concentrate on the immediate task of the manned earth orbital space flight program both with respect to direct support of the later phases of the Apollo Applications program and to the long term implications of these plans. As a result of manned space flight experience to date and of a series of studies conducted over the past several years, there has developed a strong conviction among space planners that a space station is logical, practical, and necessary in development and use of our national capability for manned space flight. Such a station, with its supporting equipment and expendables, could be launched with a Saturn V. It would make use of equipment and experience developed for Apollo, the orbital workshop and other projects such as MOL, to the extent

practical. Once in orbit, it would serve as a semipermanent base of operation for astronomical and other scientific observations, earth resources studies, biomedical research, technological developments, and for operational research and development to further enhance our national capability for manned space flight. By utilizing a modular approach, with a capability to operate in conjunction with automated but man tended spacecraft in the near vicinity, great operational flexibility can be achieved. This flexibility should make the space station system capable of meeting a wide variety of national needs.

A further aspect of the flexibility envisaged for the system, is that its occupancy and use could be varied from full crew/full time to a part time or standby operation, depending on requirements of users, funding availability, or other factors. The space station would constitute a continuing capability, in being, in orbit to serve national needs in accordance with future decisions on specific objectives and on resources to be allocated.

Space Station Studies

Most of the funds requested for FY 1969 will be expended on efforts to define an initial space station to be launched by a Saturn V following the completion of the current Apollo Applications program in the early 1970's. Lead times are such that this work cannot be deferred if we are to maintain a national capability for a continuing manned space flight program in earth orbit. The preliminary design and definition effort will build on previous work and will include all aspects of space station missions and configurations, including the related logistics transportation system.

Intermediate Vehicles

A portion of the space station study funds will be allocated to determining the need for a launch vehicle intermediate in payload capability between the Saturn IB/Titan III and the Saturn V. It is possible that such a need will emerge from considerations of the logistics transportation system required to support the station. The determination of need for an intermediate vehicle is part of a larger picture, however, since other programs and agencies may also have requirements for such a vehicle. In particular, NASA will join with DOD in evaluating possible future space flight systems and the extent to which future requirements can be best met with NASA hardware, DOD hardware, or jointly developed systems.

Other Advanced Studies

In addition, it is planned in FY 1969 to continue some advanced studies of other missions and vehicles, particularly those applicable to lunar exploration. The latter will concentrate on alternate and contingency systems and operational modes for the mid-1970's.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1969 ESTIMATES

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS PHYSICS AND ASTRONOMY PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Physics and Astronomy program is directed toward the increase of our knowledge of the earth, sun, the interplanetary medium, and the nature of the universe. The program is a coordinated effort for national participation in research which involves: the space environment of the earth, the sun, and the solar relationship to the earth's environment and to interplanetary space, interplanetary dust, meteors, comets, stars, nebulae, galaxies, interstellar and intergalactic phenomena, and the basic nature of the universe. The program uses a variety of tools including automated observatories, manned spacecraft, interplanetary spacecraft, explorers, sounding rockets, balloons, aircraft, ground-based observatories, and laboratory and theoretical research. Each tool is selected for a specific application because of a unique capability or because it is the most efficient way to do the research.

Many of the studies contribute to the over-all objective of the program as well as provide knowledge for a specific area. Although many practical applications have been made of the knowledge gained, the primary objective continues to be one of basic research dedicated to the expansion of knowledge. Therefore, considerable effort has been expended to insure that the knowledge gained is made available and that the program is integrated with the programs of educational and scientific institutions.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1967	1968	1969
Supporting research and technology/advanced studies...	$ 20,365	$ 23,050	$ 25,300
Solar observatories.....	10,106	12,100	12,000
Astronomical observatories.....	27,700	40,400	35,200
Geophysical observatories.....	24,770	20,200	13,200
Pioneer.....	6,900	7,000	6,000
Explorers.....	18,224	17,300	23,200
Sounding Rockets.....	20,000	20,000	22,000
Data Analysis.....	1,735	2,900	5,000
Total	$129,800	$142,950	$141,900

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

In the Supporting Research and Technology project, NASA supports the basic research required to provide for a firm foundation for the Physics and Astronomy program. It is in this program that development of new instruments is initiated. Laboratory, balloon, and aircraft data are provided as a basis for evaluation of flight results. Computer support for spacecraft operations, analysis of data and theoretical research is also provided.

The advanced studies funded are aimed at providing the technological advances, the establishment of concepts, characteristics and feasibility of future missions so necessary to continue a viable Physics and Astronomy Program.

Solar Observatories

The objective of the Orbiting Solar Observatory (OSO) project is to provide the capability to advance man's understanding of the sun's constitution and behavior and to determine the fundamental physical processes by which the sun influences the earth and its space environment. The OSO makes available regions of the electromagnetic spectrum that are not available to ground-based instruments. The experiments on the OSO series of flight missions will determine the rapid changes, as well as the long-term changes in solar radiation, during the major portion of the eleven-year solar cycle. The first and second solar observatories obtained significant scientific data in the 1962 and 1965 time period during the period when solar activity was close to a minimum. A third OSO spacecraft failed to achieve orbit when it was launched in 1965. In 1967 two more OSO missions were launched that are providing more detailed knowledge of the sun and its environment at the time that solar activity is increasing. Three more OSO missions will continue studies of the sun into the period of maximum solar activity. Fiscal year 1969 funds will provide for publication of data from OSO III and OSO IV; support pre-launch, launch, and in-orbit operations of the sixth OSO; and continue hardware effort on the seventh and eighth OSO's.

Astronomical Observatories

The Orbiting Astronomical Observatory (OAO) project is designed to develop and use an accurately stabilized automated space observatory system for telescopic observations of celestial objects in the electromagnetic spectral range from the x-ray region through the ultraviolet into the visible region. The primary experiments for the approved OAO series have been selected to initially perform exploratory sky mapping surveys and progress to high resolution viewing of faint objects. The first mission, which was launched in 1966 by an Atlas Agena vehicle, failed before any

scientific data were obtained. The second flight was delayed about 21 months in order to thoroughly review and correct the weaknesses in the OAO system. Launches for the remaining approved missions are now scheduled in 1968, 1969, and 1970, using the Atlas Centaur vehicle. Fiscal Year 1969 funds will provide for completion of the OAO-A2 observatory tests and simulated operations, as well as support for launch, in-orbit operations, and data processing and analysis from the two scientific experiments. Funds will also be used for the acceptance tests of the OAO-B experiment instrumentation, qualification tests of the OAO-C experiment hardware and development of flight hardware; modification, fabrication, integration and test initiation of the OAO-B spacecraft; and fabrication and test of the subsystems for the OAO-C spacecraft.

Geophysical Observatories

The Orbiting Geophysical Observatory (OGO) project has as a primary objective the accomplishment of a series of scientific measurements for study of the near-earth environment and for correlation of geophysical phenomena with the effluent activity of the sun and with phenomena in interplanetary space. Geophysical observatories have been launched at approximately one year intervals, starting with OGO-I in 1964. These missions and the planned OGO-E and OGO-F missions cover the period from minimum to maximum activity of the current sunspot cycle, and provide for widely-spaced measurements within the interplanetary and magnetospheric medium. OGO-I and III are transmitting data and are spin stabilized. OGO-IV, launched July 28, 1967, has been in the three-axis stabilization mode for over 150 days. Operations of the OGO-II satellite were discontinued after two years in orbit. Fiscal Year 1969 funds provide for launch of OGO-F and data analysis for OGO-IV, -E, and -F.

Pioneer

Pioneers in orbit around the sun are investigating the interplanetary environment and the propagation of solar and galactic phenomena through this medium. Data from three Pioneers and similar measurements made near earth provide simultaneous observations at widely separated points in space. Pioneer VI was successfully launched in December 1965, and **Pioneer** VII was successfully launched in August 1966. Both continue to return useful data from deep space. Pioneer VIII was successfully placed into orbit December 13, 1967. At this time all systems appear to be working satisfactorily. Two additional Pioneer missions are scheduled for missions approaching as close as 0-7 AU and going out as far as 1.2 AU from the sun (1 AU is equal to the mean earth to sun distance 92,900,000 miles).

We are proposing to initiate the development of two additional spacecraft, Pioneers F & G, to be launched into trajectories that will carry them out beyond the orbit of Mars, through the asteriod belt, and toward

the orbit of Jupiter. With this type of trajectory we should be able to obtain information on the hazardous region of the asteriod belt and gain knowledge of the gradient of the sun's influence on interplanetary space and the penetration of galactic cosmic radiation into the solar system. The new trajectory will require modifications to be incorporated in the spacecraft to compensate for the lessening of solar radiation as a power source and the more demanding communications and thermal conditions. New experiment instrumentation will also be required. These spacecraft will be launched in the 1973-74 time period by Centaur launch vehicles. The change from the Delta launch vehicles used on earlier missions is required to provide the velocity for this new trajectory.

Funds requested for FY 1969 will continue to support the post-launch operations for Pioneer VI, VII, and VIII, final testing and launch of the fourth spacecraft, and initial integration and testing for the fifth spacecraft. These funds will also provide for the initial procurement of experiments and long lead time spacecraft components for Pioneer F & G.

Explorers

The Explorer class of satellites has been one of the most efficient and economical means of accomplishing a variety of scientific missions. A substantial portion of the scientific data gathered and many new discoveries are attributable to instruments carried in Explorer spacecraft. These spacecraft, most of which are launched by the relatively inexpensive Scout and Delta vehicles, are specifically designed for particular types of scientific investigations, and are flown in orbits suitable for these investigations.

We are proposing to initiate development of two new atmosphere Explorers in FY 1969 to extend exploration by satellites into the 75 to 150 mile region above the earth, which has previously only been sampled by sounding rockets. Exploration of the ionosphere will be continued through our cooperative ISIS project with Canada. Work on IMP and small scientific satellite Explorers for magnetospheric exploration, which is being deferred in FY 1968 because of budget and manpower limitations will be pursued again in FY 1969 in an effort to compensate in some degree for the phaseout of geophysical exploration by OGO missions. The small interplanetary Explorer called Sunblazer, which was deferred in FY 1968, will be placed in full scale development in FY 1969. Development of Explorers for astronomy missions will continue, including missions for radio, X-ray and gamma-ray surveys.

These actions will cause the level of effort in Explorers to increase in FY 1969, reflecting our increased reliance on this class of spacecraft for geophysical and interplanetary exploration.

Sounding Rockets

Sounding rockets offer a uniquely effective means of conducting scientific studies at altitudes between 40 and 175 miles. These rockets are relatively small, inexpensive vehicles capable of carrying a wide variety of instrumentation to conduct studies in planetary atmospheres, the ionospheric physics, energetic particles, astronomy, and solar physics. Sounding rocket flights have been extremely useful in developing instrumentation for later use on satellites. The usefulness of sounding rockets for astronomical observations of the sun and stars in the X-ray and ultraviolet regions of the spectrum has been greatly increased by the development of accurate attitude control systems capable of spatial pointing accuracies on the order of an arc second.

The increase in the funding requirements for the sounding rocket program in FY 1969 is largely due to the development and increased use of improved attitude control systems for astronomical observations; and to the increased use of larger, more expensive vehicles to carry stabilized heavier payloads.

Data Analysis

The primary objective of this project is to carry out NASA's obligation to make the scientific information gained from space projects available to the public. Data accumulated from NASA's earth orbiting spacecraft, sounding rockets, and space probes are being reduced and placed in the National Space Science Data Center located at the Goddard Space Flight Center. Here it is cataloged and distributed to interested researchers. The expansion of funding in FY 1969 reflects the increased activity at the National Space Science Data Center, a concerted effort to complete data analysis and preparation of data records for experiments no longer supported under flight projects, and support of the increasing interest in research using data from a number of experiments.

SCHEDULE OF LAUNCHES

Project	Mission	Calendar Year
Solar Observatories	OSO F	1968
	OSO G	1969
	OSO H	1970
Astronomical Observatories	OAO-A2	1968
	OAO-B	1969
	OAO-C	1970
Geophysical Observatories	OGO-E	1968
	OGO-F	1969

Project	Mission	Calendar Year
Explorers	4 Scouts, 3 Deltas	1968
(includes international)	3 Scouts, 1 Delta	1969
(cooperative satellites)	6 Scouts, 2 Deltas	1970
	4 Scouts, 3 Deltas	1971
	1 Scout, 2 Deltas	1972
Pioneer	Pioneer D	1968
	Pioneer E	1969
	Pioneer F	1973
	Pioneer G	1973-74
Sounding Rockets	100-125 launches per year	

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1969 ESTIMATES

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS — LUNAR AND PLANETARY EXPLORATION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Lunar and Planetary Exploration program carries out the scientific exploration of the solar system by means of earth-based research and automated spacecraft. The immediate objectives are the exploration of the Moon, the planets Mars, Venus, and Mercury, and the intervening interplanetary space. Long range objectives include eventual exploration of the outer planets and their moons, comets, asteroids, and the interplanetary medium enroute to these bodies. Achievement of these objectives will provide the data with which we can better understand the origins and history of our solar system, the mechanisms by which it developed, and knowledge about the origin of life. These objectives require the development of spacecraft technology and its successful application to flight missions.

The initial scientific exploration of the moon was performed with automated spacecraft and has lead the way for the more detailed investigations to be carried out later by man. The Ranger, Surveyor, and Lunar Orbiter projects have provided three major accomplishments. First, they have demonstrated that our country possesses the technological capability of performing significant exploration of another planet with automated spacecraft. Second, they indicated that the moon is a complex and significant body worthy of further exploration by man. Third, they paved the way for the first manned landing. Ranger provided initial visual data about the moon which was 1,000 times better than any photographs through earth-based telescopes. Surveyor has significantly contributed to the certification of four sites in the Apollo zone, obtained scientific data about the moon's bearing strength and soil mechanics, surface texture, topography and morphology, radar reflectivity, thermal characteristics, and chemical composition. The Lunar Orbiters have successfully photographed the entire surface of the moon; inspected for hazards as small as several feet in size at candidate manned landing sites, and increased our knowledge about the near edges of the moon. The FY 1969 program will provide for the data analysis required to finish up the work and prepare the scientific reports on the valuable information obtained from these successful projects.

The planets present us with a scientifically attractive opportunity for exploration because they all differ markedly from our earth. In these

differences may lie the clues to the nature, origin, and evolution of our solar system and of life itself. Objectives of the Mariner program are to explore the planets, their moons, and interplanetary space with the light weight Mariner systems. Mariner II acquired interplanetary and planetary data on a flyby mission to Venus in 1962. Mariner IV flew past Mars in 1965. It acquired data on the interplanetary medium, the atmosphere of the planet and transmitted to earth 22 pictures of the surface of the planet. Mariner V flew by Venus in October 1967. It acquired data on the interplanetary medium and planetary atmosphere which improved and augmented significantly the data acquired five years earlier by Mariner II and will provide a basis for future exploration of Venus. These missions demonstrated the value of the Mariner class spacecraft to provide precursory type scientific and engineering data which will allow for the more detailed exploration of the planets and lead to automated surface exploration. The Mariner spacecraft concept is serving as an effective and economical means to obtain initial information on which to base future missions to Venus, Mars, and Mercury. It is anticipated that these spacecraft will continue to gain valuable data in understanding our solar system on missions to Mars in 1969 and 1971, with the further possibility of missions to Venus in 1972 and a dual planet swingby to Venus and Mercury in 1973. It is also anticipated that the Mariner class of spacecraft will play a major role in the early scientific exploration of the comets and other bodies in the solar system.

The Titan Mars 1973 program will initiate a baseline orbiter/lander configuration applicable to future exploration of the planets. The program will establish a step-wise approach to increase the performance capability of each succeeding mission opportunity from extended orbital missions (3-6 months) with simple landers to long life orbital missions (6-12 months) with surface laboratories and later to mobile automated laboratory landers. The Titan Mars 1973 approach provides maximum flexibility to implement future mission options depending upon the national interest and economic support for planetary exploration.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1967	1968	1969
Supporting research and technology	$ 22,350	$ 19,800	$ 30,000
Advanced planetary missions technology	---	12,000	6,700
Data analysis	---	600	2,600
Mariner	43,188	63,000	48,000
Titan Mars 1973	---	---	20,000
Lunar Orbiter	26,000	9,500	---
Surveyor	79,942	35,600	---
Voyager	12,670	1,000	---
Total	$184,150	$141,500	$107,300

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

Supporting Research and Technology provides for support of flight missions by conceiving and developing science experiments and engineering capabilities and by conducting studies that define the objectives and requirements of various long-range flight mission possibilities. Data obtained from ground-based activities supported by this program are combined with flight results to yield significant advancement in our knowledge of the solar system. The advanced technical development part of this program is oriented toward initiating technological development of future subsystems, components, techniques and processes that may have application to long range spacecraft concepts and providing the laboratory research required to determine the feasibility of alternative design concepts for future, more complex missions to the moon and planets. Areas of interest are new telecommunication and data automation techniques and concepts and increased reliability and life-time of components. The advanced studies program identifies and evaluates long range potential missions in terms of new information to be gained from the moon and the planets.

During FY 1969 efforts in the planetary area will continue at about the same level of funding as FY 1968. Efforts in the lunar area will be increased with an emphasis on scientific support for Apollo and post-Apollo missions based on the results of the Ranger, Surveyor and Lunar Orbiter programs, and on technical development of new methods and instruments for the optimization of existing mission plans and future plans for lunar exploration.

Advanced Planetary Missions Technology

The Advanced Planetary Missions Technology program was begun in FY 1968 in view of the conclusion of the Mariner V, Lunar Orbiter, and Surveyor programs and the deferral of Voyager after the Phase B completion. This effort is maintaining a nucleus of the scientific, technical, and management competence made available by the completion of these successful programs to conduct the necessary mission design studies to shorten lead time requirements for future missions, to accelerate specific technology tasks in advanced subsystem development essential for executing missions in the early 1970's and to advanced scientific instrumentation development associated with probes and landers. Mission design studies include computing trajectories, formulating mission profiles, carrying out preliminary engineering studies and generating operational requirements and plans to establish feasible design concepts for these missions. The advanced subsystem research and development effort supports these studies by providing increased subsystem performance specifications obtained from laboratory research. In addition, this effort ensures through focussed attention and scheduled achievements that the critical subsystems will be sufficiently developed for use in the appropriate spacecraft. Currently being developed are propulsion, aerodynamic

entry and guidance subsystems. The science definition and instrument development effort defines the scientific instrumentation and ensures its development for these early missions to Mars, Venus, and Mercury. These efforts serve to organize science teams to develop advanced scientific instrumentation which must operate in conjunction with other flight instruments to ensure maximum scientific return from each mission.

Data Analysis

With the completion of the Surveyor project scheduled for early 1968 and the already completed Lunar Orbiter, Mariner IV, and Mariner V projects, analysis of the scientific and engineering data will be continuing activities. To consolidate these activities, the Data Analysis project has been established. This project will provide for the preparation of reports, support experiments, and provide for the final acquisition of engineering and scientific data of all these missions. The funds requested in FY 1969 will provide for continuation of the analysis of and reporting on the vast amount of scientific and engineering data obtained from the Surveyors, Lunar Orbiters, and Mariners IV and V.

Mariner

The objective of the Mariner project is to conduct the early exploration of the planets with automated spacecraft in the medium weight class, about 400 to 1,200 pounds. These spacecraft carry out the precursory missions to Mars, Venus, Mercury, the major asteroids, and the comets. Mariner II flew by Venus in December 1962 to make the first direct measurements of that planet. Mariner IV in July 1965 photographed Mars from a distance of 6,118 miles. In September and October 1967, a series of engineering tests were conducted with Mariner IV which turned on the spacecraft gyros for the first time in nearly 3 years. This spacecraft responded satisfactorily to all commands and demonstrated that all subsystems were still in good working order. Its attitude control system gas supply was finally exhausted in December 1967. Mariner V flew within 2,500 miles of the surface of Venus in October 1967. Fields and particles measurements were made enroute through interplanetary space beyond Earth and Venus and measurements were made to derive the fundamental properties of the environment that surrounds the planet.

Mariner Mars 1969 is designed to fly by Mars to carry out improved experiments that will yield high resolution topographic information about the Martian surface, provide atmospheric profile measurements by means of the occultation technique, and identify some atmospheric constituents with new spectrographic instruments. These instruments will be detecting the presence of polyatomic molecules that suggest biochemical processes, the presence of an oxidizing or a reducing atmosphere, molecular nitrogen, nitric oxide, carbon monoxide, cyanogen and water.

Mariner Mars 1971 will continue the exploration to Mars with two Atlas/ Centaur launched spacecraft. The Mariner Mars 1971 spacecraft configuration will be based on the Mariner Mars 1969 design modified to permit placing the spacecraft in orbit about the planet Mars. The conversion of this spacecraft from a flyby to an orbiter will enhance the accomplishment of scientific measurements by allowing the spacecraft to transmit data from close to the planet for approximately ninety days.

The FY 1969 funds requested will provide for the completion of flight spacecraft testing, launch operations, and inflight mission operations for Mariner Mars 1969; and the completion of detailed system design, procurement of subsystems and the development and test of prototypes of critical subsystems for Mariner Mars 1971.

Titan Mars 1973

The orbital reconnaisance of Mars initiated in 1971 will be continued in 1973. In addition, the initial direct measurements of the atmosphere and on the Martian surface will be made by means of a small survivable lander. The Titan Mars 1973 project will, therefore, capitalize on the technology developed by Lunar Orbiter, Surveyor, Mariner, and the earlier Voyager concepts. Two launches of Titan class launch vehicles are planned in 1973. Each launch will contain an orbiter and a small survivable lander.

The orbiter will carry instruments that will photograph the surface and measure the planet's thermal radiation, surface and atmospheric composition, magnetic fields, and trapped radiation. The lander will directly measure during entry through the atmosphere the density profile and the atmospheric temperature, pressure, and composition. The landed package will also contain instruments for measuring moisture, soil composition, and atmospheric properties on the surface. A limited photographic capability from the surface is planned.

The orbiting spacecraft will offer the advantage of observing the planet for a period of several months thus permitting the study of the Martian diurnal, seasonal, and synoptic characteristics during a single mission. The survivable lander will provide the opportunity for the first direct measurements in the atmosphere and on the Martian surface.

The funds requested in FY 1969 will provide for the establishment of functional specifications, initiation of detailed system designs, and the development, fabrication, and testing of engineering models for both the orbiter and lander.

Surveyor, Lunar Orbiter and Voyager

Due to the completion of Surveyor and Lunar Orbiter, and the termination of Voyager, no funds are requested for these projects in the FY 1969 budget.

Schedule of Launches

Project	Mission	Calendar Year
Mariner	Mars 1969 (2)	1969
	Mars 1971 (2)	1971
Titan Mars 1973	Mars 1973 (2)	1973

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS LAUNCH VEHICLE DEVELOPMENT PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Launch Vehicle Development program provided for the development of new vehicles and vehicle stages to support mission requirements. During FY 1967, the program consisted of Supporting Research and Technology, Advanced Studies, and Centaur Development. Development of the Centaur vehicle was completed in FY 1967. During FY 1968 and FY 1969 Supporting Research and Technology and Advanced Studies are budgeted under Launch Vehicle Procurement.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1967	1968	1969
Supporting research and technology/advanced studies..	$4,000	---	---
Centaur development.....	27,200	---	---
Total.....	$31,200	---	---

BASIS OF FUND REQUIREMENTS:

No funds are being requested in FY 1969 for Launch Vehicle Development.

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RESEARCH AND DEVELOPMENT

FISCAL YEAR 1969 ESTIMATES

SUMMARY

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 related services to support mission requirements and to accomplish minor development activities necessary to support future mission needs.

The Launch Vehicle Procurement program is presented as a separate program, but vehicle funding requirements associated with specific flight projects are also shown as parenthetical entries with these projects. The operational vehicles currently being procured are: Scout, Delta, Thor Agena, Atlas Agena, and Centaur.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1967	1968	1969
Supporting research and technology/ advanced studies	---	$4,000	$4,000
Scout	$9,400	10,200	6,500
Delta	23,835	30,300	30,800
Agena	29,396	14,400	14,000
Centaur	55,019	68,200	53,000
Total	$117,650	$127,100	$128,300

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology/Advanced Studies

This project was presented under the Launch Vehicle Development program until FY 1967 when the development of the Centaur vehicle was completed. The objective of the Advanced Studies effort is to define vehicle requirements for future missions and to establish the methods by which performance in excess of current capabilities can best be developed. Supporting Research and Technology tasks are directed toward developing new technology and techniques for which a need has been demonstrated by the Advanced Studies. In FY 1967 and FY 1968 Advanced Studies efforts were directed toward very

high velocity launch vehicles. In FY 1969 studies will be concerned with mission analyses, vehicle and stage alternatives, and program planning. Fiscal year 1968 Supporting Research and Technology tasks are being conducted on strapdown guidance systems and a variety of other tasks important to the future of the launch vehicle program. In FY 1969 development of strapdown guidance systems will continue and effort will also be directed toward a variety of tasks including improvement of a small solid propellant motor and investigation of advanced pressurization systems.

Scout Procurement

Scout is the smallest launch vehicle in the NASA vehicle family. It is capable of lifting small payloads into earth orbit and performing small probe and re-entry missions. In FY 1969 funds for Scout Procurement will be utilized for the production, assembly, and launch of the Scout vehicle. In addition, Sustaining Engineering and Maintenance funds will be required for maintenance of ground support equipment at the Scout launch sites, for management and engineering support, and for minor improvements to the Scout vehicle.

Delta Procurement

The Delta vehicle system consists of the Thor booster, the Delta second stage, and a third stage if necessary to support given missions. This launch vehicle is capable of performing medium-sized earth orbital missions and small space probes. It has been utilized for a wide variety of scientific, meteorological and communications missions. During FY 1969 funds will be utilized to complete purchase of fourteen first and second stage vehicles initially funded in FY 1968, to initiate purchase of ten additional vehicles and to procure associated vehicle hardware, launch services and other supporting services. Sustaining Engineering and Maintenance funds will be utilized for the maintenance of ground support equipment, for engineering support, for minor improvements including modification of the FW-4 motor nozzle and conversion to S-band telemetry, and for completion of improvement efforts started in FY 1968.

Agena Procurement

The Agena project includes the Thor Agena and the Atlas Agena launch vehicles. These vehicles have been utilized for a wide variety of missions which exceed the capability of the Delta vehicle. With the demonstrated success of the more powerful Atlas Centaur and with a low projected launch rate of heavy automated missions, NASA is planning to phase out the Atlas Agena launch vehicle in FY 1968. Thor Agena vehicles will continue to be utilized. In FY 1969 funds for Agena Procurement will be required for Agena upper stages, Thor boosters, mission modifications, and supporting activities. Sustaining Engineering and Maintenance funds will be needed for maintenance of ground support equipment, engineering services, and minor improvements.

Centaur Procurement

The Atlas Centaur is the largest launch vehicle currently employed by NASA exclusively for automated space missions. It features the Centaur upper stage whose high energy propellants make this vehicle uniquely qualified to perform high velocity deep space missions in addition to relatively large earth orbit and lunar missions. In FY 1969 funds will be required to continue funding for the Orbiting Astronomical Observatory, Applications Technology Satellites, and Mariner Mars 1969 vehicles. Funds will also be required to initiate purchase of vehicles for the Mariner Mars 1971 mission and future Applications Technology Satellite missions. In addition, FY 1969 funds will be required for Sustaining Engineering and Maintenance which will include efforts to improve the reliability of the Centaur vehicle.

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS — BIOSCIENCE PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Bioscience program has two principal objectives. The first, to determine the effects of the space environment on terrestrial organisms, includes work on ground-based experiments, the Biosatellite flight program, and the development of flight experiments for other missions.

The second objective, to determine the location, origin, nature, and level of development of extraterrestrial life, includes laboratory research and space flight missions to investigate conditions in the space environment and on the planets which may relate to the question of the existence of extraterrestrial life.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1967	1968	1969
Supporting research and technology	$10,050	$11,800	$16,000
Biosatellite	31,950	30,000	32,500
Total	$42,000	$41,800	$48,500

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

Research in Environmental Biology is concerned with the response of living terrestrial systems to the variables of the space environment. One of the greatest scientific challenges today for biologists is to understand the role gravity plays in the origin, nature, and function of highly organized life. Gravity (and its variation) has not, until recent years, been a matter of great concern to biologists because of its constancy here on Earth. In addition to the obvious need to understand its effect on living systems for the purposes of space flight, many practical implications follow from a deeper understanding of the effects of altered gravity.

In Behavioral Biology research, experiments are being conducted to assess the general problem of visual-motor coordination in animal and man, particularly as it may be affected by alterations in gravity and the consequent changes in feedback from the muscles. The implications of such work are broad. As basic

research, this and related investigations should lead to a better understanding of brain-behavior relationships and of certain illnesses. As applied research, more information is being obtained on the relation of the research results thus far obtained to long term behavior, such as would be encountered on any long term space flight mission.

The Physical Biology effort includes work in bioinstrumentation, comparative physiology, and molecular biology. Stable, accurate, and long-lived implantable telemetric devices have been developed for recording temperature changes indicative of cyclic (circadian) biological phenomena. Such devices have been applied to the design of Biosatellite experiments and by several researchers studying biological rhythms. Work is continuing on development of a low cost, multichannel, implantable transmitting device weighing no more than 3.5 grams and not exceeding two cubic centimeters in volume that would be capable of efficient operation over two years.

The Exobiology research program continues, with its dual objectives of understanding the controlling factors in the origin of life and determining the uniqueness of life here on Earth. The research ranges from the analysis of fossil remains and simulation of planetary atmospheres and other environmental extremes, to the development of automated life detection equipment intended to increase the reliability of the data by broadening the basis for analysis of individual samples. In addition to data previously reported on Mars as a candidate planet for investigation, laboratory experiments now suggest that organic synthesis may be occurring on Jupiter which has a primitive reducing atmosphere. These studies point to Jupiter as a most interesting planet from the point of view of chemical evolution.

Earlier Planetary Quarantine efforts were directed toward reducing and assaying the biological contamination on spacecraft and toward defining sterilization procedures needed to reduce that contamination to an acceptable level. Two areas of research are proving to be especially fruitful. The use of laminar downflow air, combined with high efficiency filters, is producing excellent results in limiting contamination in the spacecraft assembly areas. Additionally, examination of the sterilization requirements and studies of the probability of growth of organisms in planetary environments, are tending to significantly reduce the severity of sterilization requirements. Modest investments in research of this nature could pay handsome dividends in spacecraft manufacture and assembly costs.

The Bioscience Communications program meets the need for effective and timely communication between NASA program scientists and administrators, scientists in universities, industry, and other government agencies. This program provides support for the Space Science Board of the National Academy of Sciences, scientific training programs, research literature and reports, and conferences, symposia, and informal meetings in furtherance of timely communications in the bioscience disciplines.

Biosatellite

Biosatellite II was launched from the Eastern Test Range on September 7, 1967, and was recovered over the Pacific Ocean on September 9, 1967. The capsule was recovered one day earlier than planned because a severe storm was predicted for the recovery area the following day. Biosatellite II experiments investigated the effects of the space environment on simple forms of life, seedlings, and plants, especially with reference to the interaction of weightlessness with a known intensity of ionizing radiation.

Flights D and F, the two 30 day primate flights, which are scheduled for 1969, are the most demanding of all Biosatellite payloads in terms of instrumentation and life support. The principle areas of scientific investigation are: (1) the central nervous system, (2) the cardiovascular system, (3) general metabolism, and (4) performance and behavior.

The 21 day missions, flights C and E, are scheduled for 1970 and 1971, respectively. Two basic experiments will be performed on rats: (1) studies of changes in gross body composition as a result of weightlessness, and (2) a study of metabolic rhythms under conditions of weightlessness, compared with Earth controls, to test differences in rhythmicity of animals which have been removed from Earth's 24 hour periodicity. Other experiments include the influence of weightlessness on human liver cells and on plant development.

SCHEDULE OF LAUNCHES

Project	Mission	Calendar Year
Biosatellite	Biosatellite I	1966
	Biosatellite II	1967
	Biosatellites D and F (30 day)	1969
	Biosatellite C (21 day)	1970
	Biosatellite E (21 day)	1971

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1969 ESTIMATES

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS — SPACE APPLICATIONS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATIONS:

The objectives of the Space Applications Program are to: (1) expand the knowledge of atmospheric and space phenomena; (2) conduct a broad program of research and technical development oriented toward the application of space techniques for the benefit of mankind; (3) develop and test procedures, instruments, subsystems, spacecraft, and interpretive techniques for various applications; (4) fulfill NASA's responsibilities under the Communications Satellite Act of 1962; (5) develop and implement for the Environmental Science Services Administration (ESSA), Department of Commerce, the operational meteorological satellite system; and (6) cooperate with other government agencies in the study and development of space technology which will lead to the early realization of practical benefits in areas of agriculture/forestry, hydrology/oceanography, geography/cartography and geology/mineralogy through periodic systematic surveys of earth resources.

The Space Applications Program effort is directed toward research, development, and flight test in the areas of: applications technology, communications, earth resources, geodesy, meteorology, and navigation and includes implementation of operational systems with appropriate user agencies. Current flight projects include TIROS, Nimbus, Applications Technology, Geodetic Satellites, and a number of Meteorological Sounding Rockets. Fiscal year 1969 endeavors will also include initial studies of an Earth Resources Technology Satellite. Application Technology Satellites offer great potential to mankind by developing and extending the technology common to many applications. Communications Satellites provide an economical method for worldwide communication, and can be used to relay to ground stations data obtained by earth resources, meteorology, geodetic, and scientific spacecraft. Earth Resources satellites can obtain valuable data in such areas as agriculture/forestry, geology/mineralogy, hydrology/oceanography, and geography/cartography. Geodetic satellites can help determine the size and shape of the Earth and the vector properties of its gravitational field. Meteorological satellites provide the capability to improve weather prediction on a global basis, and increase our knowledge of the atmosphere. Navigation satellites provide location, traffic control, search and rescue, and communications systems for aircraft and ships.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1967	1968	1969
Supporting research and technology/ Advanced studies	$11,030	$19,300	$23,800
TIROS/TOS Improvements	1,292	9,100	5,800
Nimbus	24,410	33,700	32,100
Meteorological Soundings	2,855	3,000	3,000
International Applications Satellite	100	100	100
Applications Technology Satellites	30,013	25,600	31,200
Geodetic Satellites	1,600	3,400	4,000
Earth Resources Survey	---	5,300	12,200
Aircraft Program	(---)	(5,300)	(10,200)
Earth Resources Technology Satellite	(---)	(---)	(2,000)
Total	$71,300	$99,500	$112,200

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

The objectives of Supporting Research and Technology are to: (1) conduct studies; develop and test new concepts, techniques, materials, components, sensors, subsystems and data handling systems which have application to future satellite flight programs and (2) improve the space technology related to materials, components, sensors and subsystems to achieve greater reliability and longer life in space. These efforts are applied to the following disciplines: applications technology, communications, earth resources, geodesy, meteorology, and navigation. Selected advanced studies will be conducted in these disciplinary areas to determine feasibility, concepts, and design of future missions. Fiscal Year 1969 funds are required to maintain the current level of Supporting Research and Technology efforts in the six discipline areas, and to increase efforts by means of specialized studies, comparative analyses, and research activities in areas that have indicated special promise for early benefits. Also, in FY 1969, additional support will be provided to user agencies to determine the potential value of remote sensing technology in detecting, measuring and mapping earth resources phenomena from space and the related associated data handling systems.

TIROS/TOS Improvements

The objectives of this project are to: (1) conduct research and development leading to improvements in the operational meteorological satellite system, (2) observe cloud cover and patterns and measure the earth-atmosphere heat balance, (3) measure emitted infrared and reflected solar radiation in selected spectral regions and, (4) provide data for operational use in weather analysis and forecasting. Nine TIROS spacecraft, and seven TIROS Operational system (TOS) spacecraft, based on the TIROS configuration, have been launched. One additional spacecraft, designated TIROS M is currently being developed for launch in calendar year 1969. This spacecraft will carry two advanced vidicon camera systems (AVCS), two automatic picture transmission systems (APT) and two high resolution radiometers (HRR), in a single spacecraft. Data will be utilized by Goddard Space Flight Center, ESSA, and cooperating government and non-government meteorological organizations. FY 1969 funds are required to complete the TIROS M spacecraft and sensors; for integration, test and launch of the TIROS M spacecraft; and to continue the TOS improvement efforts.

Nimbus

The objectives of Nimbus are: (1) to develop an advanced meteorological satellite to provide data for use by the scientific community, (2) to carry out flight tests to prove the applicability of the instrumentation, (3) to fulfill special data requirements of the atmospheric sciences research community which can be provided uniquely by this instrumentation functioning as a space meteorological observatory, and (4) to provide the basis for further significant technological advances in meteorological satellites for scientific and operational uses. The project consists of six spacecraft of which two have been launched, Nimbus I, August 28, 1964, and Nimbus II, May 15, 1966. These launches have validated the Nimbus concept of testing a variety of advanced sensors on a stabilized earth oriented spacecraft. Nimbus B and D are currently under development for launch in 1968 and 1970, respectively, to test a variety of additional advanced meteorological experiments. Effort is being initiated in FY 1968 on development of Nimbus E and F scheduled for launch in 1971 and 1973, respectively, to test additional experiments and to further extend the technology advancements in meteorological satellites for scientific and operational purposes utilizing spacecraft of greater weight and power capability. Sensors to be flight tested include radiometers, spectrometers, cameras, and data handling systems to obtain a variety of atmospheric data such as cloud cover, temperatures, water vapor and pressure at various altitudes from the earth's surface to upper atmosphere levels.

FY 1969 funds are required to continue the development of Nimbus D, E and F spacecraft and experiments and continued data handling for missions in orbit.

Meteorological Soundings

The objectives of the meteorological soundings project are to: (1) determine the structure and characteristics of the atmosphere in the region 20 to 60 miles above the earth through the use of research and development type sounding rockets, and (2) develop a meteorological sounding rocket system amenable to research, range support, and supporting operational requirements. Three areas of effort are involved: (1) development and use of large sounding rockets to explore atmospheric characteristics in the region 30 to 60 miles above the Earth, (2) design and test small sounding rocket systems to obtain data from the region 20 to 40 miles above the Earth, and (3) participate in conducting sounding rocket experiments in cooperation with other countries on a cost sharing basis. FY 1969 funds are required to launch about 50 research sounding rockets to continue study of the relationship of the atmospheric structure in the arctic, sub-arctic mid-latitude, and the tropics during various seasons; for launch of about 150 operational development sounding rockets, conduct research to improve rocket performance, and the continuation and development of the field experiment projects with other cooperative countries.

International Applications Satellite

This project was entitled French Satellite in the FY 1968 budget. It is a cooperative meteorology experiment involving the use of free-floating balloons to obtain the velocity of air masses at various altitudes and an orbiting satellite to collect and relay data to ground stations. France will provide the balloons and spacecraft and furnish ground operational support; NASA will provide the launch vehicle and back-up if required, launch support services, technical assistance and will assist in data acquisition and analysis. FY 1969 funds will be required for continued spacecraft and balloon subsystem studies and analysis.

Applications Technology Satellites

The objectives of the applications technology satellites project are to design, develop, flight test, and evaluate a variety of experiments in the space applications disciplines by use of a series of spacecraft, most of which are launched into synchronous orbits. Seven spacecraft are in the series, of which three have been launched to date, one into medium altitude and two spin stabilized spacecraft into synchronous orbit. Four additional spacecraft are scheduled for launch in the 1968 - 73 period on Atlas Centaur launch vehicles. The launch of ATS-II into medium altitude was unsuccessful due to failure to obtain the circular orbit required. ATS-I and III have successfully demonstrated the feasibility of a variety of experiments at synchronous altitude such as black and white and color cloud cover pictures from synchronous altitude, very high frequency communication experiments with aircraft, and a number of environmental measurement experiments. ATS-D and E are scheduled for launch in 1968 and 1969,

respectively, and will test new and additional space applications experiments at synchronous altitude using gravity gradient stabilized spacecraft. ATS F and G are scheduled for launch in the 1972 - 73 period to flight test a 30 foot space erectable parabolic antenna; an accurate, lone-life stabilization system; precision radio-interferometer, and other applications and scientific experiments to be selected. FY 1969 funds are required to continue development of the three spacecraft (E through G), experiments, and ground operational support of the missions in orbit.

Geodetic Satellites

The objectives of this project are to conduct geodetic experiments from space on a global basis which in combination with astro-geodetic, surface baseline and gravity data from other sources will provide: (1) establishment of a unified world datum in a geocentric coordinate system to which the major world datums could be connected, (2) definition of the structure of the Earth's gravitational field, and (3) improvement in the positioning accuracy of tracking sites and locations of features of the Earth surface.

The geodetic-satellite project consists of 4 missions, including PAGEOS-I successfully launched June 23, 1966, GEOS I successfully launched November 6, 1965, GEOS B scheduled for launch early in 1968 and GEOS C scheduled for launch in 1969. Fabrication of the GEOS C spacecraft will draw heavily on hardware currently supporting the GEOS B mission.

GEOS B will contain flashing lights, minitrack beacon, doppler beacon transmitters, range and range rate, SECOR and C-band transponders, and optical reflectors for laser tracking. GEOS C will be launched at an inclination and altitude required to supply the data to complete a unified world datum, improve the location of the tracking stations, and for evaluating the several observational networks. FY 1969 funds are required for continued GEOS B and PAGEOS-I data acquisition and analysis and for GEOS C spacecraft development and operational support.

Earth Resources Survey

This project consists of two activities in the earth resources discipline, as follows: (1) an aircraft program to develop and test remote sensing techniques, sensors, and data handling systems, and (2) feasibility, definition, and design studies pertaining to an earth resources technology satellite.

The objectives of the aircraft program are to: (1) conduct feasibility studies and program definitions on testing of sensors and data collecting techniques for earth resources, (2) design, develop, and flight test these equipments, and (3) conduct aircraft flights over selected test sites to evaluate the performance of the sensing equipment and to obtain significant

data in the discipline areas of agriculture/forestry, geography/cartography, oceanography/hydrology, and geology/mineralogy. The objectives of the earth resources technology satellite (ERTS) effort are to conduct feasibility, definition, and design studies of a satellite containing a variety of sensors capable of obtaining fundamental experimental data in the earth resources disciplines. Analysis of these data would locate, identify, and assess many earth resource phenomena. In agriculture and forestry for example, crop growth area, forest area, brush range land interface, crop yield, and damage assessment data could be obtained by an ERTS. The Departments of Agriculture, Commerce, Interior and the U.S. Naval Oceanographic Office have participated in a cooperative program with NASA to identify uses and assess the value of space acquired data when applied as improvements to functions for which they have responsibility. Fiscal Year 1969 funds are required for instrumentation development for a high-altitude aircraft; operational support for two P3A and the high altitude aircraft; and for data acquisition, analysis, and utilization, in the aircraft program; and in earth resources technology satellite activity to conduct feasibility, definition, and design studies for a satellite system. These endeavors will be coordinated with user government agencies.

SCHEDULE OF LAUNCHES

Schedule of Significant Research and Development Events

Project	Mission	Calendar Year
Applications Technology Satellites	Launch of ATS-D	1968
	Launch of ATS-E	1969
	Launch of ATS-F	1972
	Launch of ATS-G	1973
International Applications Satellite	Launch of FR-2	1969
Geodetic Satellites	Launch of GEOS-B	1968
	Launch of GEOS-C	1969
Nimbus	Launch of Nimbus B	1968
	Launch of Nimbus D	1970
	Launch of Nimbus E	1972
	Launch of Nimbus F	1973
TIROS	Launch of TIROS M	1969

Project	Mission	Calendar Year
TOS*	Launch of TOS E through H, refurbished prototypes P1 and P2, and ITOS A-E	1968-71
INTELSAT**	Launch of INTELSAT II E	1968
	Launch of INTELSAT III A-C	1968-69

* Funded by ESSA.
** Funded by the Communications Satellite Corporation

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RESEARCH AND DEVELOPMENT

FISCAL YEAR 1969 ESTIMATES

SUMMARY

OFFICE OF UNIVERSITY AFFAIRS — SUSTAINING UNIVERSITY PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

NASA depends upon universities to supply research expertise and competence essential to the space effort, and the particular needs of the Agency. University scientists conceive and develop experiments contributing to new scientific knowledge; do research in areas directly related to manned and unmanned space science; serve on space advisory planning and evaluation groups; and train scientists, engineers and managers for the space program. By their participation, universities gain new knowlege and experience necessary to their own advancement and the advancement of non-space related technology. The nature of NASA's relationships with universities changes somewhat from time to time to meet changing needs, but regardless of the level or direction of the nation's space program, universities must be an essential part of it. Most of NASA support to universities is through the Agency program offices and centers which deal directly with university scientists and engineers in carrying out specific research and development projects. However, many needs fall outside the interest of these offices and must be met by the Sustaining University Program. These include sustaining research on subjects broader in scope than the responsibilities of any other NASA office, training of graduate students in disciplines which represent particular NASA needs, special training for senior faculty members in space research and engineering systems design.

SUMMARY OF RESOURCES REQUIREMENTS:

(Thousands of Dollars)

	1967	1968	1969
Training	$16,000	$3,000	$3,000
Research	11,000	7,000	7,000
Research facilities	4,000	---	---
Total	$31,000	$10,000	$10,000

BASIS OF FUND REQUIREMENTS:

Training

As the national space effort attains its mission objectives, training activities under NASA's Sustaining Unviersity Program are continuously reviewed and reassessed to insure compatibility with new conditions and tasks the Agency will encounter in ensuing years.

In FY 1969, $3 million is requested for training, $1.5 million of which will be allocated to predoctoral training in systems engineering design and public administration and the other $1.5 million to special summer training programs. The predoctoral training programs have been established so that senior faculty members and graduate students may use NASA installations in which to study problems which are relevant to NASA needs while helping to strengthen the graduate programs at their universities.

NASA's special training opportunities include a Summer Faculty Fellowship Program which helps young faculty members keep abreast of the latest developments in science and engineering; a faculty fellowship program in systems engineering design which brings together faculty members from different engineering disciplines to work on broad space related problems requiring a team approach; summer institutes for upper division undergraduates to familiarize them with space science and engineering problems; and post-M.D. training in aerospace medicine for a few very select medical doctors in preparation for direct or supporting careers in manned space flight activities.

Research

Through the research element of the Sustaining University Program, NASA is able to support high priority programs that are broader and longer range than mission oriented project research. Here a multidisciplinary approach to research is stressed and the participating universities have authority and flexibility to assess and meet Agency needs. Particular emphasis is placed on multidisciplinary studies in social, economic, and public policy aspects of scientific and technical developments and projects closely related to NASA center research. This program balances and complements NASA's project research and flight experiments.

With a budget of $7 million in FY 1969, the research element of the Sustaining University Program will support multidisciplinary programs at 35 universities. This number is down from the 44 institutions funded in FY 1968 and 50 universities in the program in FY 1967.

Research Facilities

Under a period of declining budget, NASA has established priorities for the elements of the Sustaining University Program, and no FY 1969 funds are requested for construction of university research laboratory facilities on university campuses.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1969 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — BASIC RESEARCH PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Basic Research Program supports fundamental research in the physical and mathematical sciences. It is aimed at providing an understanding of the physical phenomena pertinent to other NASA programs concerned with current and future aircraft and space activities. This basic research is carried out principally in NASA's Research and Flight Centers with some contract assistance by universities, industrial research laboratories, and other Government research centers. Fundamental understanding of physical phenomena in many fields of science is required to develop the technology for NASA's programs. Basic research in NASA, therefore, must encompass a wide spectrum of disciplines. It ranges from very fundamental studies into the nature and properties of atoms and molecules to the more applied research areas of determining the best materials for the supersonic transport airplane.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1967	1968	1969
Supporting research and technology	$21,401	$21,465	$22,000
Total	$21,401	$21,465	$22,000

BASIS OF FUND REQUIREMENTS:

The Basic Research Program is divided into four broad disciplines: Fluid Physics, Electrophysics, Materials, and Applied Mathematics.

Fluid physics research concentrates in the areas of aeronautical fluid dynamics, entry fluid physics and internal fluid mechanics of propulsion and power systems. Aeronautics research investigates such subjects as clear air turbulence, sonic boom and aerodynamic heating. Space research efforts focus on such studies as entry heating, ablative response of the heat shield and flow fields about maneuverable bodies.

Electrophysics research is concerned with obtaining new knowledge about the electrical characteristics of matter and their interaction with acoustic, gravitational, and magnetic forces present in molecules, atoms

and nuclei. New information in the electrophysics area is the source not only for advances in the technology programs of electronics, space power and space propulsion, but also for the investigation and understanding of complex space phenomena.

The objective of materials research is the understanding of the characteristics and behavior of materials when subjected to the environmental stresses and strains of advanced aircraft and more sophisticated spacecraft. Research ranges from studies into the fundamental properties of solids to investigations of how and why engineering materials fail.

The research in applied mathematics is concerned with the improvement of mathematical models and techniques needed or potentially useful for problems in aerospace science and technology. A mathematical approach is often the most feasible and economical one for planning experiments and predicting their results. It is also a necessary basis for precise and reliable designing of the complicated and expensive pieces of hardware for the varied NASA development programs.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1969 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY SPACE VEHICLE SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objectives of this program are to identify and solve technical problems important to the design and operation of spacecraft and launch vehicles. The program supports current missions of NASA and the military services and seeks to provide advanced technology for the conception and design of future space vehicles. The program encompasses problems of manned and unmanned flight including launch and exit through the atmosphere, flight in space, entry into the atmospheres of earth and other planets, and landing.

Research activities are conducted in a variety of ground-based facilities in aerothermodynamics, structures, and a number of space environmental areas such as high-energy radiation, meteoroids and thermal control. Key flight experiments are also conducted in close association with the ground-based research. The program also provides a centralized function within NASA for the formulation and documentation of authoritative space vehicle design criteria based on operational experience and the latest research information.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1967	1968	1969
Supporting research and technology.....	$26,777	$30,258	$31,300
Lifting-body program.....	1,000	1,200	1,200
Reentry heating flight experiments.....	1,800	2,206	1,500
Project Pegasus.....	70	---	---
Small space vehicle flight experiments.	4,262	1,336	1,300
Total.....	$33,909	$35,000	$35,300

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

Special emphasis will continue in FY 1969 to develop the technology of gliding flexible-wing descent systems for land recovery of manned vehicles. This effort will include flight tests of large-size flexible wings to investigate deployment, air loads, flight control and structural design. Research will also continue on aerodynamic performance, flight control, heat protection and structural problems of advanced entry vehicles having substantial reentry maneuverability.

Research in space vehicle structures will be undertaken to develop advanced structural concepts, to exploit new structural materials, and to advance structures technology for improved efficiency and cost effectiveness of space vehicles. Particular attention will be given to improved techniques of analysis and better ground test simulation of high-frequency dynamic conditions to reduce the necessity for overdesign and overtesting. Advanced structural analysis techniques are being developed for complex integrated space vehicles, including interactions on stages and subsystems. Research will continue on improved structural techniques for storing cryogenic fluids in space.

Efforts will continue on the effects of the space environment on vehicle design and operation. Research will continue on the effects of space radiation on spacecraft materials and components to advance the technology of shielding methods and design. Promising advances for simulating meteoroid impact will be pursued in FY 1969 to improve capability in the laboratory for investigating the meteoroid penetration hazard. Also, emphasis will be placed on new detection techniques for use in obtaining better flight data on the meteoroid hazard in the near-earth and asteroid regions of space. A broad attack on problems of thermal control of spacecraft will be continued in FY 1969.

In FY 1968, substantial progress was achieved in preparing authoritative space vehicle design criteria documents in areas of structures, chemical propulsion and guidance and control. Effort will be continued in these areas in FY 1969 and some initial activity will be undertaken in electromechanical mechanisms.

Lifting-Body Program

The flight program with manned research vehicles (currently two NASA types designated the M2-F2 and the HL-10) will continue to investigate the piloting and control problems of lifting-body configurations at transonic speeds and during terminal approach and landing. Flight testing was delayed in FY 1968 due to a landing accident with the M2-F2 (NASA lifting body) on its sixteenth flight, and due to modifications found necessary for the HL-10 (NASA lifting body). The FY 1969 funds are required to continue the HL-10 flight tests and to initiate tests of the USAF's X-24A which is a part of this cooperative program.

Reentry Heating Flight Experiments

Two reentry experiment payloads are being fabricated for launch with Scout vehicles to obtain anchor-point data on the heating rates associated with turbulent boundary layers on clean, nonablating surfaces at high Mach numbers and on the conditions related to transition from laminar to turbulent flow.

The first experiment will be flown in the first half of CY 1968. FY 1969 funds will provide for completion of the second payload and launching of the second experiment.

Preliminary definition of follow-on experiments with ablative heat shields to determine the effects of complex ablation processes on heat shield performance and body motions will be initiated during FY 1969.

Small Space Vehicle Flight Experiments

Selected flight experiments will be conducted using small sounding rockets and other techniques to provide critical data that cannot be acquired in ground-based facilities, as well as to provide anchor-point data in flight to verify laboratory theoretical and experimental research. The principal effort in FY 1967 and FY 1968 involved flight tests of large parachutes high in the earth's atmosphere to develop technology for deceleration of instrumented capsules in the low-density Mars atmosphere. Further tests will be conducted in FY 1969 to extend the Mach number range of investigation.

Small rocket-launched tests of advanced heat shield materials will also be continued in FY 1969 in close association with ground-based research.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1969 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — ELECTRONICS SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Electronics Systems program supports basic and applied research and advanced technical development efforts in the allied areas of electronics and control systems. Its objective is to provide the knowledge and technology needed to satisfy the requirements of future space and aeronautical systems in the most efficient and effective manner. Research activities are performed both in-house and under contract. They range from conceptual studies through the development and evaluation of new or improved components and systems in the functional areas of guidance, control, communications and tracking, data processing, instrumentation, and electronic components. Flight experiments are performed, as necessary, to collect data needed for advanced system developments and verify experimental results.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1967	1968	1969
Supporting research and technology	$32,302	$38,700	$38,900
Flight projects	1,295	500	500
Total	$33,597	$39,200	$39,400

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

Funds requested in FY 1969 are needed to support an expanding program in aeronautical electronics and to continue the development of electronic systems for future space missions. Guidance research requires increased effort on precision inertial components and electromagnetic sensors to meet the navigation needs of supersonic aircraft and guidance requirements of future space missions. Increased emphasis on flight controls and displays is necessary to effect safe and efficient operation of V/STOL and general aviation type aircraft. Long-life control systems and precise pointing techniques will require continuing support to insure effective use of our

capabilities to operate in the space environment. Expanded research on optical systems for space astronomy and deep space communications, together with a continuing effort on microwave antennas and tubes, is required to insure a maximum return of data and information from our space explorations. Advanced computer concepts and techniques for speeding the processing of data must receive continued support to provide efficient conversion of accumulated data into useable knowledge. Research in instrumentation technology offers potential solutions to problems of clear air turbulence and will be expanded in the coming fiscal year. Continued support of research on reliable components and advanced integrated circuit technology is necessary to make available to system designers techniques and components which satisfy the performance demands of tomorrow's systems.

Flight Projects

Project RAM (Radio-Attenuation-Measurements) is a research investigation concerned with overcoming the communication blackout incurred by a spacecraft as it reenters the atmosphere. RAM C-1 was successfully flown in October 1967 and demonstrated the partial effectiveness of higher frequencies and water injection. RAM C-B will be flown in calendar year 1968 to measure plasma characteristics at higher reentry speeds. Funds requested in FY 1969 will permit flight of a back-up payload to test the use of materials other than water for plasma injection.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1969 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY HUMAN FACTOR SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of the Human Factor Systems Program is to provide the research and technology to qualify and support man for advanced aeronautical and space missions. It is equally important to determine optimal procedures for man's utilization in space as an observer, as a mechanic, and as a decision maker.

Timely ground based research in human factors validated by critical flight experiments in air and space will provide confidence in the use of man in the future spectrum of missions. The technological tasks to be accomplished include assessment of the physiological and psychological effects on man, human engineering, extra-vehicular engineering, personal protection and life support. Understanding of the physiological effects on man as he responds to future aeronautical and space stresses is necessary for his effective integration with the total system. Human engineering is essential to human factors in aviation, maintainability in space, and for the appropriate design for man in the man-machine complex. Extra-vehicular engineering will provide the astronaut with work aids, translation devices, and other augmentation systems for use in free space as well as in extra-terrestrial surface environments.

The Human Factor Systems Program is accomplished through a multi-disciplined approach including research in medicine, biology, psychology, engineering, physics, and electronics located at NASA Centers, Department of Defense aero-space medical facilities, other government facilities, universities, and industry.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1967	1968	1969
Supporting research and technology.....	$14,765	$19,385	$20,200
Small biotechnology flight projects.....	1,500	1,600	1,500
Total.....	$16,265	$20,985	$21,700

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

This is an integrated program directed toward the accomplishment of the four major objectives of the overall Human Factor Systems Program. The program includes effort toward the definition and understanding of the effects of advanced aerospace flight on man brought about by altered and zero-gravity, spacecraft atmospheres, stress, radiation, and noise. Suitable and protective life support systems are developed and tested. The research involved covers cardiovascular stress and respiratory physiology, radiobiology, microbiology, water and waste management, oxygen regeneration, air pollution control, space suits, systems to sustain life, extravehicular equipment and studies of man-machine interactions. The research is directed toward defining and solving next-generation aerospace problems.

Small Biotechnology Flight Projects

These projects cover a continuing series of small flight experiments designed for the qualification of man, his support, and use in extended space flight. Work on experiments in FY 1969 will include the measurement of physiological processes in humans and animals under conditions of stress encountered in aerial and space flight and tests of life support and protective equipment designed for zero-gravity.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1969 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

SPACE POWER AND ELECTRIC PROPULSION SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of the Space Power and Electric Propulsion Systems Program is to determine the technologies required to adequately support potential future missions; and by application of effective research and exploratory development to improve or establish these technologies to the degree required to ensure eventual successful development and application by future mission program offices.

Current estimates of potential future mission power system requirements encompass a wide range of power, life and mission environments. No one power system can meet these varied requirements. The space power program is aimed at providing the research and technology necessary for the improvement and/or development of a limited number of solar, chemical and nuclear systems for anticipated auxiliary power and electric propulsion mission requirements ranging from watts to kilowatts in the 1970's to megawatts in the 1980's.

The early application of solar powered electric thrusters for spacecraft position control and for small, automated, interplanetary spacecraft continues to be a major goal of the electric propulsion program. The experience to date from the ATS (Applications Technology Satellite) flight program coupled with the design and ground evaluation of typical thruster systems confirms their potential advantages of spacecraft operational flexibility and simplicity, increased payload or decreased trip time or reduced spacecraft weight. The proposed SERT (Space Electric Rocket Test) flight, the continuing ATS program and the ground technology program are essential steps toward the goal of early application.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1967	1968	1969
Supporting Research and Technology	$34,940	$35,400	$35,800
Space Electric Rocket Test (SERT)	---	1,100	1,500
SNAP-8 Development	5,500	7,500	7,500
Total	$40,440	$44,000	$44,800

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

The objective of the nuclear electric power technology program is to provide a broad option and design basis for the selection and evaluation of energy conversion equipment to be used in advanced nuclear electric power systems for future space missions. The primary program emphasis continues to be on a limited number of energy conversion concepts, e.g., the Brayton, Rankine and thermionic systems, to meet the anticipated broad range of power requirements from watts and kilowatts in the 1970's **to megawatts** in the 1980's. The technology underlying these systems is long range and requires sustained effort to establish engineering data on new materials, working fluids and components at high temperatures never before used in power systems.

The chemical power system technology program is primarily concerned with increasing the usefulness of fuel cells and batteries for a wide range of applications ranging from low earth orbital satellites to planetary landers. Significant improvements such as metal-gas batteries and new engineering concepts for fuel cells appear feasible based on previous years' work. During FY 1969 emphasis will be directed toward evaluating these concepts in **breadboarded systems.**

The solar power system technology program continues to focus on solar cell systems with special attention directed toward the requirements emphasized by consideration of high power (kilowatt) systems. Research aimed at reducing system cost, area and weight, as well as improving resistance to the space environment, will be continued in FY 1969.

Continued progress is being made in the electric thruster technology program toward the goal of early mission application. In previous years emphasis in the primary propulsion program has been on obtaining suitable thruster system performance and endurance. In FY 1969 emphasis will be directed toward evaluating and solving the problems of solar powered electric propulsion systems representative of those that could be utilized to propel small, automated, interplanetary spacecraft. Based on results obtained in FY 1966, 1967 and 1968 the operational use of resistojets (electrically heated gas thrusters) for spacecraft position control is scheduled on the ATS D&E satellites which also will carry ion engine experiments. During FY 1969 the auxiliary propulsion program emphasis will be directed toward electrostatic thruster systems to achieve the benefits of high specific impulse and electrical thrust vectoring associated with this type of thruster and toward higher temperature resistojets for large orbiting satellites.

Space Electric Rocket Test (SERT)

The overall objective of the SERT flight program is to provide information on the operations of electric thruster systems in the space environment. SERT I successfully demonstrated that an ion beam could be neutralized in space. A second flight is planned for 1969 to provide a long term evaluation (minimum of six months) of the performance and reliability of an ion thruster system and to study the effects of ion engines on other spacecraft components such as radio frequency interference. SERT II represents the next major step in the development and acceptance of electric thrusters for prime propulsion of interplanetary spacecraft. Current plans are to utilize a THORAD-Agena vehicle for launch of SERT II during Calendar Year 1969.

SNAP 8 Development

The objective of this technology project is to conduct the ground development of a 10,000 hour, 35 kilowatt nuclear electric generating system suitable for space applications in the 1970's and beyond. Principal potential applications for SNAP 8 are large earth orbiting space stations, lunar exploration, direct TV broadcast satellites and utltimately, manned interplanetary missions.

In the past year priority has been placed on developing solutions to the major life-limiting problems found in the boiler and turbine from previous development testing and on endurance testing of the other major components of the power conversion system in small component loops. During this period the first SNAP-8 component, the lube/coolant pump, passed the 10,000 hour endurance test milestone.

The budget request for FY 1969 provides primarily for the continued life development of the power conversion system components toward the 10,000 hour mark in component loops. It is planned to complete a 2500 hour demonstration of the life capability of all major components in the bread-boarded SNAP-8 power conversion system.

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RESEARCH AND DEVELOPMENT

FISCAL YEAR 1969 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — NUCLEAR ROCKETS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of the Nuclear Rockets program is to provide rocket propulsion systems for application to high-energy, high-payload missions of the future. In carrying out this objective, the AEC-NASA Space Nuclear Propulsion Office is conducting a detailed system-analysis, design, development and test program to provide an approximately 75,000 pound thrust NERVA engine of between 800-850 seconds specific impulse for flight status by approximately FY 1976. This work is proceeding on the basis of data, designs, and experience established in the technology phase of the program.

The specific NERVA activities to be conducted in FY 1969 include the completion of the technology phase of the NERVA program and continuation at an increased level of the design, development, procurement, and component testing of the approximately 75,000 pound thrust NERVA engine initiated in FY 1968. Included in FY 1969 will be the establishment of the NERVA engine detailed requirements and configuration, and facility modifications as needed.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1967	1968	1969
Supporting research and technology	$16,506	$15,000	$15,000
NERVA	34,162	35,000	41,000
NRDS operations	2,332	4,000	4,000
Total	$53,000	$54,000	$60,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

The supporting research and technology effort supplies four basic needs: (1) general SRT data for current projects; (2) advancing basic technology for nuclear rocket engines and vehicles; (3) feasibility effort on advanced nuclear propulsion concepts; and (4) studies of special flight safety considerations of nuclear rockets.

NERVA

The prime output of the Nuclear Rockets program is the NERVA nuclear rocket engine. The nuclear rocket provides a major advance in space propulsion capability. This engine in a nuclear stage could increase the payload and enhance the efficiency and operational characteristics in a variety of potential missions. The NERVA-powered stage applied as a third stage of the Saturn V launch vehicle improves significantly its payload and mission versatility.

NRDS Operations

The mission of the Nuclear Rocket Development Station (NRDS) is to provide a site for ground static testing of the reactors, engines and eventually the propulsion modules or rocket stages associated with nuclear rocket development. These funds will continue to provide for NASA's share of the general site operations, the major part of which is funded by the AEC.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1969 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY CHEMICAL PROPULSION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The purpose of the Chemical Propulsion Program is to provide a firm base in science and technology for the improvement and future development of propulsion equipment using combustion or chemical reaction processes. Rockets using the combustion of an oxidizer and a fuel to expel high-velocity exhaust continue to be the principle means of propulsion for space missions. Their thrust levels vary from megapounds to micropounds, and their applications include launch vehicles, earth orbit and de-orbit systems, spacecraft systems for lunar and planetary orbit and landing, trajectory correction systems, attitude control systems, rendezvous engines, propellant settling thrusters, and personnel transport devices. Work within the program encompasses scientific investigation of poorly understood phenomena relating to rocket use, obtaining an adequate base of data on engineering problems such as heat transfer, thermodynamic properties, or kinetics of reactions, design refinement of components, integration of complete propulsion systems, and demonstration testing to prove the validity of extrapolations of the basic design data to useful hardware form. The research and technology efforts anticipate needs of the Nation's space program and establish a store of knowledge and experience from which future propulsion developments can proceed with confidence. The future development and production of high-reliability propulsion devices at low cost is a key objective of the work.

Research and technology programs covering both liquid propellant and solid propellant motors investigate chemical and physical properties of propellants, combustion phenomena, ignition, non-equilibrium and classical thermodynamic processes, development and application of new materials, processes of fluid mechanics, gas dynamics, heat transfer, and solid material behavior. New propulsion concepts and design methods are assessed with a view to the functions that our future space missions must perform. Future requirements and new problem areas are identified for further work.

The experimental engineering programs in liquid and solid propellant motors verify research design and data extrapolations by demonstration tests of breadboard systems approximating anticipated mission needs. Very often such tests disclose new problems that require continued research effort. The experience helps greatly in defining the appropriate design criteria, cycle selection, and operating conditions for such new equipment. The work involves the design, fabrication and test of experimental subcomponents and systems to determine their practicality. It provides a

sound basis for selection of advanced propulsion equipment. It furthermore provides a clear indication of design and test methods that will reduce the cost of development and production of these equipments. Fabrication process specifications, development procedures, costs, schedules, facility and special equipment requirements can be assessed as a result of such work.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1967	1968	1969
Supporting research and technology	$30,688	$33,750	$33,600
Large solid motor project	2,950	3,500	3,100
Total	$33,638	$37,250	$36,700

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

Advanced engine design concepts and operating conditions which will improve our capabilities to launch payloads at low cost and to transport payloads and maneuver in the solar space environment are being investigated. High performance liquid, solid, and hybrid propellants are being examined for use in lunar, solar, and planetary spacecraft systems. High performance propellants can be translated into greater payload capability or into carrying the necessary payload with a smaller launch and space vehicle system. The work extends the use of hydrogen fuel as a rocket propellant for space missions and is examining the use of high density mild cryogenic oxidizers and fuels for certain long-duration-in-space missions. A strong effort in simplified relatively low cost engine systems for launch vehicle systems will be continued.

Research on solid propellant motor systems includes nondestructive testing techniques for inspection and qualification of loaded motors, ignition, methods of combustion termination and restart, and improved predictability of propellant burning rate.

Large Solid Motor Project

Three test firings of the 260 inch diameter, 75 foot long large motor were successfully completed by FY 1967, with peak thrust of 5.9 million pounds produced in the last test. In FY 1968 and FY 1969, the funding in-

dicated for this project will be used to preserve a competitive position between liquid and solid stages in the event there is established a future space launch vehicle requirement that can benefit from such a competition.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1969 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY AERONAUTICAL VEHICLES PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The role of the Aeronautical Vehicles program is to provide through research in the disciplinary areas of aerodynamics, loads and structures, propulsion, operating environment and flight dynamics continued improvements in the safety, efficiency and utility of all classes of military and commercial aircraft. In order to supply the industry with advanced data for the design of new aircraft, to seek the technological advances needed to develop safer and superior commercial and military aircraft and to provide the leadership in the generation of advanced aircraft concepts, the Aeronautical Vehicles program is organized with emphasis on the disciplines in the Advanced Research and Technology Category and supporting research in appropriate disciplines and proof-of-concept activities for General Aviation, V/STOL, Subsonic, Supersonic and Hypersonic aircraft. Proof of concept activity is systems integration research whereby a full scale operating system is used to extend laboratory research on system elements. The programs in all these areas encompass work in materials, noise and sonic boom, operational aspects, propulsion system and airframe integration and the relationships which exist between the pilot and the total aircraft system as appropriate.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1967	1968	1969
Advanced research and technology	$ 3,730	$13,440	$16,080
General aviation aircraft technology supporting research	200	450	520
V/STOL aircraft technology supporting research	5,550	7,417	9,600
Subsonic aircraft technology supporting research	6,100	6,780	15,100
Supersonic aircraft technology supporting research	14,040	24,175	24,220
Hypersonic aircraft technology supporting research	6,280	14,538	11,380
Total	$35,900	$66,800	$76,900

BASIS OF FUND REQUIREMENTS:

Advanced Research and Technology

Much of the research in aircraft aerodynamics is configuration - dependent and therefore oriented toward a specific class of vehicles. It is therefore programmed under the appropriate Aircraft Technology Supporting Research area. Research of a more fundamental nature or applicable to several aircraft classes is carried out with aircraft aerodynamics funding. This research is a continuing effort on aircraft components and flow fields and associated boundary-layer phenomena throughout the aircraft and speed range. It involves the formulation and refinement of applicable theories and calculative methods, the improvement of wind-tunnel capabilities and other experimental techniques and the application of these tools to advanced aircraft technology.

The loads and structures program area is aimed at a broad spectrum of problems common to several or all types of aircraft since there is a common design goal of lightweight efficient airframes which will withstand the operating environment and reliability and safety. Gust and maneuver loads, acoustic response, wing and tail and panel flutter, fatigue, composite materials, thermal stresses are all specific problem areas in which research will be conducted.

The primary goals of the air-breathing propulsion program area are to initiate and conduct investigations of propulsion components and system concepts, either not readily identified with a specific flight spectrum or else identified over a broad flight spectrum. Basic studies are conducted on inlets, compressors, combustors, turbines, nozzles and materials to provide higher ratios of thrust-to-engine-weight, higher ratios of thrust-to-engine volume, and lower specific fuel consumption along with minimization of air pollution due to engine operation.

The research in the aircraft operating environment program area is aimed at solving general problems associated with flight environment, flight safety, noise, flight instrumentation and sonic boom. It involves theoretical analyses and laboratory and flight test experiments to validate current engineering procedures and to explore solutions to aircraft **operational problems. The results provide the technological know how for safer and** quieter aircraft operations and the basic environmental data for application to specific classes of aircraft (for example, V/STOL, Subsonic, etc.).

Research in the flight dynamics area is directed toward obtaining a better understanding of the interrelationship between the pilot and the vehicle he controls. This includes improving methods for aircraft control, handling characteristics and the improvement in the capability of ground and flight piloted simulators for handling qualities investigations of all classes of aircraft.

The Research Centers use various aircraft in direct support of advanced research and technology programs. The maintenance, spare parts and ground support equipment for these R&D support aircraft and chase and proficiency aircraft which are used for various missions are included in this funding category.

General Aviation Aircraft Technology Supporting Research

General aviation aircraft are rapidly assuming a position of increasing importance to the economy and are not restricted to the hobby type of flying but are a principal mode of transportation for individuals such as businessmen, doctors, etc., and also include expanding air taxi and charter services which even fly U.S. Mail. The principal factors of concern in general aviation are first safety and second utility. NASA has examined these problems with industry and with the FAA and agreement has been reached that most of the R&D effort should be directed at examining the flight dynamic characteristics best suited to the class of pilots who are becoming increasingly involved in this type of flying.

V/STOL Aircraft Technology Supporting Research

V/STOL aircraft have a great potential in an increasingly crowded and transportation dependent society. The problem is one of flight dynamics of the aircraft, of matching the machine and the pilot and in providing proper integration of propulsion systems which are for this class of vehicle also a primary means of control. To be successful, a V/STOL machine must convert its thrust-producing power into lift-producing power very efficiently; propulsion and aerodynamics must interact strongly and properly to achieve this. The NASA V/STOL supporting research program is therefore defined with these problems as a primary focus. Full-scale wind tunnel tests have been completed of a model aircraft using a full span rotating cylinder flap as an efficient means of providing the powered lift required for improving propeller driven STOL aircraft. The rotating cylinder flap concept will be tested by modification of an OV-10A aircraft being provided by the Navy.

Subsonic Aircraft Technology Supporting Research

Research on subsonic aircraft is oriented toward safety of flight, improvement of flight efficiency and the reduction of noise. In the disciplinary areas aerodynamics research required funding for new models, model changes, instrumentation for wind tunnel tests and the uprating of wind tunnel hardware. The research to be carried out will be aimed at studying the lift, drag and stability characteristics of aircraft configurations most suitable for improved subsonic/transonic operation. Loads and structures research will examine the specific application of fatigue, buffeting and aeroelastic studies to advanced commercial aircraft and the funding will cover the costs of models, instrumentation and structural/fatigue specimens. Propulsion research will include an increase in support

of long neglected areas for fuel, combustor and engine component efficiency studies to suppress the tendency of jet engines to smoke and requires the procurement of the necessary components and materials to support the in-house effort. The safe climbout and landing techniques for noise minimization, the refinement of flight instrumentation for more accurate measurement of airspeed at transonic speeds and the meteorological environment of particular concern to operations at high transonic speeds will be studied. Flight dynamics research will be concentrated on continuing studies of aircraft control for flight through turbulence and will include both simulator and flight tests.

As its part of the Inter-Agency Aircraft Noise Abatement Program, the NASA has the primary responsibility for the research and development leading to the reduction of aircraft noise at its source. This has involved NASA in proof-of-concept activities in aircraft noise and the quiet research engine. A fan-compressor noise minimization program was initiated in FY 1967, and in FY 1968 has involved wind tunnel testing and design and testing of boilerplate nacelle modifications. In FY 1969 the final nacelle configurations will be constructed for flight proof tests on a 707 type aircraft and on a DC-8 type aircraft.

In FY 1968 preliminary work will be conducted to define the scope and some of the hardware components of a quiet research engine. The second phase of this proof-of-concept, to be implemented in FY 1969, will include large scale engine component fabrication and full-scale tests of compressors and fans designed for minimum noise.

Supersonic Aircraft Technology Supporting Research

NASA's Aeronautical Vehicles program in supersonic aircraft technology supporting research is conditioned largely to meet the needs of two national activities associated with supersonic aircraft; the supersonic transport and the military supersonic aircraft such as the F-111, FX, VFAX, and AMSA. In general, the NASA program is designed either to study potential improvements not incorporated in original designs because of high technical risks, to study problem areas which might be expected to become critical in later stages of vehicle development or operation or to lay the groundwork well in advance for new state-of-the-art advances such as the SST or the F-111 have turned out to be. The program to support the supersonic transport contains three major elements; direct support of the FAA and its contractors, anticipation of future problem areas and the research directed at a "second generation" supersonic transport. The NASA program is designed to explore the areas of technology which carry the potential of significant performance but with advances involving technical uncertainties. The principal area of research is therefore propulsion. The supersonic aircraft supporting research program also contributes much to research in support of the military aircraft listed previously.

In FY 1969 measurements of the stability and control characteristics of the XB-70A and the evaluation of its handling qualities throughout the complete flight test envelope will be completed. Special tests will be performed to obtain additional information leading to an explanation of the major differences found between flight measured characteristics and those obtained by theoretical prediction and wind-tunnel techniques in FY 1968. Another area to be explored in FY 1969 is the ground effect on the aerodynamic forces and moments in the landing configuration when close to the ground. This has not been accomplished on an aircraft of this size before. An important structural problem which has been noted during the flight tests of the XB-70 is the relatively large response to turbulence. During FY 1969 a modal suppression system will be installed and flight tested to determine possible means of gust alleviation at supersonic speeds. As planned the flight tests of the modal suppression system will be completed by mid-Fiscal Year 1969.

With the completion of the handling qualities program and the gust alleviation research program the XB-70 flight research program will be completed. The funding requirement for the XB-70, which is the responsibility of the NASA in FY 1968 and in FY 1969 since the transfer of the aircraft to the NASA in March 1967, **will be for one-half year. The program is expected to be completed by January 1969.**

Hypersonic Aircraft Technology Supporting Research

The possibility of achieving sustained, efficient hypersonic flight has not been proven, yet systems analyses of such vehicles based upon best available theory shows it to be a potentially economically sound transport mode. Verification of the theories is required and the NASA research program is designed to provide information against which the adequacy of the theories can be judged. The program is directed first at examining the most fundamental first order assumptions in aerodynamics, propulsion and structures. Questions regarding the soundness of analyses in other disciplines are deferred until these primary answers have been obtained.

The various experiments currently being carried on the X-15 research aircraft will be completed by the end of FY 1968 or early in FY 1969 and it is not planned to operate the aircraft following the completion of these tests. Therefore no funding is required for the X-15 program in FY 1969.

The Hypersonic Research Engine proof-of-concept program was initiated in FY 1965 as the result of an obvious need for information relating to propulsion systems operating at hypersonic speed in a real environment. The Garrett Corporation is proceeding with the design and development and construction of one flight weight regeneratively cooled research engine. A boilerplate engine will be under test in FY 1969 at the **Ordnance Aerophysics** Laboratory in clean air up to **Mach 5. The regeneratively cooled engine** will be delivered to the Lewis Plum Brook Research Facility for research testing in FY 1970.

SUMMARY

OFFICE OF TRACKING AND DATA ACQUISITION — **TRACKING AND DATA ACQUISITION PROGRAM**

PROGRAM OBJECTIVES AND JUSTIFICATION:

The purpose of this program is to provide responsive and efficient tracking and data acquisition support to meet the requirements of all NASA flight projects. In addition, support is provided, as mutually agreed, for projects of the Department of Defense, other Government agencies, and other countries and international organizations engaged in space research endeavors.

Support is provided for manned and unmanned flights; for spacecraft, sounding rockets, and research aircraft; and for earth orbital and suborbital missions; lunar and planetary missions, and space probes.

Types of support provided include: (a) tracking to determine the position and trajectory of vehicles in space, (b) acquisition of data from scientific experiments and on the engineering performance of spacecraft and launch vehicle systems, (c) transmission of commands from ground stations to spacecraft, (d) communication with astronauts and acquisition of medical data on their physical condition, (e) communication of information between various ground facilities and mission control centers, and (f) processing of data acquired from the space vehicles. Such support is essential for the critical decisions which must be made to assure the success of all flight missions, and, in the case of manned missions, to insure the safety of the astronauts.

Tracking and data acquisition support is provided by a worldwide network of NASA ground stations supplemented by instrumentation ships, aircraft, and selected ground stations of the Department of Defense. These facilities are interconnected by a network of ground communications lines, undersea cables, high frequency radio links, and communication satellite circuits, which provide the capability for instantaneous transmission of data and critical commands between spacecraft and the control centers in the United States from which the flights are directed. Facilities also are provided to process into meaningful form the large amounts of data which are collected from flight projects. In addition, instrumentation facilities are provided for support of sounding rocket launchings and flight testing of research aircraft.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1967	1968	1969
Operations	$195,050	$213,600	$239,800
Equipment	62,000	49,450	52,200
Supporting research and technology	13,800	12,800	12,800
Total	$270,850	$275,850	$304,800

BASIS OF FUND REQUIREMENTS:

Operations

Funds are required for the operation and maintenance of the worldwide tracking and data acquisition facilities. Most of the increase in the FY 1969 operations program is related to the support requirements for the Apollo manned lunar landing program. All Manned Space Flight Network stations which were augmented for the Apollo Program, the Apollo instrumentation ships, and the Apollo/Range Instrumentation Aircraft will be fully operational during FY 1969. The currently planned mission workload will require a limited second shift of personnel at network stations in FY 1969. Communications services will increase to provide the required capacity for the heavier Apollo flight program.

Operations in support of the unmanned space flight programs will remain at approximately the same level as in the current year. A small increase in funding for Satellite Network operations is required in FY 1969 to provide for the operation of special Orbiting Astronomical Observatory ground equipment at selected stations and for additional personnel to operate the control center complex at the Goddard Space Flight Center. Completion of Lunar Orbiter and Surveyor program support will permit some reductions in funding for Deep Space Network operations in FY 1969.

The FY 1969 operations budget also includes an increase for funds required to reimburse the Air Force Eastern Test Range for downrange instrumentation services heretofore provided to NASA without charge. This charge is one part of the results of a study which was made by the Bureau of the Budget of the entire Air Force Eastern Test Range operation to determine an appropriate basis for NASA reimbursement to ETR for costs attributable to support of NASA's requirements.

Equipment

The tracking and data acquisition support requirements placed on the networks establish needs for equipments which are essential to provide the continual ongoing support to approved and planned programs. Funds for equipment are required to replace obsolete and wornout items, to modify existing systems to maintain compatibility with changes in spacecraft instrumentation, to increase the support utilization and efficiency of existing systems, and to complete or provide new systems required to support specific flight missions of approved and planned programs. In FY 1969, effort will be directed primarily toward sustaining the existing capability of the networks with only minor augmentations of equipment to meet the requirements of new programs.

Supporting Research and Technology

Supporting Research and Technology is the activity whereby concepts, techniques, and hardware are developed, tested, and evaluated for use in the networks to meet support requirements of new flight projects. In FY 1969, emphasis will be placed on network performance and operating techniques aimed at improved network effectiveness and lower operating costs.

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SUMMARY

OFFICE OF TECHNOLOGY UTILIZATION — TECHNOLOGY UTILIZATION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

This program provides for NASA a necessary follow-on to all government supported programs in line with the principle that techniques and methods discovered and/or developed with public support should be made available to the public expeditiously for their benefit. Those techniques and methods which are of direct benefit to the aeronautical and space communities almost automatically are put to use throughout that community. However, there are inevitably discoveries and developments in any line of research which are of potential benefit to users outside of the developing community. It is the purpose of the program to uncover such useful discoveries and provide a mechanism for making them known and available to the general public. In addition, this program provides a similar service in connection with management techniques for large, complex research and development activities by giving wide dissemination to new systems and concepts in this area.

The objectives of the NASA Technology Utilization Program are: (1) to increase the return on the national investment in aerospace research and development by encouraging additional uses of the knowledge gained in those programs; (2) to shorten the time gap between the discovery of new knowledge and its effective use in the marketplace; (3) to aid the movement of new knowledge across industry, disciplinary, and regional boundaries; (4) to contribute to the knowledge of better means of transferring technology from its points of origin to its points of potential use.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1967	1968	1969
Identification and publication.....	$1,265	$1,500	$1,600
Evaluation.....	650	700	800
Dissemination.....	2,085	1,600	1,400
Analysis.....	1,000	200	200
Total.....	$5,000	$4,000	$4,000

BASIS OF FUND REQUIREMENTS:

Identification and Publication

Technology Utilization Officers at NASA field installations and specialists from universities, research institutes and private industry search through selected areas of scientific and technical endeavor, and identify and document those inventions, innovations, improvements, and discoveries that have potential utility to the nonaerospace sector of the economy. Continued increased emphasis is placed on the identification and reporting of new technology by NASA contractors.

Evaluation

Personnel at NASA installations and research institutes evaluate the new technology so identified, determine its potential industrial utility and prepare reports which are published and made available to the scientific, industrial and academic communities.

Dissemination

This program element is accomplished by the employment of regional dissemination centers that store, retrieve and interpret, the new technology developed by NASA for local industry. Biomedical application teams are also employed to assist researchers in defining and solving medical problems by adaptation of NASA technology. Cooperative programs are underway with several other agencies such as the Bureau of Reclamation, Office of Law Enforcement Assistance, Social Rehabilitation Service of HEW, Small Business Administration, Atomic Energy Commission and others to disseminate applicable new technology developed by NASA.

Analysis

This program element is concerned with the goal of understanding new and improved techniques for managing complex research and development activities. Methods used in achieving this goal include support of research covering the organization and management of large research and development projects, and defining the various roles of the research director in both government and industry.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROPOSED APPROPRIATION BILL

CONSTRUCTION OF FACILITIES

For advance planning, design, and construction of facilities for the National Aeronautics and Space Administration, and for the acquisition or condemnation of real property, as authorized by law, [$35,900,000] *$45,000,000,* to remain available until expended. (*42 U.S.C. 2451, et seq., 50 U.S.C.* [*151–160*] *511–515; National Aeronautics and Space Administration Appropriation Act, 1968; additional authorizing legislation to be proposed.*)

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

CONSTRUCTION OF FACILITIES

Program and Financing (in thousands of dollars)

	Budget Plan			Costs to this appropriation		
	1967	1968	1969	1967	1968	1969
Program by activities:						
Direct program:						
1. Manned space flight	45,057	25,665	18,659	139,227	57,300	26,500
2. Scientific investigations in space	4,688	3,595	1,200	12,771	9,500	4,500
3. Space applications	.....	.....	.....	8	.....	.....
4. Space technology	8,590	2,115	386	24,309	26,800	9,700
5. Aircraft technology	21,010	3,170	.....	1,530	13,600	4,300
6. Supporting activities	7,066	3,255	24,755	71,279	18,800	14,300
Total direct program costs, funded	86,411	37,800	45,000	249,124	126,000	59,300
Reimbursable program:						
3. Space applications	.....	.....	.....	618	211	.....
Total program costs, funded	86,411	37,800	45,000	249,742	126,211	59,300
Change in selected resources[1]	.....	.....	.....	-133,745	-31,111	-14,300
10 Total	86,411	37,800	45,000	115,997	95,100	45,000

CONSTRUCTION OF FACILITIES

Program and Financing (in thousands of dollars) - Continued

	Budget Plan			Costs to this appropriation		
	1967	1968	1969	1967	1968	1969
10 Total	86,411	37,800	45,000	115,997	95,100	45,000
Financing:						
11 Receipts and reimbursements from: Federal funds	.....	.....	.....	718	.....	.....
21 Unobligated balance available, start of year, for completion of prior year budget plans	.....	.....	.....	-128,103	-95,386	-38,686
22 Unobligated balance transferred from other accounts	.....	.....	.....	.....	-600	.....
23 Unobligated balance transferred to other accounts	.....	.....	.....	1,002	.....	.....
Reprogramming from prior year budget plans	-1,411	.....	.....	.....	.....	.....
24 Unobligated balance available, end of year, for completion of prior year budget plans	.....	.....	.....	95,386	38,686	38,686
New obligational authority	85,000	37,800	45,000	85,000	37,800	45,000
New obligational authority:						
40 Appropriation	83,000	35,900	45,000	83,000	35,900	45,000
42 Transferred from other accounts	2,000	1,900	.....	2,000	1,900	.....
43 Appropriation (adjusted)	85,000	37,800	45,000	85,000	37,800	45,000

CONSTRUCTION OF FACILITIES

Program and Financing (in thousands of dollars) - Continued

		Budget Plan			Costs to this appropriation		
		1967	1968	1969	1967	1968	1969
	Relation of obligations to expenditures:						
10	Total obligations				115,997	95,100	45,000
70	Receipts and other offsets (items 11-17)				718	.....	.....
71	Obligations affecting expenditures				116,715	95,100	45,000
72	Obligated balance, start of year				316,977	145,043	80,143
74	Obligated balance, end of year				-145,043	-80,143	-49,643
90	Expenditures				288,648	160,000	75,500
	Expenditures are distributed as follows:						
01	Out of current authorizations				16,070	15,000	4,500
02	Out of prior authorizations				272,578	145,000	71,000

		1967 actual	1968 estimate	1969 estimate
	Note.--Reconciliation of budget plan to obligations:			
	Total budget plan	86,411	37,800	45,000
	Deduct portion of budget plan to be obligated in subsequent years	36,370	11,800	19,400
	Add obligations of prior year budget plans	65,956	69,100	19,400
	Total obligations	115,997	95,100	45,000

	[1]Selected resources as of June 30 are as follows:	1966	1967	1968	1969
	Unpaid undelivered orders	215,702	82,061	50,950	36,650
	Advances	105	1	1	1
	Total selected resources	215,807	82,062	50,951	36,651

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

SUMMARY OF CONSTRUCTION OF FACILITIES BUDGET PLAN BY LOCATION

Location	(Thousands of dollars) Fiscal Year 1967	Fiscal Year 1968	Fiscal Year 1969
Ames Research Center	---	$3,170	$386
Electronics Research Center	$7,500	---	---
Goddard Space Flight Center	710	565	---
Jet Propulsion Laboratory	350	1,900	---
John F. Kennedy Space Center, NASA.	35,370	26,035	13,909
Langley Research Center	6,100	---	---
Lewis Research Center	16,000	2,115	---
Manned Spacecraft Center	10,200	750	3,100
Marshall Space Flight Center	---	745	---
Michoud Assembly Facility	700	425	400
Wallops Station	205	740	500
Various Locations	3,910	---	23,705
Facility Planning and Design	5,366	1,355	3,000
Total	$86,411	$37,800	$45,000

The geographic location of NASA installations is shown on the map under the General Statement tab. Installations for which construction projects are requested in the fiscal year 1969 budget are identified thereon.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 69 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION	COGNIZANT PROGRAM OFFICE FOR INSTALLATION	
Ames Research Center	Advanced Research and Technology	
LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Moffett Field, California	Santa Clara	Mountain View, California

INSTALLATION MISSION

Laboratory research in aerodynamics, thermodynamics, materials, structures, guidance and control, space sciences, environmental biology, life detection, life synthesis, human factors, and fundamental physics and chemistry; project management of unmanned space flight projects (scientific probes and satellites); development of scientific experiment payloads for space flight projects managed at Ames and elsewhere.

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 19 59 THRU CURRENT YR	FY 19 69 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Water Supply and Distribution System	ART	18	386		404
ALL OTHER PROJECTS		53,862			
TOTALS		53,880	386		

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1969 BUDGET ESTIMATES

(Dollars in thousands)

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

INSTALLATION MISSION

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

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YR	FY 1969 (Estimated)	FUTURE YEARS (Estimated)	TOTAL ALL YEARS (Estimated)
Launch Complexes 34 and 37	MSF	106,846	1,800		108,646
Launch Complex 39	MSF	488,679	5,328		494,007
Utility Installations	MSF	65,076	2,521		67,597
Land Acquisition	MSF	73,413	3,560		76,973
Alteration to Launch Complex 17	SSA	6,999	700	500	8,199
ALL OTHER PROJECTS		163,836			
TOTALS		904,849	13,909		

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 69 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION		COGNIZANT PROGRAM OFFICE FOR INSTALLATION
Manned Spacecraft Center		Manned Space Flight
LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Houston, Texas	Harris	Houston, Texas

INSTALLATION MISSION

The Manned Spacecraft Center has as its primary mission the development of spacecraft for manned space flight programs. The Center is also responsible for manned space flight operations, conduct of astronaut training, and the earth resources program.

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 19 59 THRU CURRENT YR	FY 19 69 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Modifications to the Environmental Testing Laboratory	MSF	48,229	1,500		49,729
Addition to the Flight Crew Training Facility	MSF	1,235	1,600		2,835
ALL OTHER PROJECTS		44,057			
TOTALS		93,521	3,100		

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 69 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION		COGNIZANT PROGRAM OFFICE FOR INSTALLATION
Michoud Assembly Facility		Manned Space Flight
LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
New Orleans, Louisiana	Orleans Parish	New Orleans, Louisiana

INSTALLATION MISSION

The mission of the Michoud Assembly Facility is the manufacturing of the first stage booster of the Saturn family of launch vehicles.

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YR	FY 1969 (Estimated)	FUTURE YEARS (Estimated)	TOTAL ALL YEARS (Estimated)
Rehabilitation, Alterations and Improvements	MSF	23,887	400		24,287
ALL OTHER PROJECTS		20,120			
TOTALS		44,007	400		

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 69 BUDGET ESTIMATES

(Dollars in thousands)

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

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, acquire and record the data sought. These data are processed and reduced to meaningful form and analyzed.

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 19 59 THRU CURRENT YR	FY 19 69 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Beach Erosion Protection	ØSSA	25	500	-0-	525
ALL OTHER PROJECTS		37,819			
TOTALS		37,844	500		

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 69 BUDGET ESTIMATES

(Dollars in thousands)

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

INSTALLATION MISSION

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 19 59 THRU CURRENT YR	FY 19 69 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Repairs, Rehabilitation & Improvements at Various Locations	**MSF**	80	1,600		1,680
Air Pollution Control Facility	**MSF**	19	350		369
Deep Space Antenna (210 foot) Facilities	**TDA**	540	17,000	17,000	34,540
Phased Array Antenna System	**TDA**	60	2,880		2,940
Power Plant Replacement STADAN Facility-Fairbanks, Alaska	**TDA**	135	1,875		2,010
ALL OTHER PROJECTS		643,905			
TOTALS		644,739	23,705		

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INSTALLATION SUMMARY

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 69 BUDGET ESTIMATES

(Dollars in thousands)

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

INSTALLATION MISSION

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 19 59 THRU CURRENT YR	FY 19 69 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Facility Planning and Design	AD	52,865	3,000		Not Applicable
ALL OTHER PROJECTS		---			
TOTALS		52,865	3,000		

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROPOSED APPROPRIATION BILL

ADMINISTRATIVE OPERATIONS

For necessary expenses of operation of the National Aeronautics and Space Administration, not otherwise provided for, including uniforms or allowances therefor, as authorized by law (5 U.S.C. 5901[; 80 Stat. 299]-*590*%); minor construction; supplies, materials, services, and equipment; awards; [purchase of not to exceed three and] hire, maintenance and *operation* of administrative aircraft; purchase *(not to exceed ten for replacement only)* and hire of [motor vehicles (including purchase of not to exceed twenty-three] passenger *motor* vehicles [, for replacement only]; and maintenance, repair, and alteration of real and personal property; [$628,000,000] *$648,-200,000: Provided*, That contracts may be entered into under this appropriation for maintenance and operation of facilities, and for other services, to be provided during the next fiscal year. (*42 U.S.C. 2451, et seq.; 50 U.S.C.*[*151-160*]*511-515; National Aeronautics and Space Administration Appropriation Act, 1968; additional authorizing legislation to be proposed.*)

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

ADMINISTRATIVE OPERATIONS

Program and Financing (in thousands of dollars)

	Budget Plan			Costs to this appropriation		
	1967	1968	1969	1967	1968	1969
Program by activities:						
Direct program:						
1. Manned space flight.....	324,459	323,743	322,753	323,019	324,825	323,752
2. Scientific investigations in space.....	78,412	71,577	72,808	78,066	71,813	73,029
3. Space applications.....	18,719	19,966	20,395	18,637	20,029	20,458
4. Space technology.....	143,609	139,863	144,435	142,970	140,328	144,882
5. Aircraft technology.....	48,466	52,711	54,535	48,251	52,885	54,704
6. Supporting activities....	32,920	32,513	33,274	32,774	32,620	33,375
Total direct program costs, funded.....	646,585	640,373	648,200	643,717	642,500	650,200
Reimbursable program:						
1. Manned space flight.....	559	1,281	1,368	620	1,291	1,368
3. Space applications.....	748	640	594	630	782	594
4. Space technology.....	730	895	895	707	929	895
Total reimbursable program costs.....	2,037	2,816	2,857	1,957	3,002	2,857

ADMINISTRATIVE OPERATIONS

Program and Financing (in thousands of dollars) - Continued

		Budget Plan			Costs to this appropriation		
		1967	1968	1969	1967	1968	1969
	Total program costs, funded	648,621	643,189	651,057	645,674	645,502	653,057
	Change in selected resources[1]	.....	.....	.....	2,947	-2,313	-2,000
10	Total	648,621	643,189	651,057	648,621	643,189	651,057
	Financing:						
	Receipts and reimbursements from:						
11	Federal funds	.....	.....	.....	-1,808	-2,541	-2,578
14	Non-Federal sources[2]	.....	.....	.....	-229	-275	-279
25	Unobligated balance lapsing.	.....	.....	.....	898	.....	.....
	New obligational authority	.....	.....	.....	647,483	640,373	648,200
	New obligational authority:						
40	Appropriation				640,000	628,000	648,200
41	Transferred to other accounts				-417	-127	.....
42	Transferred from other accounts				7,900	12,500	.....
43	Appropriation (adjusted)				647,483	640,373	648,200

ADMINISTRATIVE OPERATIONS

Program and Financing (in thousands of dollars) - Continued

	Budget Plan			Costs to this appropriation		
	1967	1968	1969	1967	1968	1969
Relation of obligations to expenditures:						
10 Total obligations				648,621	643,189	651,057
70 Receipts and other offsets (items 11-17)				-2,037	-2,816	-2,857
71 Obligations affecting expenditures				646,585	640,373	648,200
72 Obligated balance, start of year				106,465	101,291	101,164
74 Obligated balance, end of year				-101,291	-101,164	-101,164
77 Adjustments in expired accounts				-1,906	.....	.....
90 Expenditures				649,852	640,500	648,200
Expenditures are distributed as follows:						
01 Out of current authorizations				570,498	539,209	547,036
02 Out of prior authorizations				79,354	101,291	101,164

[1]Selected resources as of June 30 are as follows:	1966	1967 adjustment	1967	1968	1969
Unpaid undelivered orders	53,285	-2,031	54,265	51,951	49,951
Advances	220	.....	157	157	157
Total selected resources	53,505	-2,031	54,421	52,108	50,108

[2]Reimbursements from non-Federal sources are receipts for services performed on Communications Satellite Corporation projects (42 U.S.C. 2473) and for personal property sold for replacement purposes (40 U.S.C. 481).

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

ADMINISTRATIVE OPERATIONS

SUMMARY OF OBLIGATIONS BY INSTALLATION
(In thousands of dollars)

	Fiscal Year 1967	Fiscal Year 1968	Fiscal Year 1969
MANNED SPACE FLIGHT	$317,102	$312,957	$312,984
John F. Kennedy Space Center, NASA	$92,742	$93,831	$97,710
Manned Spacecraft Center	95,659	95,908	97,096
Marshall Space Flight Center	128,701	123,218	118,178
SPACE SCIENCE AND APPLICATIONS	80,798	77,392	79,502
Goddard Space Flight Center	71,069	68,525	70,594
Wallops Station	9,729	8,867	8,908
ADVANCED RESEARCH AND TECHNOLOGY	188,128	188,882	195,108
Ames Research Center	33,824	33,563	33,975
Electronics Research Center	12,219	15,467	19,079
Flight Research Center	9,488	9,439	9,728
Langley Research Center	64,337	62,095	62,765
Lewis Research Center	66,280	66,220	67,352
Space Nuclear Propulsion Office	1,980	2,098	2,209
SUPPORTING OPERATIONS			
NASA Headquarters	60,557	61,142	60,606
TOTAL	$646,585	$640,373	$648,200

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

ADMINISTRATIVE OPERATIONS

DISTRIBUTION OF OBLIGATIONS BY FUNCTION
BY INSTALLATION

(Thousands of dollars)

FUNCTION	TOTAL NASA	SUBTOTAL OMSF	J. F. KENNEDY SPACE CENTER, NASA	MANNED SPACECRAFT CENTER	MARSHALL SPACE FLIGHT CENTER	SUBTOTAL OSSA	GODDARD SPACE FLIGHT CENTER	WALLOPS STATION	SUBTOTAL OART	AMES RESEARCH CENTER	ELECTRONICS RESEARCH CENTER	FLIGHT RESEARCH CENTER	LANGLEY RESEARCH CENTER	LEWIS RESEARCH CENTER	SPACE NUCLEAR PROPULSION OFFICE	NASA HEADQUARTERS
Personnel																
FY 1967	$413,957	$183,031	$33,108	$59,664	$90,259	$52,242	$47,089	$5,153	$142,807	$25,923	$7,407	$7,098	$46,865	$53,823	$1,691	$35,877
FY 1968	436,075	192,539	37,683	63,672	91,184	55,289	49,988	5,301	149,922	26,943	10,126	7,205	48,726	55,029	1,893	38,325
FY 1969	442,502	192,680	39,979	64,747	87,954	57,854	52,508	5,346	154,684	27,372	12,428	7,368	49,246	56,327	1,943	37,284
Travel																
FY 1967	17,953	8,398	867	4,433	3,098	2,766	2,630	136	4,141	841	310	197	1,542	1,058	193	2,648
FY 1968	16,491	7,857	819	4,093	2,945	2,310	2,183	127	3,815	793	440	211	1,188	988	195	2,509
FY 1969	16,530	7,857	819	4,093	2,945	2,310	2,183	127	3,860	793	485	211	1,188	988	195	2,503
Automatic Data Processing																
FY 1967	36,919	18,352	1,302	6,430	10,620	7,375	7,284	91	9,999	1,819	1,031	103	6,557	463	26	1,193
FY 1968	31,506	17,529	1,200	6,843	9,486	5,972	5,897	75	6,676	1,544	1,273	51	3,515	293	---	1,329
FY 1969	31,487	17,257	1,320	,843	9,094	5,991	5,916	75	6,825	1,544	1,366	51	3,515	349	---	1,414
Facilities Services																
FY 1967	106,209	71,867	47,801	12,647	11,419	11,252	8,110	3,142	22,118	3,932	1,971	1,161	6,452	8,602	---	972
FY 1968	92,635	63,562	43,403	10,861	9,298	7,944	5,634	2,310	20,363	3,191	2,007	1,162	6,077	7,926	---	766
FY 1969	94,928	65,093	45,305	11,047	8,741	7,777	5,432	2,345	21,376	3,174	2,943	1,268	6,247	7,744	---	682
Technical Services																
FY 1967	23,689	5,694	---	1,256	4,438	1,455	1,365	90	2,080	205	554	80	310	865	66	14,460
FY 1968	18,790	3,498	---	834	2,664	839	746	93	1,853	70	704	88	310	671	10	12,600
FY 1969	18,785	3,200	---	834	2,366	825	736	89	1,840	70	636	83	310	670	71	12,920
Administrative Support																
FY 1967	47,858	29,760	9,664	11,229	8,867	5,708	4,591	1,117	6,983	1,104	946	849	2,611	1,469	4	5,407
FY 1968	44,876	27,972	10,726	9,605	7,641	5,038	4,077	961	6,253	1,022	917	722	2,279	1,313	---	5,613
FY 1969	43,968	26,897	10,287	9,532	7,078	4,745	3,819	926	6,523	1,022	1,221	747	2,259	1,274	---	5,803
Total																
FY 1967	646,585	317,102	92,742	95,659	128,701	80,798	71,069	9,729	188,128	33,824	12,219	9,488	64,337	66,280	1,980	60,557
FY 1968	640,373	312,957	93,831	95,908	123,218	77,392	68,525	8,867	188,882	33,563	15,467	9,439	62,095	66,220	2,098	61,142
FY 1969	648,200	312,984	97,710	97,096	118,178	79,502	70,594	8,908	195,108	33,975	19,079	9,728	62,765	67,352	2,209	60,606

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

ADMINISTRATIVE OPERATIONS

DISTRIBUTION OF OBLIGATIONS BY OBJECT CLASSIFICATION
BY FUNCTION

(Thousands of Dollars)

Object Classification	Total NASA	Personnel	Travel	Automatic Data Processing	Facilities Services	Technical Services	Administrative Support
FISCAL YEAR 1967							
Personnel compensation	$381,148	$381,148	---	---	---	---	---
Personnel benefits	28,744	28,744	---	---	---	---	---
Benefits for former personnel	49	49	---	---	---	---	---
Travel & transp. of persons	19,517	262	$17,953	---	---	---	$1,30
Transportation of things	4,819	771	---	---	---	$166	3,88
Rents, communications, and utilities	47,701	---	---	$17,927	$17,315	---	12,45
Printing and reproduction	6,458	---	---	---	---	899	5,55
Other services	107,010	2,383	---	13,493	62,680	18,338	10,11
Services of other agencies	11,330	600	---	79	6,291	2,360	2,00
Supplies and materials	20,719	---	---	---	10,057	419	10,24
Equipment	13,219	---	---	5,420	4,061	1,507	2,23
Lands and structures	5,805	---	---	---	5,805	---	---
Grants, subsidies & contributions	12	---	---	---	---	---	1
Insurance claims and indemnities	54	---	---	---	---	---	54
Totals	$646,585	$413,957	$17,953	$36,919	$106,209	$23,689	$47,85
FISCAL YEAR 1968							
Personnel compensation	$400,419	$400,419	---	---	---	---	---
Personnel benefits	30,777	30,777	---	---	---	---	---
Benefits for former personnel	1,137	1,137	---	---	---	---	---
Travel & transp. of persons	18,120	284	$16,491	---	---	---	$1,34
Transportation of things	4,683	753	---	---	---	$147	3,78
Rents, communications, and utilities	51,637	---	---	$19,630	$18,111	---	13,89
Printing and reproduction	6,036	---	---	---	---	769	5,26
Other services	94,481	2,085	---	11,827	55,839	15,204	9,52
Services of other agencies	9,514	620	---	16	5,956	1,351	1,57
Supplies and materials	17,004	---	---	---	8,502	418	8,08
Equipment	4,842	---	---	33	2,565	901	1,34
Lands and structures	1,662	---	---	---	1,662	---	---
Grants, subsidies & contributions	22	---	---	---	---	---	22
Insurance claims and indemnities	39	---	---	---	---	---	39
Totals	$640,373	$436,075	$16,491	$31,506	$92,635	$18,790	$44,87
FISCAL YEAR 1969							
Personnel compensation	$407,328	$407,328	---	---	---	---	---
Personnel benefits	31,247	31,247	---	---	---	---	---
Benefits for former personnel	100	100	---	---	---	---	---
Travel & transp. of persons	18,169	294	$16,530	---	---	---	$1,34
Transportation of things	4,545	788	---	---	---	$143	3,61
Rents, communications, and utilities	53,457	---	---	$20,314	$19,181	---	13,96
Printing and reproduction	6,031	---	---	---	---	761	5,27
Other services	95,528	2,125	---	11,132	57,678	15,204	9,38
Services of other agencies	9,494	620	---	16	5,963	1,331	1,56
Supplies and materials	16,244	---	---	---	8,150	442	7,65
Equipment	4,544	---	---	25	2,498	904	1,11
Lands and structures	1,458	---	---	---	1,458	---	---
Grants, subsidies & contributions	22	---	---	---	---	---	22
Insurance claims and indemnities	33	---	---	---	---	---	33
Totals	$648,200	$442,502	$16,530	$31,487	$94,928	$18,785	$43,96

NATIONAL AERONAUTICS AND SPACE ADMINIST

FISCAL YEAR 1969 ESTIMATES

ADMINISTRATIVE OPERATIONS

DISTRIBUTION OF OBLIGATIONS BY OBJECT CLASS
BY INSTALLATION

(Thousands of dollars)

Object Classification	Total NASA	Subtotal OMSF	J. F. Kennedy Space Center, NASA	Manned Spacecraft Center	Marshall Space Flight Center	Subtotal OSSA	Goddard Space Flight Center	Wallop Statio
FISCAL YEAR 1967								
Personnel compensation	381,148	168,842	30,521	55,008	83,313	48,169	43,503	4,66
Personnel benefits	28,744	12,568	2,273	4,043	6,252	3,542	3,193	34
Benefits for former personnel	49	1	---	1	---	---	---	--
Travel & transportation of persons	19,517	9,774	1,843	4,695	3,236	2,870	2,668	20
Transportation of things	4,819	2,168	1,436	585	147	1,502	1,379	12
Rents, communications, and utilities	47,701	23,967	7,392	8,429	8,146	8,030	7,604	42
Printing and reproduction	6,458	4,051	2,558	629	864	377	360	1
Other services	107,010	70,823	35,450	16,658	18,715	8,969	7,657	1,31
Services of other agencies	11,330	7,771	4,581	688	2,502	417	339	7
Supplies and materials	20,719	11,262	4,339	2,827	4,096	2,978	1,686	1,29
Equipment	13,219	3,050	1,197	1,128	725	1,635	1,066	56
Lands and structures	5,805	2,797	1,130	963	704	2,304	1,609	69
Grants, subsidies & contributions	12	---	---	---	---	---	---	--
Insurance claims and indemnities	54	28	22	5	1	5	5	--
Totals	646,585	317,102	92,742	95,659	128,701	80,798	71,069	9,7
FISCAL YEAR 1968								
Personnel compensation	400,419	176,578	34,506	58,694	83,378	51,113	46,273	4,8
Personnel benefits	30,777	13,603	2,816	4,376	6,411	3,731	3,368	3
Benefits for former personnel	1,137	855	---	60	795	---	---	-
Travel & transportation of persons	18,120	9,267	1,839	4,345	3,083	2,424	2,218	2
Transportation of things	4,683	2,193	1,529	506	158	1,446	1,316	1
Rents, communications, and utilities	51,637	25,298	8,089	9,022	8,187	8,806	8,344	4
Printing and reproduction	6,036	3,952	2,677	450	825	160	145	
Other services	94,481	62,688	31,954	15,192	15,542	6,185	4,899	1,2
Services of other agencies	9,514	7,094	4,364	678	2,052	193	120	
Supplies and materials	17,004	9,086	4,639	2,129	2,318	2,331	1,269	1,0
Equipment	4,842	1,713	1,057	354	302	550	220	
Lands and structures	1,662	612	346	100	166	450	350	
Grants, subsidies & contributions	22	---	---	---	---	---	---	
Insurance claims and indemnities	39	18	15	2	1	3	3	
Totals	640,373	312,957	93,831	95,908	123,218	77,392	68,525	8,8
FISCAL YEAR 1969								
Personnel compensation	407,328	177,609	36,741	59,756	81,112	53,508	48,626	4,
Personnel benefits	31,247	13,576	2,885	4,449	6,242	3,919	3,553	
Benefits for former personnel	100	---	---	---	---	---	---	
Travel & transportation of persons	18,169	9,267	1,839	4,345	3,083	2,424	2,218	
Transportation of things	4,545	2,193	1,529	506	158	1,252	1,122	
Rents, communications, and utilities	53,457	25,536	8,125	9,224	8,187	9,269	8,817	
Printing and reproduction	6,031	3,943	2,668	450	825	160	145	
Other services	95,528	63,614	33,993	15,103	14,518	5,647	4,375	1,

ERONAUTICS AND SPACE ADMINISTRATION

ISCAL YEAR 1969 ESTIMATES

ADMINISTRATIVE OPERATIONS

F OBLIGATIONS BY OBJECT CLASSIFICATION
BY INSTALLATION

(Thousands of dollars)

Subtotal OSSA	Goddard Space Flight Center	Wallops Station	Subtotal OART	Ames Research Center	Electronics Research Center	Flight Research Center	Langley Research Center	Lewis Research Center	Space Nuclear Propulsion Office	HDQTRS.
48,169	43,503	4,666	131,989	23,952	6,716	6,551	43,351	49,900	1,519	32,148
3,542	3,193	349	9,996	1,833	510	480	3,267	3,738	168	2,638
---	---	---	20	---	---	---	---	20	---	28
2,870	2,668	202	4,200	864	328	200	1,550	1,065	193	2,673
1,502	1,379	123	854	57	83	23	468	220	3	295
8,030	7,604	426	13,331	3,787	1,459	234	4,565	3,286	---	2,373
377	360	17	295	36	78	9	100	72	---	1,735
8,969	7,657	1,312	13,157	1,805	1,731	1,340	4,029	4,221	31	14,061
417	339	78	975	151	321	115	22	300	66	2,167
2,978	1,686	1,292	5,835	726	444	294	2,407	1,964	---	644
1,635	1,066	569	6,768	359	549	223	4,501	1,136	---	1,766
2,304	1,609	695	704	253	---	18	77	356	---	---
---	---	---	---	---	---	---	---	---	---	12
5	5	---	4	1	---	1	---	2	---	17
80,798	71,069	9,729	188,128	33,824	12,219	9,488	64,337	66,280	1,980	60,557
51,113	46,273	4,840	138,601	24,899	9,270	6,622	45,109	51,009	1,692	34,127
3,731	3,368	363	10,567	1,899	686	500	3,434	3,851	197	2,876
---	---	---	---	---	---	---	---	---	---	282
2,424	2,218	206	3,891	815	470	221	1,196	994	195	2,538
1,446	1,316	130	757	48	50	30	400	225	4	287
8,806	8,344	462	14,725	3,935	1,835	245	5,310	3,400	---	2,808
160	145	15	275	10	75	15	100	75	---	1,649
6,185	4,899	1,286	12,331	1,190	2,141	1,275	3,560	4,155	10	13,277
193	120	73	523	151	190	15	22	145	---	1,704
2,331	1,269	1,062	5,087	541	457	275	2,500	1,314	---	500
550	220	330	1,517	50	288	215	164	800	---	1,062
450	350	100	600	25	---	25	300	250	---	---
---	---	---	---	---	---	---	---	---	---	22
3	3	---	8	---	5	1	---	2	---	10
77,392	68,525	8,867	188,882	33,563	15,467	9,439	62,095	66,220	2,098	61,142
53,508	48,626	4,882	142,887	25,291	11,268	6,765	45,601	52,223	1,739	33,324
3,919	3,553	366	10,930	1,927	900	506	3,462	3,935	200	2,822
---	---	---	---	---	---	---	---	---	---	100
2,424	2,218	206	3,947	815	525	222	1,196	994	195	2,531
1,252	1,122	130	813	48	96	40	400	225	4	287
9,269	8,817	452	15,569	3,916	2,533	260	5,460	3,400	---	3,083
160	145	15	277	10	72	20	100	75	---	1,651
						1,299	3,560	4,155	71	13,511

48,169	43,503	4,666	131,989	23,952	6,716	6,551	43,351	49,900	1,519	32,148
3,542	3,193	349	9,996	1,833	510	480	3,267	3,738	168	2,638
---	---	---	20	---	---	---	---	20	---	28
2,870	2,668	202	4,200	864	328	200	1,550	1,065	193	2,673
1,502	1,379	123	854	57	83	23	468	220	3	295
8,030	7,604	426	13,331	3,787	1,459	234	4,565	3,286	---	2,373
377	360	17	295	36	78	9	100	72	---	1,735
8,969	7,657	1,312	13,157	1,805	1,731	1,340	4,029	4,221	31	14,061
417	339	78	975	151	321	115	22	300	66	2,167
2,978	1,686	1,292	5,835	726	444	294	2,407	1,964	---	644
1,635	1,066	569	6,768	359	549	223	4,501	1,136	---	1,766
2,304	1,609	695	704	253	---	18	77	356	---	---
---	---	---	---	---	---	---	---	---	---	12
5	5	---	4	1	---	1	---	2	---	17
80,798	71,069	9,729	188,128	33,824	12,219	9,488	64,337	66,280	1,980	60,557
51,113	46,273	4,840	138,601	24,899	9,270	6,622	45,109	51,009	1,692	34,127
3,731	3,368	363	10,567	1,899	686	500	3,434	3,851	197	2,876
---	---	---	---	---	---	---	---	---	---	282
2,424	2,218	206	3,891	815	470	221	1,196	994	195	2,538
1,446	1,316	130	757	48	50	30	400	225	4	287
8,806	8,344	462	14,725	3,935	1,835	245	5,310	3,400	---	2,808
160	145	15	275	10	75	15	100	75	---	1,649
6,185	4,899	1,286	12,331	1,190	2,141	1,275	3,560	4,155	10	13,277
193	120	73	523	151	190	15	22	145	---	1,704
2,331	1,269	1,062	5,087	541	457	275	2,500	1,314	---	500
550	220	330	1,517	50	288	215	164	800	---	1,062
450	350	100	600	25	---	25	300	250	---	---
---	---	---	---	---	---	---	---	---	---	22
3	3	---	8	---	5	1	---	2	---	10
77,392	68,525	8,867	188,882	33,563	15,467	9,439	62,095	66,220	2,098	61,142
53,508	48,626	4,882	142,887	25,291	11,268	6,765	45,601	52,223	1,739	33,324
3,919	3,553	366	10,930	1,927	900	506	3,462	3,935	200	2,822
---	---	---	---	---	---	---	---	---	---	100
2,424	2,218	206	3,947	815	525	222	1,196	994	195	2,531
1,252	1,122	130	813	48	96	40	400	225	4	287
9,269	8,817	452	15,569	3,916	2,533	260	5,460	3,400	---	3,083
160	145	15	277	10	72	20	100	75	---	1,651
5,647	4,375	1,272	12,756	1,201	2,470	1,299	3,560	4,155	71	13,511
193	120	73	518	151	185	15	22	145	---	1,697
2,321	1,259	1,062	5,135	541	605	275	2,500	1,214	---	500
509	209	300	1,596	50	423	225	164	734	---	1,068
300	150	150	675	25	---	100	300	250	---	---
---	---	---	---	---	---	---	---	---	---	22
---	---	---	5	---	2	1	---	2	---	10
79,502	70,594	8,908	195,108	33,975	19,079	9,728	62,765	67,352	2,209	60,606

Personnel compensation	381,148	168,842	30,521	[illegible]			
Personnel benefits	28,744	12,568	2,273	4,043	6,252	3,542	3,193
Benefits for former personnel	49,	1	---	1	---	---	---
Travel & transportation of persons	19,517	9,774	1,843	4,695	3,236	2,870	2,668
Transportation of things	4,819	2,168	1,436	585	147	1,502	1,379
Rents, communications, and utilities	47,701	23,967	7,392	8,429	8,146	8,030	7,604
Printing and reproduction	6,458	4,051	2,558	629	864	377	360
Other services	107,010	70,823	35,450	16,658	18,715	8,969	7,657
Services of other agencies	11,330	7,771	4,581	688	2,502	417	339
Supplies and materials	20,719	11,262	4,339	2,827	4,096	2,978	1,686
Equipment	13,219	3,050	1,197	1,128	725	1,635	1,066
Lands and structures	5,805	2,797	1,130	963	704	2,304	1,609
Grants, subsidies & contributions	12	---	---	---	---	---	---
Insurance claims and indemnities	54	28	22	5	1	5	5
Totals	646,585	317,102	92,742	95,659	128,701	80,798	71,069
FISCAL YEAR 1968							
Personnel compensation	400,419	176,578	34,506	58,694	83,378	51,113	46,273
Personnel benefits	30,777	13,603	2,816	4,376	6,411	3,731	3,368
Benefits for former personnel	1,137	855	---	60	795	---	---
Travel & transportation of persons	18,120	9,267	1,839	4,345	3,083	2,424	2,218
Transportation of things	4,683	2,193	1,529	506	158	1,446	1,316
Rents, communications, and utilities	51,637	25,298	8,089	9,022	8,187	8,806	8,344
Printing and reproduction	6,036	3,952	2,677	450	825	160	145
Other services	94,481	62,688	31,954	15,192	15,542	6,185	4,899
Services of other agencies	9,514	7,094	4,364	678	2,052	193	120
Supplies and materials	17,004	9,086	4,639	2,129	2,318	2,331	1,269
Equipment	4,842	1,713	1,057	354	302	550	22(
Lands and structures	1,662	612	346	100	166	450	35(
Grants, subsidies & contributions	22	---	---	---	---	---	---
Insurance claims and indemnities	39	18	15	2	1	3	
Totals	640,373	312,957	93,831	95,908	123,218	77,392	68,52
FISCAL YEAR 1969							
Personnel compensation	407,328	177,609	36,741	59,756	81,112	53,508	48,6
Personnel benefits	31,247	13,576	2,885	4,449	6,242	3,919	3,5
Benefits for former personnel	100	---	---	---	---	---	-
Travel & transportation of persons	18,169	9,267	1,839	4,345	3,083	2,424	2,2
Transportation of things	4,545	2,193	1,529	506	158	1,252	1,1
Rents, communications, and utilities	53,457	25,536	8,125	9,224	8,187	9,269	8,8
Printing and reproduction	6,031	3,943	2,668	450	825	160	
Other services	95,528	63,614	33,993	15,103	14,518	5,647	4,
Services of other agencies	9,494	7,086	4,356	678	2,052	193	
Supplies and materials	16,244	8,288	4,359	2,129	1,800	2,321	1,
Equipment	4,544	1,371	917	354	100	509	
Lands and structures	1,458	483	283	100	100	300	
Grants, subsidies & contributions	22	---	---	---	---	---	
Insurance claims and indemnities	33	18	15	2	1	---	
Totals	648,200	312,984	97,710	97,096	118,178	79,502	70,

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ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1969 ESTIMATES

JOHN F. KENNEDY SPACE CENTER, NASA

MISSION:

The Kennedy Space Center was established at Cape Kennedy, Florida, as a separate Center within NASA in July 1962. Prior to that time, it had been the Launch Operations Directorate of the Marshall Space Flight Center. It serves as the primary Center within NASA for the test, checkout, and launch of space vehicles. This presently includes launch of manned and unmanned vehicles at Kennedy Space Center, Florida, and unmanned vehicles at the Western Test Range. Kennedy Space Center has participated in the flight preparations for projects Mercury and Gemini; and Saturn vehicle development flights. The Center is now concentrating on the Apollo program unmanned and manned launches, as well as scientific unmanned launches. Kennedy Space Center is specifically responsible for:

1. Launch vehicle checkout and preparation.

2. Spacecraft and payload checkout and preparation.

3. Launch facility design, construction, maintenance, and operations.

4. Final integration and integrated checkout of vehicle, spacecraft and launch facilities, and the conduct of actual launch operations.

5. Operation and coordination of supporting facilities, ground support equipment, and tracking and data acquisition and logistics support required for operation of all NASA activities at the Eastern and Western Test Ranges.

In fulfilling its assigned programs, the Kennedy Space Center has developed into a highly flexible "space port" capable of handling a wide variety of launch activities for present and future manned and unmanned space missions.

DESCRIPTION:

The Kennedy Space Center is situated approximately 50 miles east of Orlando, Florida, in northeast Brevard County.

The total land area occupied by the installation is approximately 87,800 acres, including 84,303 acres owned by NASA. In addition to the land area occupied, the state of Florida has dedicated to the United States exclusive use rights to some 53,563 acres of State-owned submerged lands.

In addition to the operation and maintenance of all facilities at the Kennedy Space Center, the Center is responsible for certain facilities within the national Eastern Test Range launch area. The total capital investment of Kennedy Space Center including work in progress, contractor-held facilities at various locations, and the Western Test Range, as of June 30, 1967, is $948,606,000.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1967	1968	1969
Authorized Permanent Positions, end of year	2,720	2,931	2,931
Administrative Operations	$92,742	$93,831	$97,710

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1969 ESTIMATES

MANNED SPACECRAFT CENTER

MISSION:

The Manned Spacecraft Center was established in November 1961 at Houston, Texas, as NASA's primary Center for the design, development, and manufacture of manned spacecraft, and for selection and training of astronaut crews and the conduct of space flight missions. Manned Spacecraft Center and its predecessor organization, the NASA Space Task Group, have completed two major programs: (1) the Mercury program, which was the United States' pioneering venture into manned space flight; and (2) the Gemini program, which extended manned flight capability in space in many significant ways. Manned Spacecraft Center is now heavily engaged in the Apollo program and is also proceeding with necessary program planning and technical analysis of the Apollo Applications program and other post-Apollo activities.

The Apollo program utilizes the capabilities of the Manned Spacecraft Center in several ways. This Center is responsible for:

1. The design, development, and fabrication of the Apollo spacecraft, including the command and service modules, and the lunar module.

2. Over-all program management and control of the spacecraft including module integration, testing, and qualification.

3. Conduct of a program of spacecraft environmental testing.

4. Selection and training of astronauts and preparation of primary and backup crews for each mission.

5. Operation of the Mission Control Center and control of the space flight missions from lift-off to recovery.

6. Development of scientific experiments to be flown on Apollo flights.

7. Operation of the Lunar Receiving Laboratory, which provides a central complex where samples of materials brought to earth by lunar exploration teams may be received, quarantined, processed, undergo limited experiments, and be distributed to the scientific community for further analysis.

The longer duration flights planned for the Apollo Applications missions will make it necessary to use the experienced personnel of this Center to upgrade spacecraft and lunar module subsystems. This Center is also responsible for the development of earth sensor experiment modules and biomedical,

bioscience, and behavioral experiment modules to be flown on Apollo Applications missions.

DESCRIPTION:

The Manned Spacecraft Center is located two miles east of the town of Webster, Texas. The site is approximately 20 miles southeast of downtown Houston and 25 miles northwest of Galveston, Texas. Total NASA-owned land consists of 1,620 acres. The Center also holds an additional 55,880 acres under use agreement at the White Sands Test Facility. The total capital investment of the Manned Spacecraft Center, including work in progress, contractor-held facilities at various locations, and the White Sands Test Facility, as of June 30, 1967, is $351,469,000.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1967	1968	1969
Authorized Permanent Positions, end of year	4,704	4,579	4,579
Administrative Operations	$95,659	$95,908	$97,096

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1969 ESTIMATES

GEORGE C. MARSHALL SPACE FLIGHT CENTER

MISSION:

The Marshall Space Flight Center (MSFC) became a part of NASA in July 1960, and has served as NASA's primary center for the design, development, and test of launch vehicles and space transportation systems for manned space flights. MSFC also includes the Michoud Assembly Facility at New Orleans, Louisiana; the Slidell Central Computer Facility nearby; and the Mississippi Test Facility in southwest Mississippi. Building on the wealth of experience gained through work on Army missile programs, MSFC has, since its transfer from the Army, successfully completed the Saturn I program, and is now managing:

1. The Saturn IB program which provides a launch vehicle for Apollo spacecraft development and serves as a carrier for large scientific satellite payloads.

2. The Saturn V program which will provide the launch vehicle for actual manned lunar landing missions, planetary missions, and future very large scientific satellite payloads.

3. Selected payloads for Apollo Applications missions, such as the Apollo telescope mount and the S-IVB orbital workshop.

In carrying out its management responsibilities for these programs, MSFC has developed the capability to:

1. Design, develop, and manufacture large launch vehicle systems, including vehicle systems test and integration.

2. Conduct test programs such as the static testing program for the S-IC and S-II stages at the Mississippi Test Facility.

3. Design, develop, and test large launch vehicle engines such as the H-1, J-2, and F-1 systems.

4. Develop and integrate scientific experiment payload packages to be flown on Saturn-Apollo vehicles or subsequent post-Apollo missions.

In support of its assigned programs, MSFC also maintains the research and development capability to conduct advanced studies on launch vehicle and space systems, space navigation techniques, astronautics, and space science investigations. Its capability for both research and for the management of industrial operations give MSFC a highly flexible base for manned space programs.

DESCRIPTION:

Operations of MSFC are conducted at three primary locations.

The first location, the main MSFC site is near Huntsville, Alabama, on Army property at the Redstone Arsenal. The Center occupies 1,797 acres under a nonrevocable use permit from the Army, and 64 leased acres. The capital investment as of June 30, 1967, was $551,022,000. Certain facilities such as the Redstone Arsenal Army Air Field and some utilities are used jointly by NASA and the Army. The Huntsville location has deep-water access via the Tennessee, Ohio, and Mississippi Rivers.

The second location, the Michoud Assembly Facility, is located 15 miles east of New Orleans, Louisiana. The main facility occupies 890 acres. The Slidell Central Computer Facility, a satellite facility 20 miles to the northeast, occupies 14 additional acres bringing the total acreage to 904. The capital investment as of June 30, 1967, was $142,382,000. Michoud Assembly Facility space totals 3,483,862 square feet, including the main assembly plant, covering an area of 43 acres under one roof. The vehicle prime contractors produce the Saturn IB and Saturn V booster stages at this location. The Michoud Assembly Facility is on the Gulf Intra-Coastal Waterway, and has deep-water access via the Mississippi River.

The third location, the Mississippi Test Facility, is in southwest Mississippi, approximately 50 miles northeast of New Orleans, Louisiana. Total land area is 138,870 acres of which 13,428 acres make up the actual test area owned by NASA. The remaining 125,442 acres are held as a buffer zone. In the buffer area, 7,568 acres are owned by NASA, and 117,874 acres are under restrictive easement. Capital investment for the Mississippi Test Facility as of June 30, 1967, was $233,953,000. Test stands include a dual-position stand for testing the Saturn V first stage (S-IC), and two stands for testing the 1,000,000-pound thrust Saturn V second stage (S-II). The vehicle prime contractors are responsible for conducting tests on the stands. The site has deep-water access for transporting large boosters via the Pearl River and the Intra-Coastal Waterway.

The total capital investment of the Marshall Space Flight Center, including work in progress and contractor-held facilities at various locations, as of June 30, 1967, is $927,357,000.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1967	1968	1969
Authorized Permanent Positions, end of year	7,086	6,386	6,386
Administrative Operations	$128,701	$123,218	$118,178

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1969 ESTIMATES

GODDARD SPACE FLIGHT CENTER

MISSION:

The Goddard Space Flight Center, established in 1959 as the first major United States laboratory devoted to the investigation and exploration of space, conducts a wide-ranging program of experimentation in the space sciences. As a result, Goddard has developed many diverse capabilities: the management of complex satellite projects; the development of wholly integrated spacecraft, ranging from systems engineering to development and integration; the development and operation of satellite tracking networks; data acquisition and analysis; and, scientific research to include both theoretical studies and the development of many significant scientific experiments flown in satellites.

Although the majority of Goddard's personnel are at the Greenbelt site, other personnel are located at the Goddard Institute for Space Studies in New York City and throughout the world, managing the operation of satellite tracking and communications network stations.

Goddard Space Flight Center is responsible for the development of the sounding rocket program; the management of communications and meteorological satellite programs, such as the Applications Technology and Nimbus Satellites; the management of scientific satellite projects to include the Orbiting Geophysical (OGO), Orbiting Solar (OSO) and the Orbiting Astronomical (OAO) Observatories and the Explorer series; project management of NASA's Delta launch vehicle; and management and operation of two world-wide tracking and data acquisition networks, the Space Tracking and Data Acquisition Network and the Manned Space Flight Network.

Significant achievements of the Goddard Space Flight Center in 1967 included:

Scientific Satellites - Major scientific satellites successfully orbited in 1967 included: OSO III and IV, to map the sun; Explorer 34, to investigate lunar space, and lunar events from a point midway to the moon; Explorer 35, the lunar anchored interplanetary monitoring probe designed to undertake a detailed study of the interaction between the solar wind and the moon, (this represented the 50th successful launch using the Goddard-managed Delta booster); OGO-D, designed to obtain data on particles, fields and characteristics of the earth's atmosphere; also the U. K. III Satellite, an international cooperative project with the United Kingdom. The Center further assisted in the launch of the first Italian Satellite San Marco from an Indian Ocean platform.

Meteorological/Communications Satellites - During 1967, Goddard, on behalf of the Environmental Science Services Administration, launched three operational weather satellites, ESSA IV, V and VI. The ESSA concept is based on the highly successful Tiros series. Three Intelsats, operational communications satellites of the Communications Satellite Corporation, were also launched by the Center during 1967. During the year, Goddard also successfully orbited the Applications Technology Satellite III which, in addition to meteorology, serves space-borne communications and scientific research. This satellite obtained first color weather photographs from a synchronous orbit.

Sounding Rockets - The sounding rocket program consisted of 162 scientific rocket launchings in 1967 including 20 launches in conjunction with foreign scientists.

Tracking and Data Acquisition - The Goddard-managed Space Tracking and Data Acquisition Network provided communications and tracking coverage for unmanned scientific and applications satellites in 1967. At year's end, the Manned Space Flight Network provided global tracking support for the first unmanned Apollo flight (Apollo 4). Insertion ships and tracking aircraft were being readied to support on-coming manned Apollo flights in 1968.

DESCRIPTION:

The Goddard Space Flight Center, located 15 miles northeast of Washington, D. C. and 1 mile east of the Baltimore-Washington Parkway, Greenbelt, Maryland exit, is situated on a 553-acre main site. Three additional plots of 639 acres comprise our remote site area and contain the Goddard Antenna Test Range, the Goddard Optical Facility, the Propulsion Research Facility, the Magnetic Fields Component Test Facility, the Attitude Control Test Facility, and the Network Training and Test Facility. Total capital investment as of June 30, 1967, under the cognizance of Goddard Space Flight Center, including the Manned Space Flight Network, the Space Tracking and Data Acquisition Network, Apollo ships, and the Goddard Space Flight Center main site at Greenbelt, Maryland is $495,734,000.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1967	1968	1969
Authorized Permanent Positions, end of year	3,782	3,686	3,841
Administrative Operations	$71,069	$68,525	$70,594

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1969 ESTIMATES

WALLOPS STATION

MISSION:

Wallops Station 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.

Today, the primary mission of Wallops Station is to prepare, assemble, and launch experimental payloads; position them correctly in space at the right velocity; track them, and acquire meaningful data. The data are then processed and turned over to the experimenter to be analyzed. The rocket-borne experiments flown from the Wallops Island range are conceived, and for the most part, designed and built by scientists and engineers in the laboratories and research centers of NASA, other Government agencies, colleges and universities, and the world-wide scientific community. They are brought by teams of experimenters to Wallops Station where the payloads are checked out, prepared for flight, and mated to an appropriate launch vehicle. Wallops personnel participate in these latter tasks and perform those engineering functions necessary to design and establish ground facilities and instrumentation systems compatible with test requirements.

In addition to supporting the launching of sounding rocket propelled experiments, Wallops uses its facilities for a variety of other research projects. The testing and development of components and instrumentation to be flown in later types of vehicles and spacecraft is a continuing Wallops project. A sizeable portion of Wallops effort is devoted to NASA's program of international cooperation in space research. Some 50 countries have sent representatives to Wallops Station over the past few years to observe its operation or to receive training in methods and techniques of launching sounding rockets and satellite payloads. The four-stage Scout, the largest launch vehicle at Wallops, is used in the launch of small scientific satellites, another important element of the Wallops research program. The Owl series of University Explorers, a small scientific satellite project for which Wallops has project management responsibility, is well underway. Responsibility for the management of the Owl series of Explorers provides Wallops with the capability of managing a project from initial design to the ultimate launch, tracking and data acquisition phases. In addition to project management responsibility, Wallops conducts a variety of scientific experiments including the recent Gravity Preference experiment and the "C" Band Radar System (GEOS-B) experiment.

Wallops Station's achievements during the past calendar year include: the first in a series of four Gravity Preference experiments; the launching of 368 sounding rockets and 220 test rockets; and the participation in a number of international projects highlighted by the joint United States/Japanese launch of 20 meteorological rockets at Wallops Station and assistance with the Italian San Marco II launch off the coast of Africa. The Station continues to play an important part in the training of foreign nationals in the techniques of launch operations. Sixteen personnel from France, Germany, Spain and Japan received training at Wallops Station during the past calendar year and a total of 104 persons from 14 countries visited the installation to observe its operations or seek assistance in establishing a sounding rocket launch facility of their own.

DESCRIPTION:

Wallops Station includes three separate areas on the Atlantic Coast of Virginia's eastern shore: the main base (formerly Chincoteaque 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 buildings are located on the main base. Wallops Island is about seven miles southeast 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. An additional Wallops holding is the Eastville tracking site located about 50 miles south of Wallops Station.

Wallops Station, totaling 6,561 acres, consists of 2,313 acres on the main base; 3,000 acres on Wallops Island, 108 acres on the mainland tracking site; and 1,140 acres of unusable marsh land. The Eastville tracking site consists of an additional 53 acres of government-owned property. The total capital investment as of June 30, 1967, including off-site holdings was $100,062,000.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1967	1968	1969
Authorized Permanent Positions, end of year	518	497	497
Administrative Operations	$9,729	$8,867	$8,908

AMES RESEARCH CENTER

MISSION:

Ames Research Center has a major research responsibility in the life sciences and space sciences, a flight-project management responsibility, and the operational responsibility for the NASA Convair 990 aircraft to conduct airborne scientific experiments in addition to the traditional research mission in the physical sciences. In the current and budget years, this installation has flight-project management responsibility for the Pioneer and Biosatellite projects. Pioneer provides scientific observations of phenomena in interplanetary space from an unmanned spacecraft, and the Biosatellite project explores the biological effects of the space environment on primates and other earth organisms.

Research in the physical sciences includes studies in atmosphere entry and environmental physics, guidance and control systems, and aeronautics. The work in entry and environmental physics includes basic studies of the physics of high-temperature gases, the stability, control, and performance of a wide range of spacecraft configurations, and of materials and structures for spacecraft. In the area of gas physics, particular emphasis is placed on problems associated with flight into earth and other planetary atmospheres. Through this effort, significant contributions have been made to the design of the Mercury, Gemini, and Apollo spacecraft, the design of Mars and Venus entry vehicles, and the design of ballistic missiles.

The work in guidance and control systems is broad in nature and is applicable to manned and unmanned spacecraft, as well as aircraft. Current emphasis in guidance systems is directed mainly at current and follow-on manned missions. This includes an intensive theoretical and experimental effort in the areas of midcourse navigation and terminal guidance with a smaller effort directed at studies involving lunar approach, lunar landing, and rendezvous. The research in control systems is directed at examining various techniques applicable to unmanned satellites and probes and techniques applicable to vertical and short take-off (V/STOL) aircraft, the supersonic transport, and manned spacecraft.

The research program in aeronautics is directed at fundamental studies in aerodynamics, propulsion and operating problems associated with supersonic aircraft with particular emphasis on the supersonic transport, a wide variety of V/STOL vehicles, and with hypersonic research aircraft. This includes studies of piloting problems with numerous fixed-base, moving-base, and flight simulators.

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Research in the space sciences includes studies in the field of solar physics, planetary environments, and geophysics. This includes ground-based and sounding rocket experiments as well as experiments requiring specialized instruments aboard satellites and space probes. The work covers studies pertaining to magnetic fields and plasmas in space, studies to determine the composition and structure of planets and of planetary and stellar atmospheres, and studies of cratering mechanics in natural materials to aid in understanding the structure of lunar surfaces.

Research in the life sciences is conducted in three major areas: (1) basic research in the physiological and behavioral sciences concerned with obtaining a basic understanding of the effects of terrestrial and extraterrestrial environments and of space flight stresses upon living organisms, including man; (2) studies in exobiology oriented towards the prediction, detection, and study of extraterrestrial fossils, chemicals, and life forms; and (3) research in long-term advanced life support systems and in the human factors aspects of the relationships between man and the machines which will transport and support him during lunar and planetary exploration.

DESCRIPTION:

The Ames Research Center was established in 1940, and is located at the southern end of San Francisco Bay on land contiguous to the U. S. Naval Air Station, Moffett Field, California. Its physical plant comprises many specialized facilities for aerospace research in the traditional physical sciences as well as the space sciences and life sciences, all of which are included in the mission of the Center. These include conventional wind tunnels, entry-heating simulators, and free-flight ballistic test facilities capable of conducting tests at speeds up to and above earth escape speed as well as laboratories equipped to study solar and geophysical phenomena, life synthesis, life detection, and life environmental factors. The Ames Research Center occupies about 365 acres of land. Certain other facilities, such as the utilities and airfield runways, are used jointly by NASA and the Navy. The total capital investment of the Ames Research Center, including work in progress and contractor-held facilities, as of June 30, 1967, is $210,781,000.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1967	1968	1969
Authorized Permanent Positions, end of year	2,173	2,092	2,092
Administrative Operations	$33,824	$33,563	$33,975

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1969 ESTIMATES

ELECTRONICS RESEARCH CENTER

MISSION:

The mission of the Electronics Research Center is to increase the nation's capability in space by providing the knowledge and advanced technology needed to improve performance and reliability of space and aeronautical electronic systems and components. The Center meets this responsibility in two principal ways:

First, the Center organizes, manages, and conducts a comprehensive program of basic and applied aerospace electronics research to: (a) investigate concepts and techniques that will provide the technological foundation for the development of electronic equipment of reduced weight, size, power drain, and complexity, able to operate for long periods of time in the temperature, radiation, vacuum, and other conditions of an aerospace flight environment; (b) investigate concepts and techniques, establish performance characteristics, test procedures, and specifications for aerospace electronic components and techniques that will make aerospace electronics equipment inherently more reliable; and (c) devise new electronic concepts and techniques and prove their feasibility both analytically and experimentally, leading to aerospace electronic equipment with performance characteristics far beyond those of today.

Second, the Center provides a focal point for national aerospace electronics research, coordinating nation-wide research efforts and sponsoring electronics research conducted by industry, universities, and private institutions. In this capacity, the Center: (a) responds to the needs of specific aerospace programs and projects for new electronic techniques, concepts, and devices, and helps shape future electronics research to resolve anticipated problems in these programs; (b) distributes knowledge about basic and applied research on aerospace electronics within NASA and also to industry, universities, and other members of the scientific and engineering community; and (c) provides to NASA programs and projects aerospace electronic scientists and engineers who are fully knowledgeable in the electronics state-of-the-art.

Electronics research being managed and conducted by the Center during FY 1968 and FY 1969 is largely contracted with industry and universities and is focused in the following areas:

1. Aerospace electronics materials and components.

2. Guidance and navigation of space vehicles, aircraft, and the supporting ground-based equipment.

3. Space vehicle and aircraft control, stabilization, and information systems.

4. Electronic system simulation, analysis, evaluation, and integration in the fields of guidance, control, navigation, tracking, communication, and instrumentation.

5. Electrical and electronic power conditioning and distribution.

6. Bioelectronics.

7. Space and ground-based computers, computing systems, and instrumentation technology.

8. Solid state physics, microwave propagation, microwave communications, and transmitting and receiving phenomena.

9. Optical communications.

10. Astrophysical measurements.

An in-house research effort is being conducted by the Center staff on those tasks offering great promise for aerospace electronics technology and on those problems requiring firsthand experience on the part of the Center personnel in order to contract, monitor, and evaluate related research with industry and universities.

DESCRIPTION:

The Electronics Research Center is being constructed on a tract in the Kendall Square area of Cambridge, Massachusetts. The site, 1½ miles west of the center of Boston, Massachusetts, is immediately north of the Massachusetts Institute of Technology and 1½ miles from Harvard University. The tract is bounded on the north by Binney Street, on the south by Broadway, on the east by Third Street, and on the west by the New York Central Railroad. In addition to the Center site, an auxiliary site will be required for the field tests and research that cannot be conducted at the main site. The total area to be occupied at the Kendall Square site in Cambridge is 26 acres. The total capital investment of the Electronics Research Center, including work in progress and contractor-held facilities, as of June 30, 1967, is $11,577,000.

Construction of foundations for the high-rise laboratory, auditorium, and the center support structures has been completed, and construction of the structures themselves has begun and is scheduled for completion as follows:

High-Rise Laboratory	- October 1969
Auditorium and Office Addition	- July 1969
Center Service Building	- May 1969

Award of the contract for construction of the Space Guidance Laboratory and Optics Laboratory is planned during FY 1968.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1967	1968	1969
Authorized Permanent Positions, end of year	700	816	965
Administrative Operations	$12,219	$15,467	$19,079

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1969 ESTIMATES

FLIGHT RESEARCH CENTER

MISSION:

The Flight Research Center, established in 1947, conducts aeronautical and space research within and outside the atmosphere. The work includes effort on problems of take-off landing, low-speed flights, supersonic and hypersonic flight, and re-entry to verify predicted characteristics and to identify unexpected problems in actual flight.

The current and projected programs at this Center include: aeronautical projects, such as X-15, XB-70, supersonic transport and hypersonic research; space vehicle systems projects in which the flight behavior of advanced re-entry vehicles including M2-F2, HL-10, and X24A heavyweight lifting bodies is studied; and electronic systems projects such as display, guidance, and control in advanced flight missions and improvements on systems and sensors used in biomedical monitoring, tracking, and data acquisition.

Most important of the facilities and special equipment for conducting programs at the Flight Research Center are the aircraft. They range from general aviation aircraft for handling qualities investigations to century series fighters used for pilot proficiency and general investigations and to X-15 rocket aircraft used for hypersonic research and re-entry investigations. Special purpose vehicles such as lifting bodies, variable stability aircraft, or airborne simulators are contractor procured or developed in-house. Specialized laboratory facilities are available to complement the flight activities with proper preliminary research and testing. Simulation equipment is used to guide and assist in the performance of productive flight activities. A three-station radar for tracking and data acquisition is operated to support the flight activity.

DESCRIPTION:

The Flight Research Center, Edwards, California, is 65 air miles northeast of Los Angeles. The Center is located at the north end of Edwards Air Force Base on 218 acres of land leased from the Air Force. Utilities are provided by the Air Force on a reimbursable basis. The Center is adjacent to Rogers Dry Lake, a 55-square-mile area with a complex of runways varying in length from 5-to-11 miles.

The physical plant consists of an office-laboratory building with adjoining shops, a flight maintenance hangar and a calibration hangar, and a high temperature loads calibration facility. Auxiliary buildings include warehouses, an auxiliary power systems building, and a communications building. The main station of the three-station radar range operated by the Center is

located on the third floor of the office-laboratory building. The total capital investment of the Flight Research Center, including work in progress and contractor-held facilities, as of June 30, 1967, is $41,069,000.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1967	1968	1969
Authorized Permanent Positions, end of year	590	566	566
Administrative Operations	$9,488	$9,439	$9,728

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1969 ESTIMATES

LANGLEY RESEARCH CENTER

MISSION:

The activities of the Langley Research Center are directed to the maintenance and improvement of the United States position in aeronautics and space. Langley Research Center assists in the attainment of this objective through an extensive program of advanced research and technology which includes analytical studies and scientific investigations in wind tunnels, specialized laboratories, and in free-flight. Langley Research Center is principally concerned with the identification of new scientific opportunities for flight progress, the recognition and mastery of critical problems which must be solved to achieve advanced aerospace flight goals, the provision of a sound technological basis for the establishment of new programs, and for the successful design, development, and operation of flight vehicles of all types. In carrying out its mission, Langley Research Center works closely with the aerospace and educational communities in a planned effort to enhance this nation's manpower capabilities.

The Langley Research Center aeronautical research program is focused on the formulation and improvement of the technological basis for the successful development and utilization of aircraft of all types. These include efficient supersonic and high-subsonic-speed transports, high-performance military aircraft, effective V/STOL aircraft, practicable hypersonic ramjet-powered vehicles, and safe general aviation aircraft. Experience gained in Langley Research Center's broad program of aeronautical research provides an outstanding basis for this Center's direct support of the military services, the Federal Aviation Administration, and the industry in their progressive aircraft development efforts, such as the F-111, C-5A, FX, VFAX, AX, and the supersonic transport.

Major emphasis in Langley Research Center's high-speed aerodynamics research has been directed to the evolution and refinement of practicable aircraft design characteristics to provide maximum flight efficiency and performance while exhibiting appropriate operational capabilities from cruise speed to the landing condition. The Langley Research Center variable-sweep wing for supersonic aircraft represents a major advance toward this goal, and is finding important applications in military and commercial aircraft.

A Langley Research Center design concept, the supercritical wing, offers strong potentials for increased efficiency at higher subsonic speeds, and is being aggressively evaluated and refined. This is one of many concepts which have been the products over the years of Langley Research Center's broad program of advanced research and technology.

Configurations for hypersonic vehicles are under investigation in wind tunnels and through research using rocket-propelled free-flight experimental techniques to increase our understanding of the complex problems involved in the design and operation of an airplane intended for flight in this speed range. Another challenging research objective in the hypersonic range is the efficient integration of advanced propulsion systems into high performance aircraft. A Langley Research Center program for the establishment and demonstration of the technology for practicable hypersonic ramjet aircraft propulsion systems is rapidly progressing.

Wide ranges of scientific investigations are leading to the establishment of rational criteria for the design of efficient and operationally effective V/STOL aircraft, including the development of advanced helicopter technology, as in the promising application of the hingeless rotor concept pioneered by Langley Research Center. In investigations on V/STOL aircraft, a subject of research at this Center since the late 1940's, considerable emphasis is placed on defining and providing adequate stability and control over the expanding operating ranges, and to achieve optimum man/machine compatibility.

At Langley Research Center, unique flight simulators, fixed and rotor-wing aircraft flight experiments, and laboratory facilities are used to explore and master problems of advanced flight operations. These include supersonic transport airways integration and terminal approach and landing, fighter combat maneuvers, flying qualities and piloting-aid requirements for efficient all-weather terminal-area operations of V/STOL aircraft, simplified aircraft proximity warning indicators, and other improved piloting aids for general aviation aircraft. Other subjects of interest to this Center in the operational area are the detection of clear-air turbulence, the improvement of the directional control and braking of aircraft on wet and slippery runways, the definition of spin characteristics and optimum recovery techniques of new aircraft, and the behavior of the new large jet transport aircraft in emergency ditching on water.

A broad research program at Langley Research Center continues to update and extend basic criteria for atmospheric, acoustical, maneuvering, and other operational loading of aircraft structures, and for prediction and control of the associated dynamic response and flutter of large and flexible aircraft under such environments. Research is providing improved construction technologies for high-performance aircraft including the development of the potentials of advanced materials, multi-material arrangements and structural configurations that offer promise of better accommodation of the high loadings and deflections, severe aerodynamic heating, fatigue stresses, corrosive atmospheres, and cryogenic fuel storage of future operations.

Langley Research Center is cooperating extensively in the national effort to reduce the seriousness of the aircraft noise problem. This Center is developing aircraft configuration features and operating procedures designed to ameliorate sonic boom effects; is studying the basic nature of propulsion system sound generation and propagation as a foundation for the development and demonstration of new compressor arrangements, inlet absorbers and flow

controls, and jet mixing processes that can substantially improve the noise characteristics of future systems. Other noise studies include the investigation of the effectiveness and safety of variations in take-off, climb, terminal approach and landing, and airport operational procedures that can reduce airport community annoyances; and the definition of factors that control the subjective annoyance character of aircraft noise and its effects on ground structures. The Langley Research Center conducts a broad range of timely space research in support of major national projects such as the manned Apollo mission, and manages important laboratory and flight activities designed to increase the Center's knowledge of the universe and to provide this nation a rational technological foundation for the definition, assessment, and successful execution of future space endeavors.

In support of the Apollo lunar landing and applications programs, Langley Research Center is contributing significantly in every area of the flight mission. This research includes the prediction of the structural dynamic characteristics of large launch vehicles such as the Saturn V in combination with the Apollo spacecraft, simulator development and astronaut indoctrination in effective operational techniques and piloting aids for execution of critical lunar landing and rendezvous maneuvers, investigation of lunar module landing loads and demonstration of the prototype landing system under simulated lunar gravity, the provision of advanced topographical and characteristics data on lunar terrain for landing site selection and piloting guidance, the establishment of mobility characteristics and surface operational techniques for space-suited explorers under lunar gravity, the development of control moment gyrostabilization and precision-pointing-control technology for the Apollo telescope mount spacecraft cluster, scientific contributions to the knowledge of atmosphere entry, aerothermodynamics, heat shielding, and the circumvention of entry communications "blackout," the investigation and development of a parawing ground-landing system capability, and the provision of advanced technological experiments for the Apollo Applications program.

Other basic research and development activities, the depth and scope of which are intended to contribute vitally to the attainment of national flight aspirations, include the precision pointing of space optical systems; the establishment of requirements and advanced design concepts for controlled atmosphere entry and landing spacecraft, refurbishable orbital logistical spacecraft, re-usable launch systems, manned orbital research laboratories, orbital astronomical laboratories, and expandable space structures; the definition and alleviation of space radiation, micrometeoroid, thermal, and vacuum hazards to vehicular systems, electronic and optical components, viable tissues, and materials; the evaluation and enhancement of the ability of man to work in the space domain; and the generation of improved technology for long-duration regenerative life support components and systems, simplified navigation and control systems, advanced horizon sensors, precision stabilization equipment, reliable and efficient space instrumentation and communication devices, high-reliability solid-propellant rocket motors and vehicles, thrust-modulating hybrid-propellant rocket motors, and unique aerospace materials.

The Langley Research Center maintains a leading position in the investigation of fluid physics problems. Its work in magnetoplasmadynamics is making contributions to the geophysical and stellar sciences, and is disclosing new potentials in electrical propulsion. In the area of magnetoplasmadynamics, an arc device under study appears promising as an advanced propulsion technique with potential usefulness beyond the ion engine concept.

Langley Research Center is responsible for the development, procurement, and operation of the solid-propellant Scout launch vehicle in its various national and international satellite and entry vehicle applications; for other spacecraft systems and experiments for evaluation of the earth's atmospheric characteristics, the radiation and micrometeoroid hazards of the earth and moon environments, the lunar gravitational field, and the properties of the lunar surface; and provides research and development support for a number of other unmanned spacecraft and launch vehicle projects.

An extensive program of research is conducted by Langley Research Center to provide guidance and technology for the formulation and execution of advanced planetary flight missions. This includes the comprehensive analysis of the scientific merits, technical feasibility, and costs of various alternate mission schemes; the optimization of space systems arrangements and operational modes; the investigation of heat transfer and heat shielding concepts for planetary-atmosphere and earth-return entry vehicles; the development and demonstration of efficient atmosphere decelerators and landing systems; the provision of technology for advanced deep-space guidance and control systems, and electrical power supplies; and the development of practicable and effective approaches to the achievement of acceptable levels of sterilization in planetary landing spacecraft.

DESCRIPTION:

The Langley Research Center, Hampton, Virginia, is located approximately 100 air miles south of Washington, D. C. The Center is divided into two separate areas adjacent to the runway facilities of the Langley Air Force Base, and occupies 772 acres of government-owned land. The west area consists of 750 acres of which 430 acres are owned by NASA and 320 acres are under permit from the Air Force. The east area consists of 22 acres under permit from the Air Force. Runways, some utilities, and certain other facilities are used jointly by NASA and the Air Force. In addition, there are 110 acres of NASA-owned land located in the city of Newport News, Virginia, 3,276 acres under permit from other government agencies, and 26 acres under lease. The total acreage owned, under permit, or leased, is 4,184. The total capital investment of Langley Research Center, including work in progress and contractor-held facilities, as of June 30, 1967, is $337,124,000.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1967	1968	1969
Authorized Permanent Positions, end of year	4,161	3,990	3,990
Administrative Operations	$64,337	$62,095	$62,765

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1969 ESTIMATES

LEWIS RESEARCH CENTER

MISSION:

The principal mission of the Lewis Research Center is research and development in the areas of aircraft and spacecraft propulsion, and power generation systems for spacecraft.

The emphasis at the Lewis Research Center is predominantly research; however, the entire spectrum of activities is undertaken going from basic research to applied research to development. The scope of research ranges from work on individual components through complete systems.

Most of the critical areas which limit the performance of engines and power systems are the subjects of in-house research effort at this Center. Research by commercial and university laboratories is also conducted under contracts directed by Lewis Research Center personnel.

Several large launch vehicle and power generation development programs are assigned here. The Centaur and Agena launch vehicle programs are under this Center's supervision. The 260-inch solid rocket program, the SNAP-8 nuclear powered electric generating system, and SERT (Space Electric Rocket Test) contracts are directed, and there is also considerable supporting in-house research effort on these projects. New projects in their early phases include the development of a quiet engine (turbofan jet) and improved hydrogen-oxygen burning rocket engines.

The research and development activities at Lewis Research Center cover many technical fields. Some examples of major activity are discussed in the following paragraphs:

It is expected that engines for future supersonic planes will be of a turbofan design incorporating high by-pass ratios, high compressor pressure ratios, and high turbine inlet temperatures. A large part of the research effort at Lewis Research Center is aimed directly at solving the problems that limit the development of engines for supersonic flight. Among these research efforts are: slotted compressor blades to increase pressure ratio per stage, cooled turbine blades, high-speed bearings, air inlets, exhaust nozzles, combustor configurations, higher energy fuels, and fuel tank fire hazard evaluations. A large addition to the Propulsion Systems Laboratory is being built to test full-scale engines for supersonic airplanes.

The problems of the supersonic combustion ramjet engine for hypersonic flight speeds up to Mach 7 are being studied in existing facilities, and construction of a new facility has begun at Plum Brook to extend the effort to engines of practical size.

At the lower end of the speed scale, the effects of cross flow on high-pressure ratio lift fans for V/STOL aircraft will be investigated in the return passage of the 8- by 6-Foot Supersonic Wind Tunnel.

Contributions to rocket technology continue to flow from Lewis Research Center. Relatively small scale chemical rockets are used to study the problems of combustion instability, fuel-oxidant mixing, regenerative cooling of nozzles, ablative nozzles, and nozzle insulating coatings. Pumps for cryogenic propellants and turbines to drive the pumps are investigated at the Plum Brook Station.

Various problems in connection with the development of the nuclear powered rocket engine are also conducted at Plum Brook. A 60-megawatt thermal reactor facility is used to determine the effects of radiation on materials, especially at very low temperatures, and the Nuclear Rocket Dynamics and Controls Facility is used for problems on the start-up phase when liquid hydrogen enters pumps and mock-ups of reactors.

Electric rockets for deep space propulsion have benefited greatly from the work in the Electric Propulsion Research Building and the newer Electric Propulsion Laboratory. These buildings contain many large vacuum tanks where the space environment essential to electric propulsion research are approximated.

Many devices for power generation in space are being studied. The solar cell converts sunlight directly into electricity. Batteries and fuel cells convert stored chemicals into electricity. For a large and sustained power supply, however, an adaptation of the familiar turbine driven generator seems most practical. To achieve the tremendous weight reduction necessary means many years of intensive research and development. Instead of steam, the turbines will be driven by liquid metal vapor (Rankine cycle) or by heated gas (Brayton cycle). The only way to reject the waste heat is by direct radiation to space, so very large radiators will be required. High rotative speeds will reduce weight, but call for new designs of compressors, turbines, bearings, and electric generators. The heat source may be either a nuclear reactor, or the sun's rays concentrated by a large concave mirror. A 20-foot flight-weight mirror has been assembled at the Lewis Research Center and a 30-foot mirror is planned.

A $28 million Space Power Facility is nearing completion at Plum Brook where nuclear powered electric generating systems will be operated under simulated space environment conditions for long periods of time.

Another type of electric generator and another source of energy are more distant prospects. A stream of ionized plasma flowing through a coil will generate electricity in that coil (magnetohydrodynamics). The success of this effort and of related activities depends largely on the development of superconducting electric magnets. The Lewis Research Center has been a leader in this field, and recently constructed a magnet with a field of 140,000 gauss over a 6-inch bore.

The performance of propulsion and power generation systems, launch vehicles, spacecraft, and practically all hardware is paced by physical limitations of available materials. Lewis Research Center has maintained a substantial materials research effort aimed at raising these limitations and improving component and system performance. The Center's activity covers the entire temperature range of materials usage going from the cryogenic temperature of liquified gases to the high temperatures encountered in the rocket nozzles of aircraft engine combustors and turbine wheels.

The material research included both fundamental studies of what makes materials strong or weak, and the development of new materials. "Super" alloys, corrosion resistant coatings, ultrapure tungsten, and composites made of metal whiskers, fibers, or sintered granules are among the many products investigated.

DESCRIPTION:

The Lewis Research Center occupies two sites in north central Ohio. The older one was established in 1941 on 200 acres adjacent to the Cleveland Municipal Airport. The original area has been expanded to 364 acres, of which 15 are leased from Cleveland for use as a parking lot. Funds for the purchase of these 15 acres are included in the FY 1968 budget. Here there are over 80 buildings, including two large supersonic wind tunnels, two zero gravity research facilities (free drop shafts, one of which is an underground evacuated shaft 477 feet deep in which zero gravity durations of about ten seconds are obtained), a large Propulsion Systems Laboratory in which full-scale engines are operated under simulated high-altitude conditions, three rocket laboratories, three materials research buildings, 18 major space simulation facilities ranging from 4- to 30-feet in diameter, a 50-foot diameter Space Power Chamber 120-feet long in which altitudes up to 100,000-feet are simulated, an Energy Conversion Laboratory, an Instrument Research Laboratory, a High Energy Fuels Laboratory, a Chemistry Laboratory, an Engine Research Building containing 64 test cells and covering nearly four acres, four office buildings, machine shops, and other service buildings.

A newer site, established in 1956, is located south of Sandusky, Ohio, about 50 miles west of Cleveland on land formerly occupied by the Plum Brook Ordnance Works. Known as the Plum Brook Station, it occupies 6,031 acres of which 5,981 are owned by the government, and 50 are in easements. Funds for the purchase of an additional 3,000 acres, to serve as a buffer zone around the present site, are included in the FY 1968 budget. There are over 77 buildings on this site, 55 built by NASA and the rest by the former tenants. The major facilities include: a Reactor Facility, an Altitude Rocket Test Facility, a Cryogenic Propellant Research Facility, a Heat Transfer Facility, a Spacecraft Dynamics Research Facility, a Rocket Pump Laboratory, a Rocket Turbine Laboratory, a Rocket Turbopump Laboratory, a Rocket Systems Hydraulic Laboratory, a Fluorine Pump Laboratory, and a temporary site for testing rockets at sea-level conditions. A Spacecraft Propulsion Research Facility is nearing completion to test the ignition and operation of spacecraft propulsion systems after a period of soaking in a space environment. Also

nearing completion is the Space Power Facility for testing full-scale nuclear powered electric generating systems. The research programs at Plum Brook are under the technical direction of personnel located at Cleveland. They are conducted at the larger site because of the need for large separation distances to minimize hazards. The total capital investment of the Lewis Research Center, including work in progress and contractor-held facilities, as of June 30, 1967, is $354,514,000, of which $95,680,000 represents facilities located at the Plum Brook Station.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1967	1968	1969
Authorized Permanent Positions, end of year	4,676	4,485	4,485
Administrative Operations	$66,280	$66,220	$67,352

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1969 ESTIMATES

SPACE NUCLEAR PROPULSION OFFICE

MISSION:

The mission of the Space Nuclear Propulsion Office is to provide the necessary research, design and engineering data, test hardware, and general technology required to develop nuclear rocket systems with power levels, operating times, restart conditions, and specific impulse values suitable to advanced space exploration missions. Through the use of nuclear rocket propulsion, significant performance advantages accrue to such missions as lunar logistics operations, deep space probing with heavy spacecraft, and unmanned planetary fly-by.

As a result of changes in the space program planning, a decision has been made to initiate the development of the 1500 megawatt, approximately 75,000-pound thrust NERVA I engine for flight status by early FY 1976.

DESCRIPTION:

The nuclear rocket program is a joint AEC-NASA undertaking. To ensure an integrated program, the Space Nuclear Propulsion Office, established by an interagency agreement between Atomic Energy Commission and NASA, manages all aspects of the program.

The Space Nuclear Propulsion Office consists of a Headquarters office located at Germantown, Maryland, and three field extensions located in Ohio, New Mexico, and Nevada. At the Nevada location, the Nuclear Rocket Development Station was established to provide a site for ground static testing of the reactors, engines, and eventually, vehicles associated with nuclear rocket development.

The Nuclear Rocket Development Station consists of a 90,000-acre site, owned by the Atomic Energy Commission, approximately 90 miles northwest of Las Vegas, Nevada. The total capital investment of NASA-funded facilities, including work in progress and contractor-held facilities, as of June 30, 1967, is $54,634,000.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1967	1968	1969
Authorized Permanent Positions, end of year	117	115	115
Administrative Operations	$1,980	$2,098	$2,209

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ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1969 ESTIMATES

NASA HEADQUARTERS

MISSION:

The mission of the National Aeronautics and Space Administration Headquarters 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:

Office of Manned Space Flight - Responsible for all NASA activities directly involving manned space flight missions. Programs include:

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;

Apollo Applications - To include the improvements of manned space operations and hardware technology and the initiation of extended use of men for scientific, technological, and applied observations in space, and to provide a fuller understanding of the abilities of men, vehicles, and systems to function effectively in the space environment by extending the flight of existing Apollo/Saturn equipment; and

Advanced Missions - To plan a broad program of explorations 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 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.

Office of Space Science and Applications - Responsible for the NASA automated space flight program directed toward scientific investigations of the earth, moon, sun, planets, and interplanetary space utilizing ground-based, airborne, and space techniques such as sounding rockets, earth satellites, and deep space probes; 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 earth resources surveys, and for the support of operational systems using these developments; and for the development, procurement, and use of light and medium class launch vehicles, such as Centaur.

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, the Jet Propulsion Laboratory (a government-owned facility operated for NASA by the California Institute of Technology), and the NASA Pasadena Office, a component field activity of Headquarters.

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 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 related to carrying out the specific flight missions in order to avoid unnecessary duplication and to insure an integrated and balanced agency 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.

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 systems. In addition, this office is responsible for agency-wide coordination of the management of automatic data processing systems and services.

The NASA Pasadena Office, Pasadena, California, was established in 1966 as a component field activity of the NASA Headquarters' Office of Space Science and Applications. The mission of the NASA Pasadena Office (NaPO) is to negotiate and administer NASA contracts with the California Institute of Technology for the operation of the Jet Propulsion Laboratory; provide patent and technology utilization services as they relate to prime and subcontracts at the Jet Propulsion Laboratory; and perform such additional procurement, contract administration, and other functions as may be assigned by the Associate Administrator for Space Science and Applications. In addition, certain public affairs, communications and financial management functions, which are presently the responsibility of the Western Support Office (WSO) in Santa Monica, California, are being transferred to NaPO. WSO, which has provided administrative and technical support to NASA elements on the west coast, is in the process of being closed. Those functions performed by WSO which are not being transferred to NaPO are being absorbed by other NASA field installations and Headquarters. This organizational change will be completed by the end of March 1968.

DESCRIPTION:

The NASA Headquarters is located at 400 Maryland Avenue, S. W., Washington, D. C., and also occupies other buildings in the District of Columbia and nearby Virginia. Except for some office space leased in the District of Columbia and a storage area in Virginia, personnel occupy government-owned buildings. The NASA Pasadena Office is physically located at the Jet Propulsion Laboratory in Pasadena, California.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1967	1968	1969
Authorized Permanent Positions, end of year	2,499	2,279	2,279
Administrative Operations	$60,557	$61,142	$60,606

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

SUMMARY OF APPROPRIATION BUDGET PLANS BY INSTALLATION

(In millions of dollars)

Installation	Research and Development			Construction of Facilities			Administrative Operations			Total		
	1967	1968	1969	1967	1968	1969	1967	1968	1969	1967	1968	1969
John F. Kennedy Space Center, NASA....	216.5	362.1	380.4	35.4	26.0	13.9	92.7	93.8	97.7	344.6	481.9	492.0
Manned Spacecraft Center.....	1,447.8	1,283.4	1,107.3	10.2	.8	3.1	95.7	95.9	97.1	1,553.7	1,380.1	1,207.5
Marshall Space Flight Center.....	1,343.1	1,139.9	979.5	-	.7	-	128.7	123.2	118.2	1,471.8	1,263.8	1,097.7
Michoud Assembly Facility.....	-	-	-	.7	.4	.4	-	-	-	.7	.4	.4
Goddard Space Flight Center.....	386.3	417.0	455.5	.7	.6	-	71.1	68.5	70.6	458.1	486.1	526.1
Wallops Station.....	6.5	8.6	8.6	.2	.7	.5	9.7	8.9	8.9	16.4	18.2	18.0
Jet Propulsion Laboratory.....	214.9	196.7	149.4	.3	1.9	-	-	-	-	215.2	198.6	149.4
Ames Research Center.....	64.8	65.0	70.6	-	3.2	.4	33.8	33.6	34.0	98.6	101.8	105.0
Electronics Research Center.....	16.4	26.3	26.9	7.5	-	-	12.2	15.5	19.1	36.1	41.8	46.0
Flight Research Center.....	10.2	23.8	18.8	-	-	-	9.5	9.4	9.7	19.7	33.2	28.5
Langley Research Center.....	91.4	85.4	105.0	6.1	-	-	64.3	62.1	62.8	161.8	147.5	167.8
Lewis Research Center.....	162.6	139.1	146.6	16.0	2.1	-	66.3	66.2	67.3	244.9	207.4	213.9
Space Nuclear Propulsion Office.....	47.8	49.7	54.6	-	-	-	2.0	2.1	2.2	49.8	51.8	56.8
NASA Headquarters:												
Headquarters.....	149.7	155.3	174.0	-	-	-	60.6	61.2	60.6	210.3	216.5	234.6
Western Support Office.....	17.1	18.3	-	-	-	-	-	-	-	17.1	18.3	-
Various Locations.....	-	-	-	3.9	-	23.7	-	-	-	3.9	-	23.7
Facility Planning and Design.....	-	-	-	5.4	1.4	3.0	-	-	-	5.4	1.4	3.0
Total Budget Plan.....	4,175.1	3,970.6	3,677.2	86.4	37.8	45.0	646.6	640.4	648.2	4,908.1	4,648.8	4,370.4

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

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

(Thousands of dollars)

PROGRAM OFFICE	TOTAL	J. F. KENNEDY SPACE CENTER, NASA	MANNED SPACECRAFT CENTER	MARSHALL SPACE FLIGHT CENTER	GODDARD SPACE FLIGHT CENTER	JET PROPULSION LABORATORY	WALLOPS STATION	AMES RESEARCH CENTER	ELECTRONICS RESEARCH CENTER	FLIGHT RESEARCH CENTER	LANGLEY RESEARCH CENTER	LEWIS RESEARCH CENTER	SPACE NUCLEAR PROPULSION OFFICE	NASA HEADQUARTERS	WESTERN SUPPORT OFFICE
Office of Manned Space Flight															
1967	3,024,000	213,950	1,444,896	1,323,017	273	-	-	365	-	-	1,426	-	-	40,073	-
1968	2,809,200	356,600	1,271,900	1,121,100	3,100	800	-	-	2,000	-	1,000	-	-	52,700	-
1969	2,483,400	374,300	1,089,700	959,900	3,200	1,100	-	-	1,200	-	1,000	-	-	53,000	-
Office of Space Science and Applications															
1967	576,100	2,546	105	1,949	179,272	143,499	761	43,489	3,544	10	41,347	109,962	-	41,385	8,231
1968	552,850	5,290	7,109	1,276	207,607	115,217	1,640	41,544	3,615	-	25,717	79,800	-	52,235	11,800
1969	538,200	5,900	12,800	1,145	215,456	64,248	1,335	44,430	4,540	-	42,515	75,800	-	70,031	-
Office of University Affairs															
1967	31,000	-	-	-	-	-	-	-	-	-	-	-	-	31,000	-
1968	10,000	-	-	-	-	-	-	-	-	-	-	-	-	10,000	-
1969	10,000	-	-	-	-	-	-	-	-	-	-	-	-	10,000	-
Office of Advanced Research and Technology															
1967	268,150	49	2,770	17,327	10,960	20,019	-	20,932	12,824	8,346	46,336	52,652	47,835	19,198	8,902
1968	318,700	175	4,420	17,090	9,006	23,502	535	23,502	20,655	21,668	56,774	59,263	49,700	25,904	6,506
1969	336,800	150	4,850	18,140	9,568	28,720	500	26,150	21,199	16,740	59,838	70,766	54,600	25,579	-
Office of Tracking and Data Acquisition															
1967	270,850	-	-	800	195,800	51,350	5,750	-	-	1,900	2,250	-	-	13,000	-
1968	275,850	-	-	400	197,350	57,200	6,400	-	-	2,100	1,900	-	-	10,500	-
1969	304,800	-	-	300	227,300	55,300	6,800	-	-	2,100	1,600	-	-	11,400	-
Office of Technology Utilization															
1967	5,000	-	-	-	-	-	-	-	-	-	-	-	-	5,000	-
1968	4,000	-	-	-	-	-	-	-	-	-	-	-	-	4,000	-
1969	4,000	-	-	-	-	-	-	-	-	-	-	-	-	4,000	-
Total Budget Plan															
1967	4,175,100	216,545	1,447,771	1,343,093	386,305	214,868	6,511	64,786	16,368	10,256	91,359	162,614	47,835	149,656	17,133
1968	3,970,600	362,065	1,283,429	1,139,866	417,063	196,719	8,575	65,046	26,270	23,768	85,391	139,063	49,700	155,339	18,306
1969	3,677,200	380,350	1,107,350	979,485	455,524	149,368	8,635	70,580	26,939	18,840	104,953	146,566	54,600	174,010	-

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1969 ESTIMATES

JET PROPULSION LABORATORY

This presentation of administrative-operations-type cost at the Jet Propulsion Laboratory is for information only and should not be considered a part of NASA's FY 1969 Administrative Operations budget estimates.

Although the plant and equipment are entirely government-owned, the Jet Propulsion Laboratory is managed and staffed by the California Institute of Technology under a contract with NASA. Because it is a contractor operation, the cost of operating Jet Propulsion Laboratory is funded almost entirely from the Research and Development appropriation. Cost of leasing administrative aircraft and purchase of passenger motor vehicles are funded from the Administrative Operations appropriation and are included in the NASA Headquarters' budget.

MISSION:

Under task orders issued by NASA, the Jet Propulsion Laboratory performs a variety of engineering, scientific, and management missions which include:

1. Lunar and deep-space automated scientific missions.

2. Project management of complete spacecraft systems.

3. Tracking, data acquisition, data reduction and analysis required by lunar and deep-space flights.

4. Conduct a program of supporting research and technology.

DESCRIPTION:

The Jet Propulsion Laboratory is located in Pasadena, California, approximately 20 miles north of downtown Los Angeles. Subsidiary facilities are located at Goldstone, California (tracking and data acquisition), Edwards Air Force Base in Muroc, California (solid-propellant formulation and testing), and Table Mountain, California (open-air testing and astronomy).

At Pasadena, California, the Jet Propulsion Laboratory occupies 160.2 acres of land of which 145.9 acres are owned by NASA and 14.3 acres are leased. At Goldstone, facilities are located on land occupied under permit from the Army. At Edwards Air Force Base, Muroc, California, facilities are located on land occupied under permit from the Air Force. The Table

Mountain, California, facilities are located on land occupied under permit from the Forest Service of the Department of Agriculture. The capital investment of Jet Propulsion Laboratory, including work in progress and contractor-held facilities, as of June 30, 1967, is $148,271,000.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1967	1968	1969
Authorized Permanent Positions, end of year	4,650	4,150	4,150
Administrative-Type Cost	$77,734	$77,783	$75,574

FISCAL YEAR 1969 ESTIMATES

CONSOLIDATED SUMMARY

FOR AERONAUTICAL ACTIVITIES

	(Dollars in Millions) 1967	1968	1969
OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY			
Research and Development:			
Aeronautical Vehicles	$35.9	$66.8	$76.9
Electronics Systems	4.0	7.8	7.4
Human Factor Systems	2.2	2.5	2.2
Basic Research	3.6	4.3	4.8
Sub-Total	45.7	81.4	91.3
Other NASA support applicable to aeronautics	20.2	20.4	20.6
Total R&D	$65.9	$101.8	$111.9
Construction of Facilities	21.0	3.2	-
Administrative Operations	48.5	52.7	54.5
Total Aeronautical Activities	$135.4	$157.7	$166.4
Number of direct personnel engaged in aeronautics research and development effort	2,146	2,270	2,296

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

SUPPORTING RESEARCH AND TECHNOLOGY
(In thousands of dollars)

	Fiscal Year 1967	Fiscal Year 1968	Fiscal Year 1969
OFFICE OF MANNED SPACE FLIGHT....	$27,000	$32,000	$32,000
Apollo supporting development..	27,000	32,000	32,000
OFFICE OF SPACE SCIENCE AND APPLICATIONS.....	$67,795	$89,950	$105,800
Physics and astronomy.....	20,365	23,050	25,300
Lunar and planetary exploration	22,350	31,800	36,700
Launch vehicle development.....	4,000	---	---
Launch vehicle procurement.....	---	4,000	4,000
Bioscience.....	10,050	11,800	16,000
Space applications.....	11,030	19,300	23,800
OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY.....	$172,315	$198,553	$206,430
Basic research.....	21,401	21,465	22,000
Space vehicle systems.....	26,777	30,258	31,300
Electronics systems.....	32,302	38,700	38,900
Human factor systems.....	14,765	19,385	20,200
Space power and electric propulsion systems.....	34,940	35,400	35,800
Nuclear rockets.....	16,506	15,000	15,000
Chemical propulsion.....	16,094	17,800	17,800
Aeronautical vehicles.....	9,530	20,545	25,430
OFFICE OF TRACKING AND DATA ACQUISITION.....	$13,800	$12,800	$12,800
GRAND TOTAL.....	$280,910	$333,303	$357,030

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1969 ESTIMATES

AUTOMATIC DATA PROCESSING EQUIPMENT

TABLE OF CONTENTS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Automatic Data Processing Equipment
General Statement

Overall requirements for ADP resources within NASA are still increasing but at a slower rate than in preceding years. NASA is now moving heavily into its active mission phases which necessitates increased utilization of our computers. The major factor in this increase is the extensive use of digital computers by our scientists and engineers to achieve success in missions. The computer makes possible operation in the hostile outer space environment with its requirements for high reliability, extreme precision, and rapid decisions. Computation requirements are further increased by the in-depth testing, planning, and controlling that must take place before, during, and after launch due to the very low margin for error that can be allowed.

Our uses of computers are divided into two categories. The Category A, or general purpose use, includes all the machines that can service multiple users. This category includes the large, high speed computing facilities within NASA. While it accounts for over two-thirds of the cost of computers in NASA, only one-third of the total number of computers are involved. Approximately one-half of our capacity in this category is used primarily in direct support for mission operations. The Category B, or special purpose use, is unique to research and development agencies. These are primarily small computers which are integrated into an overall system in such a way as to make it impracticable to use them for other functions. Some examples of these include the computers at tracking sites, automatic checkout systems, communications switching, and other data acquisition, analysis, and control functions. Although over two-thirds of the number of computers in NASA are in Category B, less than one-third of the cost is attributable to this use.

REQUIREMENTS

Category A - (General Purpose)

The main increase in Category A requirements in FY 1969 is for the mission independent or true general purpose facilities. Our scientific and engineering uses are increasing at the same rate as in previous years, and we expect this rate to continue in the future. Our scientists and engineers are becoming more adept at using this tool and more familiar with its possibilities. As more and more people become trained in the use of computers, utilization increases. The problems that can be and are solved are more complex, and greater advances are made by our scientists and engineers in their tasks. The digital computer, with its greater speed and accuracy, is now being utilized as a tool for system simulation. Previously, only analog computers could serve this function. NASA business and record keeping applications are increasing as with all Federal agencies.

Our mission dependent computer requirements are also increasing, but very slightly. The increases are entirely in the data reduction area and are primarily the result of more complex spacecraft with increased data communications capability and heavy use of our in-house testing facilities.

Category B - (Special Purpose)

Our major instrumentation and checkout facilities are operational with increased requirements for FY 1969 primarily for small additions to these facilities. However, we must increase our communications switching capability and our project operation support equipment. Also, there are several small computing systems required for special instrumentation facilities.

FUNDING

The funding of ADP equipment is given in the following tables. A one-line summary of our total costs is shown below for reference purposes (all dollar figures in thousands):

	1967	1968	1969
ADPE Costs.....	81,617	75,630	69,984

As shown, the overall costs are reflecting declines between fiscal years. The small fluctuations of lease and purchase dollars are primarily caused by minor re-configuring of systems in our conversion to third generation equipment and the continuous search for those components which prove advantageous for Government purchase. It should be noted that the rise in maintenance costs is caused by our growing capital investment in computers, with this maintenance cost reaching 10% of our estimated FY 1969 ADPE funds. Part of the purchase costs in FY 1968 and FY 1969 are for procurements made in previous years, where capital investment costs have been spread out to match actual implementation dates.

NASA has constantly stressed better management of our ADP resources at the field centers that will result in higher utilization of our equipment with the least possible cost. We continually strive to meet our increasing requirements for this vital ADP resource while operating within an austerity environment. The accommodation of the large requirements, coupled with the decreasing overall ADP equipment costs, is considered a major accomplishment by NASA.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Summary of Automatic Data Processing Requirements

FY 1967 - FY 1969

(In Thousands of Dollars)

	FY 1967	FY 1968	FY 1969
OFFICE OF MANNED SPACE FLIGHT.....	40,031	36,786	36,424
Kennedy Space Center.....	4,352	2,982	3,194
Manned Spacecraft Center.....	23,500	22,714	23,956
Marshall Space Flight Center....	12,179	11,090	9,274
OFFICE OF SPACE SCIENCE AND APPLICATIONS.....	30,229	29,690	23,238
Goddard Space Flight Center.....	19,887	20,010	15,739
Jet Propulsion Laboratory.....	10,157	9,362	6,975
Wallops Station.....	185	318	524
OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY.....	10,908	8,481	9,480
Ames Research Center.....	2,360	2,146	3,045
Electronics Research Center.....	350	1,491	1,000
Flight Research Center.....	136	428	334
Langley Research Center.....	7,259	3,715	4,280
Lewis Research Center.....	490	289	345
Space Nuclear Propulsion Office.	313	412	476
HEADQUARTERS.....	449	673	842
TOTAL.....	81,617	75,630	69,984

EXPLANATORY NOTE

Purchase funds shown in the following tables cover peripheral equipment required to augment on-board computers as well as acquisition of additional complete machines; and purchases of complete computers may result in installation of new machines in the same or future years. Therefore, purchasing activity in a given year does not ordinarily result in corresponding changes in the same year's owned inventory of complete computers.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Analysis of Automatic Data Processing Equipment
(In Thousands of Dollars)
Fiscal Year 1967

OFFICE	Summary All Appropriations				Research and Development				Administrative Operations			
	Total	Purch.	Lease	Maint.	Total	Purch.	Lease	Maint.	Total	Purch.	Lease	Maint.
MANNED SPACE FLIGHT												
Kennedy Space Center												
Category A	4,352[1]	2,506[1]	1,736	110	669	125	434	110	1,302	---	1,302	---
Manned Spacecraft Center	23,500	7,863	14,618	1,019	18,416	7,847	10,116	453	5,084	16	4,502	566
Category A	14,565	310	13,647	608	9,481	294	9,145	42	5,084	16	4,502	566
Category B	8,935	7,553	971	411	8,935	7,553	971	411	---	---	---	---
Marshall Space Flight Center	12,179	673	11,022	484	7,760	349	7,339	72	4,419	324	3,683	412
Category A	11,865	673	10,708	484	7,446	349	7,025	72	4,419	324	3,683	412
Category B	314	---	314	---	314	---	314	---	---	---	---	---
OMSF TOTAL	40,031[1]	11,042[1]	27,376	1,613	26,845	8,321	17,889	635	10,805	340	9,487	978
Category A	30,782[1]	3,489[1]	26,091	1,202	17,596	768	16,604	224	10,805	340	9,487	978
Category B	9,249	7,553	1,285	411	9,249	7,553	1,285	411	---	---	---	---
SPACE SCIENCE AND APPLICATIONS												
Goddard Space Flight Center	19,887	13,307	5,303	1,277	13,992	12,894	71	1,027	5,895	413	5,232	250
Category A	6,663	1,407	4,625	631	1,407	994	---	413	5,256	413	4,625	218
Category B	13,224	11,900	678	646	12,585	11,900	71	614	639	---	607	32
Jet Propulsion Laboratory	10,157	3,192	6,009	956	10,157	3,192	6,009	956	---	---	---	---
Category A	6,451	262	5,696	493	6,451	262	5,696	493	---	---	---	---
Caetgory B	3,706	2,930	313	463	3,706	2,930	313	463	---	---	---	---
Wallops Station	185	105	35	45	156	105	6	45	29	---	29	---
Category A	153	75	35	43	124	75	6	43	29	---	29	---
Category B	32	30	---	2	32	30	---	2	---	---	---	---
OSSA TOTAL	30,229	16,604	11,347	2,278	24,305	16,191	6,086	2,028	5,924	413	5,261	250
Category A	13,267	1,744	10,356	1,167	7,982	1,331	5,702	949	5,285	413	4,654	218
Category B	16,962	14,860	991	1,111	16,323	14,860	384	1,079	639	---	607	32
ADVANCED RESEARCH AND TECHNOLOGY												
Ames Research Center	2,360	844	1,303	213	868	652	65	151	1,492	192	1,238	62
Category A	1,521	192	1,254	75	29	---	16	13	1,492	192	1,238	62
Category B	839	652	49	138	839	652	49	138	---	---	---	---
Electronics Research Center	350	236	112	2	199	199	---	---	151	37	112	2
Category A	151	37	112	2	---	---	---	---	151	37	112	2
Category B	199	199	---	---	199	199	---	---	---	---	---	---
Flight Research Center	136	96	---	40	38	19	---	19	98	77	---	21
Category A	98	77	---	21	---	---	---	---	98	77	---	21
Category B	38	19	---	19	38	19	---	19	---	---	---	---
Langley Research Center	7,259[2]	4,860[2]	2,274	125	350	215	133	2	6,422	4,158	2,141	123
Category A	6,560	4,163	2,274	123	138	5	133	---	6,422	4,158	2,141	123
Category B	699[2]	697[2]	---	2	212	210	---	2	---	---	---	---
Lewis Research Center	490	215	188	87	28	28	---	---	462	187	188	87
Category A	363	88	188	87	---	---	---	---	363	88	188	87
Category B	127	127	---	---	28	28	---	---	99	99	---	---
Space Nuclear Propulsion Office												
Category A	313	---	313	---	313	---	313	---	---	---	---	---
OART TOTAL	10,908[2]	6,251[2]	4,190	467	1,796	1,113	511	172	8,625	4,651	3,679	295
Category A	9,006	4,557	4,141	308	480	5	462	13	8,526	4,552	3,679	295
Category B	1,902[2]	1,694[2]	49	159	1,316	1,108	49	159	99	99	---	---
HEADQUARTERS												
Category A	449	16	414	19	---	---	---	---	449	16	414	19
AGENCY SUMMARY	81,617[3]	33,913[3]	43,327	4,377	52,946	25,625	24,486	2,835	25,803	5,420	18,841	1,542
Category A	53,504[1]	9,806[1]	41,002	2,696	26,058	2,104	22,768	1,186	25,065	5,321	18,234	1,510
Category B	28,113[2]	24,107[2]	2,325	1,681	26,888	23,521	1,718	1,649	738	99	607	32

1/ Includes 2,381 purchase of Category A equipment from CoF appropriation.

2/ Includes 487 purchase of Category B equipment from CoF appropriation.

3/ Includes total of 2,868 funded from CoF appropriation.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Analysis of Automatic Data Processing Equipment
(In Thousands of Dollars)
Fiscal Year 1968

OFFICE	Summary All Appropriations Total	Purch.	Lease	Maint.	Research and Development Total	Purch.	Lease	Maint.	Administrative Operations Total	Purch.	Lease	Maint.
MANNED SPACE FLIGHT												
Kennedy Space Center												
Category A	2,982	1,000	1,548	434	1,782	1,000	348	434	1,200	---	1,200	---
Manned Spacecraft Center	22,714	3,644	17,636	1,434	17,354	3,644	12,960	750	5,360	---	4,676	684
Category A	17,587	103	16,758	726	12,227	103	12,082	42	5,360	---	4,676	684
Category B	5,127	3,541	878	708	5,127	3,541	878	708	---	---	---	---
Marshall Space Flight Center	11,090	651	9,997	442	7,112	651	6,239	222	3,978	---	3,758	220
Category A	10,761	651	9,668	442	6,783	651	5,910	222	3,978	---	3,758	220
Category B	329	---	329	---	329	---	329	---	---	---	---	---
OMSF TOTAL	36,786	5,295	29,181	2,310	26,248	5,295	19,547	1,406	10,538	---	9,634	904
Category A	31,330	1,754	27,974	1,602	20,792	1,754	18,340	698	10,538	---	9,634	904
Category B	5,456	3,541	1,207	708	5,456	3,541	1,207	708	---	---	---	---
SPACE SCIENCE AND APPLICATIONS												
Goddard Space Flight Center	20,010	11,644	6,299	2,067	14,543	11,644	1,113	1,786	5,467	---	5,186	281
Category A	11,008	4,435	5,683	890	5,950	4,435	906	609	5,058	---	4,777	281
Category B	9,002	7,209	616	1,177	8,593	7,209	207	1,177	409	---	409	---
Jet Propulsion Laboratory	9,362	2,661	5,534	1,167	9,362	2,661	5,534	1,167	---	---	---	---
Category A	5,381	56	4,760	565	5,381	56	4,760	565	---	---	---	---
Category B	3,981	2,605	774	602	3,981	2,605	774	602	---	---	---	---
Wallops Station	318	162	74	82	288	162	44	82	30	---	30	---
Category A	166	12	74	80	136	12	44	80	30	---	30	---
Category B	152	150	---	2	152	150	---	2	---	---	---	---
OSSA TOTAL	29,690	14,467	11,907	3,316	24,193	14,467	6,691	3,035	5,497	---	5,216	281
Category A	16,555	4,503	10,517	1,535	11,467	4,503	5,710	1,254	5,088	---	4,807	281
Category B	13,135	9,964	1,390	1,781	12,726	9,964	981	1,781	409	---	409	---
ADVANCED RESEARCH AND TECHNOLOGY												
Ames Research Center	2,146	475	1,468	203	744	475	131	138	1,402	---	1,337	65
Category A	1,496	---	1,410	86	94	---	73	21	1,402	---	1,337	65
Category B	650	475	58	117	650	475	58	117	---	---	---	---
Electronics Research Center	1,491	1,297	194	---	1,318	1,297	21	---	173	---	173	---
Category A	173	---	173	---	---	---	---	---	173	---	173	---
Category B	1,318	1,297	21	---	1,318	1,297	21	---	---	---	---	---
Flight Research Center	428	327	56	45	382	302	56	24	46	25	---	21
Category A	46	25	---	21	---	---	---	---	46	25	---	21
Category B	382	302	56	24	382	302	56	24	---	---	---	---
Langley Research Center	3,715	327	2,943	445	370	327	---	43	3,345	---	2,943	402
Category A	3,345	---	2,943	402	---	---	---	---	3,345	---	2,943	402
Category B	370	327	---	43	370	327	---	43	---	---	---	---
Lewis Research Center												
Category A	289	8	125	156	---	---	---	---	289	8	125	156
Space Nuclear Propulsion Office												
Category A	412	---	412	---	412	---	412	---	---	---	---	---
OART TOTAL	8,481	2,434	5,198	849	3,226	2,401	620	205	5,255	33	4,578	644
Category A	5,761	33	5,063	665	506	---	485	21	5,255	33	4,578	644
Category B	2,720	2,401	135	184	2,720	2,401	135	184	---	---	---	---
HEADQUARTERS												
Category A	673	---	639	34	---	---	---	---	673	---	639	34
AGENCY SUMMARY	75,630	22,196	46,925	6,509	53,667	22,163	26,858	4,646	21,963	33	20,067	1,863
Category A	54,319	6,290	44,193	3,836	32,765	6,257	24,535	1,973	21,554	33	19,658	1,863
Category B	21,311	15,906	2,732	2,673	20,902	15,906	2,323	2,673	409	---	409	---

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Analysis of Automatic Data Processing Equipment
(In Thousands of Dollars)
Fiscal Year 1969

OFFICE	Summary All Appropriations				Research and Development				Administrative Operations			
	Total	Purch.	Lease	Maint.	Total	Purch.	Lease	Maint.	Total	Purch.	Lease	Maint.
MANNED SPACE FLIGHT												
Kennedy Space Center												
Category A	3,194	900	1,840	454	1,874	900	520	454	1,320	---	1,320	---
Manned Spacecraft Center	23,956	4,350	18,142	1,464	18,596	4,350	13,466	780	5,360	---	4,676	684
Category A	17,954	---	17,228	726	12,594	---	12,552	42	5,360	---	4,676	684
Category B	6,002	4,350	914	738	6,002	4,350	914	738	---	---	---	---
Marshall Space Flight Center	9,274	---	9,034	240	5,340	---	5,290	50	3,934	---	3,744	190
Category A	9,144	---	8,904	240	5,210	---	5,160	50	3,934	---	3,744	190
Category B	130	---	130	---	130	---	130	---	---	---	---	---
OMSF TOTAL	36,424	5,250	29,016	2,158	25,810	5,250	19,276	1,284	10,614	---	9,740	874
Category A	30,292	900	27,972	1,420	19,678	900	18,232	546	10,614	---	9,740	874
Category B	6,132	4,350	1,044	738	6,132	4,350	1,044	738	---	---	---	---
SPACE SCIENCE AND APPLICATIONS												
Goddard Space Flight Center	15,739	6,456	6,413	2,870	10,243	6,456	925	2,862	5,496	---	5,488	8
Category A	10,457	3,000	5,879	1,578	5,245	3,000	675	1,570	5,212	---	5,204	8
Category B	5,282	3,456	534	1,292	4,998	3,456	250	1,292	284	---	284	---
Jet Propulsion Laboratory	6,975	749	5,213	1,013	6,975	749	5,213	1,013	---	---	---	---
Category A	3,799	5	3,319	475	3,799	5	3,319	475	---	---	---	---
Category B	3,176	744	1,894	538	3,176	744	1,894	538	---	---	---	---
Wallops Station	524	300	127	97	494	300	97	97	30	---	30	---
Category A	207	---	127	80	177	---	97	80	30	---	30	---
Category B	317	300	---	17	317	300	---	17	---	---	---	---
OSSA TOTAL	23,238	7,505	11,753	3,980	17,712	7,505	6,235	3,972	5,526	---	5,518	8
Category A	14,463	3,005	9,325	2,133	9,221	3,005	4,091	2,125	5,242	---	5,234	8
Category B	8,775	4,500	2,428	1,847	8,491	4,500	2,144	1,847	284	---	284	---
ADVANCED RESEARCH AND TECHNOLOGY												
Ames Research Center	3,045	1,330	1,465	250	1,643	1,330	128	185	1,402	---	1,337	65
Category A	1,551	---	1,465	86	149	---	128	21	1,402	---	1,337	65
Category B	1,494	1,330	---	164	1,494	1,330	---	164	---	---	---	---
Electronics Research Center	1,000	700	300	---	700	700	---	---	300	---	300	---
Category A	300	---	300	---	---	---	---	---	300	---	300	---
Category B	700	700	---	---	700	700	---	---	---	---	---	---
Flight Research Center	334	175	112	47	288	150	112	26	46	25	---	21
Category A	46	25	---	21	---	---	---	---	46	25	---	21
Category B	288	150	112	26	288	150	112	26	---	---	---	---
Langley Research Center	4,280	837	2,943	500	935	837	---	98	3,345	---	2,943	402
Category A	3,345	---	2,943	402	---	---	---	---	3,345	---	2,943	402
Category B	935	837	---	98	935	837	---	98	---	---	---	---
Lewis Research Center												
Category A	345	---	189	156	---	---	---	---	345	---	189	156
Space Nuclear Propulsion Office												
Category A	476	---	476	---	476	---	476	---	---	---	---	---
OART TOTAL	9,480	3,042	5,485	953	4,042	3,017	716	309	5,438	25	4,769	644
Category A	6,063	25	5,373	665	625	---	604	21	5,438	25	4,769	644
Category B	3,417	3,017	112	288	3,417	3,017	112	288	---	---	---	---
HEADQUARTERS												
Category A	842	---	808	34	---	---	---	---	842	---	808	34
AGENCY SUMMARY	69,984	15,797	47,062	7,125	47,564	15,772	26,227	5,565	22,420	25	20,835	1,560
Category A	51,660	3,930	43,478	4,252	29,524	3,905	22,927	2,692	22,136	25	20,551	1,560
Category B	18,324	11,867	3,584	2,873	18,040	11,867	3,300	2,873	284	---	284	---

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Inventory of Computers

EXPLANATORY NOTE

The inventory of computers includes machines on-board at the end of each fiscal year. The owned inventory does not include machines purchased during the year that were not yet installed at year-end. It does reflect installation of machines purchased in prior years, purchases of on-board machines previously leased, and removal of replaced machines. Therefore, there is not a direct correlation between computer purchases funded in a given year and changes in the same year's inventory of purchased computers.

DEFINITIONS

Large refers to computers costing $1,500,001 or more,

Medium $450,001 to $1,500,000,

Small $450,000 or less.

Purchase refers to equipment that is owned,

Lease to equipment leased and

P/L denotes a combination of components, some owned, some leased.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers

	June 30, 1967				June 30, 1968				June 30, 1969			
	Purchase	Lease	P/L	Total	Purchase	Lease	P/L	Total	Purchase	Lease	P/L	Total
OFFICE OF MANNED SPACE FLIGHT												
Kennedy Space Center												
Category A Total	3	4	3	10	3	2	3	8	3	3	2	8
Large	-	1	3	4	-	1	3	4	-	1	2	3
Medium	-	-	-	-	-	-	-	-	-	1	-	1
Small	3	3	-	6	3	1	-	4	3	1	-	4
Category B Total	2	-	-	2	2	-	-	2	2	-	-	2
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	2	-	-	2	2	-	-	2	2	-	-	2
Small	-	-	-	-	-	-	-	-	-	-	-	-
Summary A & B	5	4	3	12	5	2	3	10	5	3	2	10
Large	-	1	3	4	-	1	3	4	-	1	2	3
Medium	2	-	-	2	2	-	-	2	2	1	-	3
Small	3	3	-	6	3	1	-	4	3	1	-	4
Manned Spacecraft Center												
Category A Total	3	21	7	31	4	21	7	32	4	21	7	32
Large	1	8	3	12	1	9	3	13	1	9	3	13
Medium	2	1	3	6	3	1	3	7	3	1	3	7
Small	-	12	1	13	-	11	1	12	-	11	1	12
Category B Total	92	5	4	101	96	6	4	106	101	6	4	111
Large	-	-	3	3	2	1	3	6	3	1	3	7
Medium	21	-	1	22	23	-	1	24	25	-	1	26
Small	71	5	-	76	71	5	-	76	73	5	-	78
Summary A & B	95	26	11	132	100	27	11	138	105	27	11	143
Large	1	8	6	15	3	10	6	19	4	10	6	20
Medium	23	1	4	28	26	1	4	31	28	1	4	33
Small	71	17	1	89	71	16	1	88	73	16	1	90
Marshall Space Flight Center												
Category A Total	8	27	7	42	7	20	7	34	5	8	5	18
Large	-	2	3	5	-	5	3	8	-	5	1	6
Medium	3	4	-	7	2	3	-	5	-	-	-	-
Small	5	21	4	30	5	12	4	21	5	3	4	12
Category B Total	70	-	-	70	70	-	-	70	70	-	-	70
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	8	-	-	8	8	-	-	8	8	-	-	8
Small	62	-	-	62	62	-	-	62	62	-	-	62
Summary A & B	78	27	7	112	77	20	7	104	75	8	5	88
Large	-	2	3	5	-	5	3	8	-	5	1	6
Medium	11	4	-	15	10	3	-	13	8	-	-	8
Small	67	21	4	92	67	12	4	83	67	3	4	74
Michoud Assembly Facility												
Category A Total	2	11	-	13	3	10	-	13	2	2	-	4
Large	1	5	-	6	2	5	-	7	1	2	-	3
Medium	-	1	-	1	-	1	-	1	-	-	-	-
Small	1	5	-	6	1	4	-	5	1	-	-	1
Category B Total	8	1	-	9	8	1	-	9	8	-	-	8
Large	1	1	-	2	1	1	-	2	1	-	-	1
Medium	1	-	-	1	1	-	-	1	1	-	-	1
Small	6	-	-	6	6	-	-	6	6	-	-	6
Summary A & B	10	12	-	22	11	11	-	22	10	2	-	12
Large	2	6	-	8	3	6	-	9	2	2	-	4
Medium	1	1	-	2	1	1	-	2	1	-	-	1
Small	7	5	-	12	7	4	-	11	7	-	-	7

End of Year Inventory of Computers (Continued)

	June 30, 1967				June 30, 1968				June 30, 1969			
	Purchase	Lease	P/L	Total	Purchase	Lease	P/L	Total	Purchase	Lease	P/L	Total
OFFICE OF SPACE SCIENCE AND APPLICATIONS												
Goddard Space Flight Center Greenbelt, Md.												
Category A Total	1	10	15	26	1	7	17	25	1	7	12	20
Large	1	1	9	11	1	-	11	12	1	-	8	9
Medium	-	-	2	2	-	-	2	2	-	-	2	2
Small	-	9	4	13	-	7	4	11	-	7	2	9
Category B Total	28	4	12	44	43	3	12	58	44	2	12	58
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	4	-	7	11	6	-	7	13	6	-	7	13
Small	24	4	5	33	37	3	5	45	38	2	5	45
Summary A & B	29	14	27	70	44	10	29	83	45	9	24	78
Large	1	1	9	11	1	-	11	12	1	-	8	9
Medium	4	-	9	13	6	-	9	15	6	-	9	15
Small	24	13	9	46	37	10	9	56	38	9	7	54
Goddard Space Flight Center Institute for Space Studies New York, N. Y.												
Category A Total	-	-	1	1	-	-	1	1	-	-	1	1
Large	-	-	1	1	-	-	1	1	-	-	1	1
Medium	-	-	-	-	-	-	-	-	-	-	-	-
Small	-	-	-	-	-	-	-	-	-	-	-	-
Goddard Space Flight Center Tracking Stations												
Category B Total	94	-	-	94	94	-	-	94	96	-	-	96
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	-	-	-	-	-	-	-	-	-	-	-	-
Small	94	-	-	94	94	-	-	94	96	-	-	96
Goddard Space Flight Center Other Locations												
Category B Total	14	1	-	15	17	-	-	17	18	-	-	18
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	-	-	-	-	2	-	-	2	2	-	-	2
Small	14	1	-	15	15	-	-	15	16	-	-	16
Jet Propulsion Laboratory Pasadena, Calif.												
Category A Total	6	11	10	27	5	9	9	23	3	7	6	16
Large	2	3	5	10	2	1	4	7	-	1	3	5
Medium	-	3	3	6	-	3	3	6	-	3	3	6
Small	4	5	2	11	3	5	2	10	3	3	-	5
Category B Total	27	1	4	32	34	3	4	41	43	2	4	47
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	3	1	-	4	3	1	-	4	10	-	-	10
Small	24	-	4	28	31	2	4	37	33	2	4	37
Summary A & B	33	12	14	59	39	12	13	64	46	9	10	53
Large	2	3	5	10	2	1	4	7	-	1	3	5
Medium	3	4	3	10	3	4	3	10	10	3	3	16
Small	28	5	6	39	34	7	6	47	33	5	4	42
Jet Propulsion Laboratory Tracking Stations												
Category B Total	40	-	1	41	40	1	1	42	42	2	1	45
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	-	-	-	-	-	1	-	1	2	2	-	3
Small	40	-	1	41	40	-	1	41	40	-	1	42

End of Year Inventory of Computers (Continued)

	June 30, 1967				June 30, 1968				June 30, 1969			
	Purchase	Lease	P/L	Total	Purchase	Lease	P/L	Total	Purchase	Lease	P/L	Total
OFFICE OF SPACE SCIENCE AND APPLICATIONS (Cont'd)												
Wallops Station												
Category A Total	-	-	1	1	-	-	1	1	-	-	1	1
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	-	-	1	1	-	-	1	1	-	-	1	1
Small	-	-	-	-	-	-	-	-	-	-	-	-
Category B Total	2	-	-	2	3	-	-	3	4	-	-	4
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	-	-	-	-	-	-	-	-	-	-	-	-
Small	2	-	-	2	3	-	-	3	4	-	-	4
Summary A & B	2	-	1	3	3	-	1	4	4	-	1	5
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	-	-	1	1	-	-	1	1	-	-	1	1
Small	2	-	-	2	3	-	-	3	4	-	-	4
OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY												
Ames Research Center												
Category A Total	5	8	2	15	5	4	1	10	5	3	1	9
Large	1	-	-	1	1	-	-	1	1	-	-	1
Medium	1	1	-	2	1	2	-	3	1	2	-	3
Small	3	7	2	12	3	2	1	6	3	1	1	5
Category B Total	7	1	-	8	11	1	1	13	14	-	1	15
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	1	-	-	1	1	-	-	1	1	-	-	1
Small	6	1	-	7	10	1	1	12	13	-	1	14
Summary A & B	12	9	2	23	16	5	2	23	19	3	2	24
Large	1	-	-	1	1	-	-	1	1	-	-	1
Medium	2	1	-	3	2	2	-	4	2	2	-	4
Small	9	8	2	19	13	3	2	18	16	1	2	19
Electronics Research Center												
Category A Total	-	1	-	1	-	2	2	4	-	1	2	3
Large	-	-	-	-	-	-	1	1	-	-	1	1
Medium	-	-	-	-	-	-	-	-	-	-	-	-
Small	-	1	-	1	-	2	1	3	-	1	1	2
Category B Total	-	-	-	-	6	1	-	7	10	-	-	10
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	-	-	-	-	-	-	-	-	-	-	-	-
Small	-	-	-	-	6	1	-	7	10	-	-	10
Summary A & B	-	1	-	1	6	3	2	11	10	1	2	13
Large	-	-	-	-	-	-	1	1	-	-	1	1
Medium	-	-	-	-	-	-	-	-	-	-	-	-
Small	-	1	-	1	6	3	1	10	10	1	1	12
Flight Research Center												
Category A Total	1	-	-	1	1	-	-	1	1	-	-	1
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	1	-	-	1	1	-	-	1	1	-	-	1
Small	-	-	-	-	-	-	-	-	-	-	-	-
Category B Total	4	-	-	4	5	1	-	6	6	1	-	7
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	-	-	-	-	-	-	-	-	-	-	-	-
Small	4	-	-	4	5	1	-	6	6	1	-	7
Summary A & B	5	-	-	5	6	1	-	7	7	1	-	8
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	1	-	-	1	1	-	-	1	1	-	-	1
Small	4	-	-	4	5	1	-	6	6	1	-	7

End of Year Inventory of Computers (Continued)

	June 30, 1967				June 30, 1968				June 30, 1969			
	Purchase	Lease	P/L	Total	Purchase	Lease	P/L	Total	Purchase	Lease	P/L	Total
OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY (Cont'd)												
Langley Research Center:												
Category A Total	5	4	-	9	4	2	-	6	4	[illegible]	-	6
Large	3	2	-	5	2	1	-	3	2		-	3
Medium	1	1	-	2	1	-	-	1	1		-	1
Small	1	1	-	2	1	1	-	2	1		-	2
Category B Total	3	-	-	3	5	-	-	5	8		-	8
Large	-	-	-	-	-	-	-	-	-		-	-
Medium	1	-	-	1	1	-	-	1	1		-	1
Small	2	-	-	2	4	-	-	4	7		-	7
Summary A & B	8	4	-	12	9	2	-	11	12	2	-	14
Large	3	2	-	5	2	1	-	3	2	1	-	3
Medium	2	1	-	3	2	-	-	2	2	-	-	2
Small	3	1	-	4	5	1	-	6	8	1	-	9
Lewis Research Center												
Category A Total	6	1	-	7	8	1	-	9	8	1	-	9
Large	2	-	-	2	4	-	-	4	4	-	-	4
Medium	1	-	-	1	1	-	-	1	1	-	-	1
Small	3	1	-	4	3	1	-	4	3	1	-	4
Category B Total	1	-	-	1	6	-	-	6	6	-	-	6
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	-	-	-	-	1	-	-	1	1	-	-	1
Small	1	-	-	1	5	-	-	5	5	-	-	5
Summary A & B	7	1	-	8	14	1	-	15	14	1	-	15
Large	2	-	-	2	4	-	-	4	4	-	-	4
Medium	1	-	-	1	2	-	-	2	2	-	-	2
Small	4	1	-	5	8	1	-	9	8	1	-	9
Space Nuclear Propulsion Office												
Category A Total	-	1	-	1	-	1	-	1	-	1	-	1
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	-	1	-	1	-	1	-	1	-	1	-	1
Small	-	-	-	-	-	-	-	-	-	-	-	-
HEADQUARTERS												
Category A Total	-	3	1	4	-	2	2	4	-	2	2	4
Large	-	-	-	-	-	-	-	-	-	-	-	-
Medium	-	1	1	2	-	1	2	3	-	1	2	3
Small	-	2	-	2	-	1	-	1	-	1	-	1
AGENCY SUMMARY												
Category A Total	40	102	47	189	41	81	50	172	36	58	39	133
Large	11	22	24	57	13	22	26	61	11	19	19	49
Medium	9	13	10	32	9	12	11	32	7	9	11	27
Small	20	67	13	100	19	47	13	79	18	30	9	57
Category B Total	392	13	21	426	440	17	22	479	470	13	22	505
Large	1	1	3	5	3	2	3	8	4	1	3	8
Medium	41	1	8	50	48	2	8	58	58	2	8	68
Small	350	11	10	371	389	13	11	413	408	10	11	429
Summary A & B	432	115	68	615	481	98	72	651	506	71	61	638
Large	12	23	27	62	16	24	29	69	15	20	22	57
Medium	50	14	18	82	57	14	19	90	65	11	19	95
Small	370	78	23	471	408	60	24	492	426	40	20	486

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

KENNEDY SPACE CENTER

	FY 1967	FY 1968	FY 1969
Computer Cost (In thousands of dollars):			
Purchase	2,506	1,000	900
Lease	1,736	1,548	1,840
Maintenance	110	434	454
Total	4,352	2,982	3,194
Number of Computers (End of Year):			
Purchased	5	5	5
Leased	4	2	3
Purchased/Leased	3	3	2
Total	12	10	10
Number of Personnel:			
Civil Service	57	58	58
Contracting Firm	460	478	458

Contractor Identification

Name of Firm	Service Performed
ITT/Federal Electric Co.	System Design, Computer Programming, Operations and Maintenance

KENNEDY SPACE CENTER

The bulk of the general purpose computer equipment at KSC is located in the Central Instrumentation Facility. Much of this equipment is operated "on-line" as part of the count-down and launch control system for a significant portion of the total operating time, since all major space vehicle projects are supported.

FY 1967

During Fiscal Year 1967 the GE 635 system in the Central Instrumentation Facility was expanded to provide capability for supporting multiple tests, as well as accommodating a portion of the business-type computation workload. Purchase of a part of that expanded installation was made in FY 1967 and additional portions are planned for purchase in FY 1968 and FY 1969. The expanded GE 635 system achieved full operational status before the end of the year and two older systems, a GE 415 and a GE 235, were released.

FY 1968

Prior to July 31, 1967, KSC had two support contractors for data processing. Under the new contract, ITT/FEC is the sole support contractor and this change is expected to simplify contract administration. Growth in requirements to support the operational checkout procedures for the spacecraft and launch vehicle resulted in a plan to replace the balance of the older equipment being used for data processing. Selection of a single computer to replace the IBM 7010's and 1440 will be made in February with installation planned 9 to 12 months later.

FY 1969

All launches at KSC are supported by general scientific computation and telemetry data reduction. The total computer workload is responsive to the launch schedule. While future changes in the launch schedule would sharply impact ADP workload, near-term effort will be devoted to completing the implementation of existing systems without any significant changes in hardware configurations.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

MANNED SPACECRAFT CENTER

	FY 1967	FY 1968	FY 1969
Computer Cost (In thousands of dollars):			
Purchase	7,863	3,644	4,350
Lease	14,618	17,636	18,142
Maintenance	1,019	1,434	1,464
Total	23,500	22,714	23,956
Number of Computers (End of Year):			
Purchased	95	100	105
Leased	26	27	27
Purchased/Leased	11	11	11
Total	132	138	143
Number of Personnel:			
Civil Service	246	256	256
Contracting Firm	1,363	1,381	1,381

Contractor Identification

Name of Firm	Service Performed
IBM	RTCC System Design, Computer Programming, Operations, and Maintenance
Lockheed Electronics Co.	System Design, Computer Programming, Operations, and Maintenance

MANNED SPACECRAFT CENTER

At MSC the Computation and Analysis Division is responsible for all general purpose computation and data processing. Flight Operations Directorate manages the ADP equipment supporting manned spacecraft missions, while the Information Systems Division monitors ADP requirements of a special purpose nature.

FY 1967

During Fiscal Year 1967, UNIVAC 1108 computers replaced the older equipment being used for scientific, engineering and business-type applications. The CDC computer in the data reduction complex was upgraded. Three small computers were installed at remote locations to serve as terminals from the Central Computer Complex, as well as to provide peripheral support to stand-alone, large-scale computers at each location. In the Real-Time Computer Complex, conversion to IBM 360 systems was completed.

FY 1968

Software conversion of the newly installed UNIVAC equipment is the principal milestone to be passed before further development in the general purpose computer complex can be undertaken. The need for an additional main-frame in the RTCC was validated in October 1967 and release of two IBM 360/50's scheduled in 1968 was deferred. Replacement of the CDC computer in the data reduction complex is being considered. Two additional spacecraft checkout stations (four computers) are planned for purchase in Fiscal Year 1968.

FY 1969

The original plan to use several small computers to control the Apollo flight simulator was modified in favor of a single large-scale machine. Delivery of a purchased system is anticipated in FY 1969. No additional main-frames are expected to be required in the RTCC unless it becomes necessary to augment the capability to support multi-missions. In the general purpose computer complex, efforts to consolidate existing capability will continue.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

MARSHALL SPACE FLIGHT CENTER

	FY 1967	FY 1968	FY 1969
Computer Cost (In thousands of dollars):			
Purchase	673	651	---
Lease	11,022	9,997	9,034
Maintenance	484	442	240
Total	12,179	11,090	9,274
Number of Computers (End of Year):			
Purchased	88	88	85
Leased	39	31	10
Purchased/Leased	7	7	5
Total	134	126	100
Number of Personnel:			
Civil Service	176	168	168
Contracting Firm	780	711	711

Contractor Identification

Name of Firm	Service Performed
Computer Sciences Corporation	System Design, Computer Programming, Operations and Maintenance
LTV Range Systems	Operation of the Slidell Computor Office*

*Contractor users perform their own applications programming.

MARSHALL SPACE FLIGHT CENTER

Most MSFC computation requirements are served by two large central computer complexes located at Huntsville, Alabama and Slidell, Louisiana. In addition, there are a variety of smaller computers dispersed throughout the research laboratories.

FY 1967

In August 1966 MSFC contracted with the UNIVAC Division of Sperry Rand Corporation for a Third Generation Computer System to be installed at Huntsville, Alabama and Michoud/Slidell, Louisiana. This centralized system was scheduled to begin installation in May and June 1967 and extend over a twenty-four month period to completion. As a result of delays by the contractor in software development, the contract was re-negotiated with a seven month slip in the original schedule.

FY 1968

Installations at Huntsville and Slidell are scheduled to begin in January 1968. However, the schedule slip has postponed release of almost all of the replaced computers until FY 1969. Due to the delay, Slidell purchased an installed Honeywell 1800 in July and replaced most of the leased components in the IBM 7094 system with NASA owned components relocated from Langley Research Center.

FY 1969

No major computer acquisitions are anticipated at this time beyond completion of the UNIVAC Third Generation System. Development of the full potential of this system dominates the future ADP planning at MSFC.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

GODDARD SPACE FLIGHT CENTER

	FY 1967	FY 1968	FY 1969
Computer Cost (In thousands of dollars):			
Purchase	13,307	11,644	6,456
Lease	5,303	6,299	6,413
Maintenance	1,277	2,067	2,870
Total	19.887	20,010	15,739
Number of Computers (End of Year):			
Purchased	137	155	159
Leased	15	10	9
Purchased/Leased	28	30	25
Total	180	195	193
Number of Personnel:			
Civil Service	425	407	407
Contracting Firm	946	1,189	1,220

Contractor Identification

Name of Firm	Service Performed
CEIR	Programming
Computer Applications, Inc.	Programming, Operation and Maintenance
Computer Sciences Corporation	Programming
Computing and Software, Inc.	Data Processing, Operation and Maintenance
IBM	Programming, Analysis, Operation and Maintenance
The Martin Company	Programming
Sperry Rand Corporation (Univac)	Programming, Analysis and Maintenance
Westinghouse	Programming
Wolf Research and Development Corp.	Programming

GODDARD SPACE FLIGHT CENTER

GSFC uses computers extensively in support of space science research, spacecraft flight operations, tracking and telemetry, data reduction and analysis, and communications. Operational responsiblity for the computers lies with the functional groups engaged in these programs. Over half of the computers are located at tracking sites around the world. Effective Center-wide coordination and review of all automatic data processing (ADP) equipment and services are achieved through the Deputy Assistant Director for Center ADP and his supporting staff in the Tracking and Data Systems Directorate.

FY 1967

Major system up-dating continued in FY 1967. A second Univac 1108 was installed as a replacement for a Univac 1107 to augment the satellite telemetry data processing facility. An IBM 360/65J was installed on an interim basis pending replacement by an IBM 360/91 as planned. At the very end of the year, the first IBM 360/75 was added as part of the central computing facilities at Greenbelt. To achieve the computing capacity required during this year, despite some delays in IBM 360 software and hardware, a rent-free IBM 360/50 was coupled with the IBM 360/65J; and an additional 7094 was also furnished rent-free. Small computers were added for direct support of flight projects, the majority being installed at tracking sites to meet Project Apollo requirements.

FY 1968

This year marks the completion of the installation of the IBM 360 systems and the phasing-out of all but four of the IBM 7094 computers. Due to budgetary limitations, there will be one less IBM 360 than originally planned. An IBM 360/95J will be installed at the Goddard Institute for Space Studies in New York City. Other IBM 360's being installed this year at Greenbelt are a 360/95, a 360/91 and two 360/75's. A third Univac 494 is to be added to the NASCOM Communications System to provide greater reliability for communications, particularly for Project Apollo. A number of small computers will be added for a variety of projects including additional capability for the OAO Control Center and spacecraft checkout.

FY 1969

The total number of computers is expected to decrease in this fiscal year with the final transition to the IBM 360 systems from the IBM 7094 computers. This year the software to provide full operation of the IBM 360's at Greenbelt as an integrated computer complex is scheduled for completion. Three 7094 computers and their associated small support computers will be released. One completely purchased 7094 computer will be retained to support the National Space Science Data Center as planned. Two additional small computers are expected to be required at the tracking stations to meet Project Apollo requirements.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

JET PROPULSION LABORATORY

	FY 1967	FY 1968	FY 1969
Computer Cost (In thousands of dollars):			
Purchase	3,192	2,661	749
Lease	6,009	5,534	5,213
Maintenance	956	1,167	1,013
Total	10,157	9,362	6,975
Number of Computers (End of Year):			
Purchased	73	79	86
Leased	12	13	11
Purchased/Leased	15	14	11
Total	100	106	108
Number of Personnel:			
Jet Propulsion Laboratory	227	247	244
Contracting Firm	271	242	235

Contractor Identification

Name of Firm	Service Performed
Bendix Field Engineering Corporation	Operation
Computer Communications, Inc.	Software Maintenance, Operation
Computer Usage Development Corporation	Programming
IBM	Programming, System Studies, Off-Site Computation
Programatics	Programming
Mauchly-Wood Software Corporation	Programming

JET PROPULSION LABORATORY

The Jet Propulsion Laboratory--a government-owned facility managed and operated by the California Institute of Technology under contract to NASA--is involved primarily in NASA's Lunar and Planetary Program, but also maintains a comprehensive program of supporting research and development. In addition, JPL manages the operation of the Deep Space Network of Tracking and Data Acquisition stations. In support of these research and development activities, JPL makes extensive use of automatic data processing equipment.

FY 1967

A fourth computer string was added to the Space Flight Operation Facility of JPL this fiscal year to provide support to the very active Lunar and Planetary Program of Calendar Year 1967. This year also saw the addition of a number of small computers that were acquired to provide direct support to various projects. The majority of these computers were installed at the tracking sites or in the laboratory in direct support of the tracking function.

FY 1968

The bulk of the ADP equipment acquisition during this fiscal year involves numerous small purchases associated with a general upgrading of computing and data communications handling at nine Deep Space Stations. FY 1968 will see the elimination of several of the large general purpose machines of the Space Flight Operation Facility. In all cases, the computers to be removed will be leased machines. The reduction in the number of computers in the Space Flight Operation Facility is being undertaken to match the reduced requirements resulting from the anticipated lower level of deep space activity.

FY 1969

The most significant action to take place during this fiscal year will be the completion of the installation begun in late FY 1968 of a third generation computer in the Scientific Computing Facility. This system will provide increased storage, speed, accuracy, and flexibility. It will replace several existing pieces of equipment and will result in a net decrease in expenses. Also, a central processor needed to upgrade the tracking and data handling capability at the Goldstone Mars site will be purchased. FY 1969 will also see a further significant reduction in the number of general purpose computation computers. This is attributed to two factors. One factor is the assumption of some of the supporting functions by the new Scientific Computing Facility Computer. The second is the further decrease in the number of computers required by the Space Flight Operation Facility due to the very pronounced reduction in deep space missions to be supported.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

WALLOPS STATION

	FY 1967	FY 1968	FY 1969
Computer Cost (In thousands of dollars):			
Purchase	105	162	300
Lease	35	74	127
Maintenance	45	82	97
Total	185	318	524
Number of Computers (End of Year):			
Purchased	2	3	4
Leased	-	-	-
Purchased/Leased	1	1	1
Total	3	4	5
Number of Personnel:			
Civil Service	16	22	22
Contracting Firm	22	23	23

Contractor Identification

Name of Firm	Service Performed
Technitrol Engineering Corporation	Operation and Data Reduction
General Electric	Maintenance
Philco	Programming and Operations
Undetermined (in 1969)	Programming, Analysis and Operations

WALLOPS STATION

The primary function of the automatic data processing operations at Wallops Station is to support the launch facilities for sounding rockets and certain small satellites. In addition, Wallops Station provides data processing support to a wide variety of programs in the fields of scientific research, vehicle testing, and the testing of flight hardware. To accomplish those tasks computers are required for such specific purposes as: pre-flight studies to determine orbital characteristics and environmental effects on payloads under static and dynamic conditions, plotting trajectories, computing orbits, and tracking and data reduction required in the launching of approximately 300 sounding rockets per year.

FY 1967

During FY 1967 the capability of the existing RCA 4101 computer was expanded by the acquisition of a high speed printer.

FY 1968

Two computer purchases are scheduled for FY 1968. A small desk top computer to be acquired for installation in early FY 1969 will provide a means for ballistic wind determinations at remote launch sites for range safety purposes. The other computer to be acquired will become an integral part of the mobile range system and will be used to support sounding rocket launches.

FY 1969

The purchase of a Pulse Code Modulation (PCM) Decommutation System is planned in FY 1969. This machine, to be installed early in Fiscal Year 1970, will provide Wallops with the capability of handling PCM Telemetry data. The use of this coding technique is desirable to achieve greater system accuracies and reliabilities than are now available in the analog systems.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

AMES RESEARCH CENTER

	FY 1967	FY 1968	FY 1969
Computer Cost (In thousands of dollars):			
Purchase	844	475	1,330
Lease	1,303	1,468	1,465
Maintenance	213	203	250
Total	2,360	2,146	3,045
Number of Computers (End of Year):			
Purchased	12	16	19
Leased	9	5	3
Purchased/Leased	2	2	2
Total	23	23	24
Number of Personnel:			
Civil Service	62	60	65
Contracting Firm	42	59	62

Contractor Identification

Name of Firm	Service Performed
Computer Sciences Corporation	Scientific Programming and Analysis and Administrative Applications
IBM, Federal Sys. Division	Scientific Programming
Informatics, Inc.	Scientific Programming
Computer Usage Corporation	Computer Operators
Massey Temporary Services	Keypunching

AMES RESEARCH CENTER

ARC utilizes ADP equipment for research in the physical sciences, space sciences, and life sciences, and for experimental data reduction and analysis. Small scale special purpose computers are used for monitoring and controlling experiments in real-time, and for aircraft/spacecraft simulation studies. New ADP requirements are continually developing from areas of research involved in theoretical and laboratory work as new knowledge is gained and advanced techniques are developed.

FY 1967

Ames utilizes an IBM 7094 DCS system for scientific and engineering computation requirements. The DCS, including remote access units strategically located about the Center, provides additional computational support to the general scientific user. The H800/200 system is used for reduction of experimental data from space science projects including OGO, AIMP, OSO, ISIS, life science labs, wind tunnel work, and Bioscience and Pioneer projects. During this year, plans were formulated to provide increased capacity and additional capability by modifying and augmenting the DCS system.

FY 1968

ADP requirments in support of basic scientific and engineering studies in all areas of research will continue to constitute the major computer activity at the Ames Research Center and the growth rate is expected to increase during FY 1968. Data reduction requirements will remain relatively constant as the development of more sophisticated data collection techniques will compensate for increases in data volume. Consolidation of all Administrative Management Reporting Systems on the IBM 7094 DCS will be completed this year and the IBM 1401 administrative computer system released. Phase I of the Central Facility replacement plan to provide the general scientific user with increased capacity is scheduled for January 1968.

FY 1969

A gradual increase is anticipated for the Scientific and Engineering ADP workload as a result of increased usage by research personnel in support of general scientific and project applications.

The data reduction workload is expected to remain relatively constant. During FY 1969 Ames plans to complete requirements studies to provide for replacement of their central ADP facilities. Their planning is to provide the capacity and capability to consolidate functions currently being performed on the Central Facility and to provide the means to handle a class of real-time problems which currently require dedicated systems.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

ELECTRONICS RESEARCH CENTER

	FY 1967	FY 1968	FY 1969
Computer Cost (In thousands of dollars):			
Purchase	236	1,297	700
Lease	112	194	300
Maintenance	2	---	---
Total	350	1,491	1,000
Number of Computers (End of Year):			
Purchased	-	6	10
Leased	1	3	1
Purchased/Leased	-	2	2
Total	1	11	13
Number of Personnel:			
Civil Service	19	21	28
Contracting Firm	40	86	122

Contractor Identification

Name of Firm	Service Performed
Wolf Research and Development, Inc.	Numerical Analysis
LTV Aerospace	Programming
Computer Applications, Inc.	Programming
Research Calculations, Inc.	Operation and Data Reduction

ELECTRONICS RESEARCH CENTER

ADP requirements at ERC are primarily for computations in the development of improved performance and reliability of electronic components and systems used in the aeronautical and space programs. Applications include the solution of a broad range of scientific and engineering problems such as trajectory analysis, power spectral analysis, and large matrix inversion.

FY 1967

During FY 1967 ERC utilized available ADP facilities in the Boston area; and a NASA owned Univac 418 computer transferred from GSFC was installed to provide an increased data communications capability for remote access to the large scale general purpose ADP facilities at the Manned Spacecraft Center.

FY 1968

The Center's increasing requirements for scientific and technical computations capability are expected to exceed a full shift of equivalent large scale computer time by mid FY 1968. To meet the immediate needs, ERC plans to install a NASA owned IBM 7094 system during the third quarter of FY 1968. The Center also plans to install several small scale special computers required for hybrid-simulation applications, experiment sequence control, and real-time data acquisition.

FY 1969

New requirements are expected to include substantial increases in data reduction and analysis, and digital simulation. It is expected that the IBM 7094 will meet general purpose computation requirements through FY 1970. Additional small scale special purpose computers will be installed for experiment control and real-time data collection.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

FLIGHT RESEARCH CENTER

	FY 1967	FY 1968	FY 1969
Computer Cost (In thousands of dollars):			
Purchase	96	327	175
Lease	---	56	112
Maintenance	40	45	47
Total	136	428	334
Number of Computers (End of Year):			
Purchased	5	6	7
Leased	-	1	1
Purchased/Leased	-	-	-
Total	5	7	8
Number of Personnel:			
Civil Service	19	19	19
Contracting Firm	18	31	30

Contractor Identification

Name of Firm	Service Performed
General Electric	Operations, Key Punching, Data Preparation and Maintenance
Telecomputing Services	Biomedical Programming and Analysis
IBM	Maintenance
North American	B-70 Data Reduction

FLIGHT RESEARCH CENTER

ADP equipment is utilized at FRC for test data reduction, scientific and engineering computations, and flight simulators. The requirements support general aeronautical research programs in conjunction with testing phases of the Lifting Body, Supersonic Transport, hypersonic research, ramjet propulsion, and delta wing studies. The Center is installing new and improved tracking facilities and improved data collection facilities, resulting in an increased data reduction and analysis requirement.

FY 1967

FRC utilizes an IBM 360/40 system for general purpose ADP requirements. The system was expanded in FY 1967 to provide increased memory capacity and is now in operation in excess of three shifts. The Center utilizes Category B computers as flight simulators, and for data acquisition.

FY 1968

New requirements result from increased emphasis on propulsion research, from the ramjet and delta wing studies, and from bio-medical flight data collection. The Center is installing improved high precision radar tracking facilities to provide for real-time range tracking data collection and transmission to the central ADP facilities.

FY 1969

FRC expects to continue utilizing their IBM 360/40 in a continuous around-the-clock operation. The Center plans to augment their existing special purpose computers to meet increased requirements for flight simulation. FRC has completed preliminary planning for including digital simulation as a part of the general purpose ADP workload. Major problem areas include the need for further development of software to enable the Center to implement this concept.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

LANGLEY RESEARCH CENTER

	FY 1967	FY 1968	FY 1969
Computer Cost (In thousands of dollars):			
Purchase	4,860	327	837
Lease	2,274	2,943	2,943
Maintenance	125	445	500
Total	7,259	3,715	4,280
Number of Computers (End of Year):			
Purchased	8	9	12
Leased	4	2	2
Purchased/Leased	--	--	--
Total	12	11	14
Number of Personnel:			
Civil Service	132	139	142
Contracting Firm	50	103	113

Contractor Identification

Name of Firm	Service Performed
Hampton Institute	Readout and Data Preparation
Hayes International Corporation	Adm. Keypunch and Programming
Computing and Software, Inc.	Scientific Computer Operation, Key Punching and Programming
Control Data Corporation	Computer Maintenance
IBM	Computer Maintenance

LANGLEY RESEARCH CENTER

ADP requirements at Langley are primarily for analytical and engineering studies in the Space Flight and Aeronautical Research Programs. Requirements include simulation of aerospace systems as applied to the Lunar Orbiter and Landing Approach (LOLA) Project, Launch Vehicle Control, and Extra Vehicular Activities (EVA). Digital simulation is needed to provide the necessary accuracy, flexibility, and sophisticated function generators that cannot be achieved using analog equipment. Additional requirements include analysis of composite structures and studies of dynamic systems, and reflect demands for increased computational speeds, large, fast bulk memory, and greater precision.

FY 1967

Langley is installing a very large central ADP facility designed to encompass their wide range of requirements, including digital simulation of aerospace systems. The central facility includes CDC 6000 series computers, with all peripheral components, I/O equipment and bulk memory, grouped in a common "pool" and available for use by any of the computers on a shared basis. Langley is implementing new and improved research testing facilities, resulting in large quantities of more significant data. The new, third generation ADP equipment provides for an improved turn-around time and the required flexibility for data reduction and analysis.

FY 1968

Full implementation of digital simulation applications previously planned for this fiscal year will be delayed as a result of delays in the installation schedule. Digital simulation is now accomplished on a limited scale, but is expected to reflect a significantly greater impact on the total requirements as implementation proceeds over the next few years. Langley plans to release the remaining 7094 DCS system during FY 1968. Five additional IBM 1050 remote access consoles will be installed in conjunction with the general purpose facilities. Two small scale special purpose computers will be installed to provide for real-time data acquisition and display.

FY 1969

Langley plans to install a large capacity magnetic core memory to facilitate sharing of high speed bulk memory between the CDC computers and to provide interconnection between the computers. This configuration will provide a capability for multi-processor operation, but will require major emphasis on the development of software and operational procedures. Langley plans to install three small scale special purpose computers for on-line data collection, quick look analysis and display, and to provide for feedback control applications.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

LEWIS RESEARCH CENTER

	FY 1967	FY 1968	FY 1969
Computer Cost (In thousands of dollars):			
Purchase	215	8	---
Lease	188	125	189
Maintenance	87	156	156
Total	490	289	345
Number of Computers (End of Year):			
Purchased	7	14	14
Leased	1	1	1
Purchased/Leased	--	--	--
Total	8	15	15
Number of Personnel:			
Civil Service	156	156	156
Contracting Firm	5	5	5

Contractor Identification

Name of Firm	Service Performed
IBM	Maintenance

LEWIS RESEARCH CENTER

The Lewis Research Center utilizes ADP equipment for scientific/engineering computations and for data reduction from the research and testing facilities. ADP requirements are related directly to the center's primary function, research and development of techniques for advanced propulsion and space power generation. Scientific and engineering work includes basic as well as applied research, ranging from basic heat transfer calculations to trajectory calculations and other elements of mission analysis. Data reduction includes test results from wind tunnels, space environment facilities, and other specialized experimental facilities such as the full scale non-nuclear Nerva and test stands used for the study of engine control dynamics.

FY 1967

Increased ADP requirements at LeRC have been primarily in the area of data reduction. A major portion of the data reduction workload was transferred to the newly installed IBM 360/67 system. Lewis continues to utilize their IBM 7094 DCS system to meet part of the data reduction workload requirements. The Center uses an IBM 1401 for business data processing. An IBM 1620 located at the Plum Brook Station is used for both technical and business applications.

FY 1968

ADP requirements at Lewis continue to be about equally divided between scientific/engineering computations and test data reduction. The Center is constructing new testing facilities in conjunction with the renewed emphasis on supersonic transport and hypersonic engines, and advanced nuclear/electric engine studies. Lewis plans to install a NASA owned IBM 7094 DCS system available for transfer from Goddard Space Flight Center during FY 1968. This system will be used for processing the longer analysis and data reduction problems, allowing the presently installed DCS system to be used for scientific applications, and for faster turn-around time for shorter problems.

FY 1969

Lewis Research Center expects their ADP workload requirements to increase in the area of data reduction and for scientific/engineering computations. They are planning to install remote inquiry stations and graphic display units at major facilities throughout the Center, and to provide remote access to the central ADP facilities. New data reduction workloads are anticipated as a result of operation of new facilities, including the space power facility and the V/STOL test stand. Lewis is continuing to develop new techniques for monitoring of tests and for centralized collection of test data. This will also result in increased data flow to the central data processing facility and an increased requirement for data reduction.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

SPACE NUCLEAR PROPULSION OFFICE

	FY 1967	FY 1968	FY 1969
Computer Cost (In thousands of dollars):			
Purchase	---	---	---
Lease	313	412	476
Maintenance	---	---	---
Total	313	412	476
Number of Computers (End of Year):			
Purchased	-	-	-
Leased	1	1	1
Purchased/Leased	-	-	-
Total	1	1	1
Number of Personnel:			
Civil Service	--	--	--
Contracting Firm	22	22	22

Contractor Identification

Name of Firm	Service Performed
Pan American World Airways, Inc.	Programming Analysis and Operation

SPACE NUCLEAR PROPULSION OFFICE

The Space Nuclear Propulsion Office (SNPO) Nuclear Rocket Development Station (NRDS), Nevada, uses ADP equipment for data reduction from engine test stands, and for engineering analysis of test results. The major test projects are PHOEBUS - testing of advanced nuclear rocket reactors, and NERVA - testing rocket reactors and engines. Scientific and engineering work includes computations in fluid dynamics, reactor decay heat, fuel element weight loss and radiation dose predictions. Administrative support includes monitoring data and control channels to generate work orders required for status modifications and to maintain the channel data logs. Work orders and miscellaneous instruction reports are issued daily, semi-weekly, and weekly. Cost accounting and inventory control are currently a part of the ADP business applications and require weekly, semi-monthly, monthly and quarterly reports.

FY 1967

SNPO utilizes a CDC 3200 computer located at the NRDS for general purpose computer requirements. Specially designed magnetic tape units are interfaced with the research and testing facilities for on-line data recording. The recorded tapes are used for direct input to the general purpose ADP facilities. The Center is evaluating alternative methods for improving data acquisition.

FY 1968

ADP requirements are expected to increase during FY 1968, requiring three-shift operation on the CDC 3200 system. New ADP developments will center primarily around improved and more sophisticated data collection devices for direct input to the central processor. Additional requirements will include some type of display-interrogation for quick look, resulting in improved utilization of the central computer.

FY 1969

SNPO is considering up-grading their CDC 3200 to a more powerful system. Major requirements are to provide a more powerful central processor, to incorporate multi-programming capability, and to provide a large capacity on-line disk storage. Additional peripheral equipment will be included to provide for improved data flow from the engine test facilities to the central data processing facilities.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

HEADQUARTERS

	FY 1967	FY 1968	FY 1969
Computer Cost (In thousands of dollars):			
Purchase	16	---	---
Lease	414	639	808
Maintenance	19	34	34
Total	449	673	842
Number of Computers (End of Year):			
Purchased	-	-	-
Leased	3	2	2
Purchased/Leased	1	2	2
Total	4	4	4
Number of Personnel:			
Civil Service	16	17	17
Contracting Firm	81	84	84

Contractor Identification

Name of Firm	Service Performed
Documentation, Inc. (Leasco)	System Design, Programming and Operations

HEADQUARTERS

Under Headquarters cognizance are: (1) an IBM 1410 operated by the Management Information Systems Division serving NASA Headquarters administrative requirements; (2) a small computer operated by the Western Support Office for general administrative applications; and (3) two computers in the Washington area operated by Documentation, Inc. (Leasco) under a Technology Utilization contract in support of technical information retrieval functions.

FY 1967

Increasing administrative applications required an expansion of the IBM 1410. Capacity was augmented by additional storage and a high speed printer. With the phase out of the Gemini program, a leased IBM 1620 supporting the program was released. An NCR 500 computer was installed at the Western Support Office.

FY 1968

The projected administrative workload at the Headquarters cannot be adequately handled by the IBM 1410, even with the planned augmentation by an additional processor available as excess from GSA during this year. A comprehensive study of workload is underway to determine a logical course of action.

Budget restrictions have forced a severe cutback in WSO operations. It is therefore expected that the NCR 500 will have to be released and its functions transferred to Headquarters despite the resulting limitations on service which can be provided to NASA personnel in the Los Angeles area.

FY 1969

During FY 1969 the IBM 1410 will probably be replaced by equipment better suited to serving the total Headquarters ADP needs. Firm plans cannot be formulated prior to completion of the current requirements study. No major additions are expected to the Leasco installation during this time frame.

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