National Aeronautics and Space Administration

BUDGET ESTIMATES

FISCAL YEAR 1966

Volume VI

SPACE SCIENCE AND APPLICATIONS PROGRAMS

RESEARCH AND DEVELOPMENT
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

SPACE SCIENCE AND APPLICATIONS PROGRAMS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND DEVELOPMENT

GENERAL STATEMENT

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

MANNED SPACE FLIGHT: Extended duration and rendezvous flights in earth orbit, and lunar landing and return.

SPACE SCIENCE AND APPLICATIONS: A broad program of scientific study of the Earth, Moon, Sun, planets, stars and interplanetary space, and the development of technology pertinent to applied uses such as meteorological and communication satellites.

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

TRACKING AND DATA ACQUISITION: A function pertinent to the support of the extensive NASA space flight program.

MANNED SPACE FLIGHT

A major part of the amount requested for FY 1966 will be applied to the manned space flight program. The broad objectives of this program which remain unchanged are: to increase and broaden our capability to support men in space and provide them with a space operation's capability for scientific and technological purposes. Toward this end there are projects Gemini and Apollo, as well as studies and supporting development needed for advanced manned flight missions. Gemini will furnish information on the operation of two men in space for periods of up to two weeks; and will provide for the development of space navigation, guidance, rendezvous and docking techniques. The objectives of Apollo are developing hardware, operational, and support systems to provide a broad national capability for a program of space exploration. This program has as a specific goal, in this decade, of achieving manned flight to the moon, lunar landing, limited lunar exploration and the safe return of the men to Earth. The advanced flight mission activity provides information and supporting developments pertinent to the extension of the current manned flight programs.

In FY 1966 the Gemini program will move into its long duration manned flight phase and the initial rendezvous flight will be undertaken. This activity will be of direct significance to Apollo. The Apollo program will be involved in extensive ground test activity in preparation for the first flight tests of the command and service modules with the Saturn IB launch

vehicle, which will take place in FY 1966, and in preparations for later flight tests of the Saturn V launch vehicle. In the area of advanced flight missions particular attention will be given to design studies and advanced component development to extend the usefulness of the Apollo spacecraft.

SPACE SCIENCE AND APPLICATIONS

A significant part of the budget requested for FY 1966 will support the space science and applications program. The objectives of the science part of the program are scientific studies of the Earth, space about the Earth, the Moon, the planets and interplanetary space. This program encompasses the following types of flight projects: Geophysical satellites, earth orbiting solar and astronomical observatories, soft landing lunar probes, lunar orbiting satellites, probes to the planet Mars and probes into interplanetary space. The biosatellite program, directed toward the study of the effects of space environment on biological systems, will be continued. In the area of applications, projects TIROS and Nimbus continue to reflect NASA support for the on-going operational weather satellite development for the Weather Bureau; in addition, the program provides for the technology required for future operational systems. Effort will also continue in the development of the Applications Technology Satellite, which will provide information required for the design and development of future communications, meteorological and scientific satellite systems.

ADVANCED RESEARCH AND TECHNOLOGY

The advanced research and technology effort constitutes a continuing overall program to support the current aeronautics and space programs and to assure the scientific and engineering bases for undertaking future programs. The major portion of this work, which looks beyond the present programs, is to develop new knowledge and technological advancements applicable to missions of the future. This program includes effort in the fields of spacecraft and launch vehicle technology, human factors, electronics, chemical and nuclear propulsion, space power systems and aeronautics including supersonic transport research.

TRACKING AND DATA ACQUISITION

A world-wide network of tracking and data acquisition stations is essential to support the broad space flight program of the agency. The tracking and data acquisition effort during FY 1966, as in prior years, will be directed to support the planned flight programs and provide, where necessary, increased tracking and data acquisition capability. Particular attention will be given to the support of the Apollo manned space flight program and to the large observatory class of unmanned satellites in the space science program.

TECHNOLOGY UTILIZATION

The technology utilization program provides for the identification, evaluation and dissemination to the industrial community, technical information gained from the various programs for which there are potential industrial and commercial applications. Included in the program are efforts to develop better methods for management of large-scale research and development programs, to improve our understanding of matters related to the growth of science and technology programs, and to the transfer of technological advances and innovations developed in the NASA program to industry at large.

FINANCING

The FY 1966 budget to support the research and development program, discussed in detail in this volume, is $4,575,900,000. This compares to a program totaling $4,268,632,000 for FY 1965.

The program amounts shown for FY 1964 and FY 1965 in this budget reflect two significant adjustments in comparison to the amounts appropriated for these two fiscal years. These are: 1 - Certain support services (principally housekeeping) are now included in the budget for the "Administrative Operations" appropriation; and 2 - Of the FY 1965 appropriation, $72,494,000 has been applied to the FY 1964 Apollo program.

Expenditures for the current fiscal year are estimated at $3,782,000,000 and $4,120,000,000 for FY 1966.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

GENERAL STATEMENT

This appropriation provides for the design, construction, purchase of equipment, modernization of facilities, and for advanced design of facilities planned for future authorization. The major program elements may be summarized as follows:

MANNED SPACE FLIGHT: These projects will support the Apollo spacecraft and Saturn launch vehicle development and test efforts. Specific items included will provide for needed astronaut training facilities, engineering work areas and augmentation of support facilities.

SCIENTIFIC INVESTIGATIONS IN SPACE: Projects in this category will support activities in space science. They will provide for needed improvements in the testing of spacecraft and experiments carried as spacecraft payloads for the unmanned lunar and planetary exploration program, for improvements in other facilities for unmanned spacecraft missions and for necessary improvements to launch area facilities for the medium class and small launch vehicles.

ADVANCED RESEARCH AND TECHNOLOGY: These estimates cover projects including laboratory and supporting facilities for the Electronics Research Center as well as research facilities for other Installations.

AIRCRAFT TECHNOLOGY AND SUPPORTING OPERATIONS: Estimates for these projects include facilities to support the advanced aircraft programs and facilities for tracking and data acquisition.

The appropriation for FY 1965 was $262,880,500. The same amount was authorized for 1965. $74,700,000 is requested for FY 1966; a decrease of $188,180,500 from the 1965 appropriation. Total expenditures for construction of facilities are estimated to be $406,000,000 in FY 1966, a decrease of $118,000,000 from the $524,000,000 estimated for FY 1965.

The budget request contains $78,000 to provide fall-out shelters for selected new facilities. The amount has been determined in consultation with the Department of Defense based on DOD policy and criteria.

The format for reflecting fall-out shelters in each of the projects in the budget request varies. The reason is to distinguish among those facilities in which provision for fall-out protection is either inherent in the structure, provision is required, or, because of prohibitive costs and

hazardous areas provision for fall-out protection would not be desirable.

This volume contains material in support of the requested authorization and appropriation for FY 1966.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ADMINISTRATIVE OPERATIONS

GENERAL STATEMENT

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

Manpower

With the exception of an increase of 300 positions for the Electronics Research Center, there is no planned increase in manpower at other NASA installations during FY 1966. The following tabulations indicate the distribution of NASA personnel by program and the numbers of personnel by center:

Personnel Distribution

	1964	1965	1966
Direct Personnel by Program			
Manned Space Flight			
Gemini	1,141	1,402	1,385
Apollo	8,266	8,835	8,857
Advanced missions	343	343	343
	9,750	10,580	10,585
Space Science and Applications			
Physics and astronomy	1,234	1,292	1,297
Lunar and planetary exploration	296	388	382
Sustaining university program	68	73	73

	1964	1965	1966
Space Science and Applications (cont'd)			
Launch vehicle development	340	317	314
Launch vehicle procurement	324	346	334
Bioscience	240	236	239
Meteorological satellites	297	312	306
Communication satellites	127	76	65
Applications technology satellites	56	103	113
	2,982	3,143	3,123
Advanced Research and Technology			
Basic research	1,268	1,259	1,266
Space vehicle systems	1,389	1,366	1,324
Electronics systems	906	1,040	1,325
Human factor systems	214	211	219
Nuclear-electric systems	529	490	489
Nuclear rockets	530	524	524
Chemical propulsion	425	409	309
Solar and chemical power	275	318	319
Aeronautics	1,394	1,467	1,600
	6,930	7,084	7,375
Tracking and Data Acquisition	851	802	800
Technology Utilization	50	50	50
Sub-total, direct positions	20,563	21,659	21,933
Support Personnel			
Director and staff	472	537	540
Administration	4,411	4,432	4,439
Research and development support	5,499	5,521	5,533
NASA-wide support	1,039	1,051	1,055
Sub-total, support positions	11,421	11,541	11,567
Total, permanent positions	31,984	33,200	33,500
Sub-total, other positions	515	600	600
Total, all positions	32,499	33,800	34,100

Personnel Requirements

	1964	1965	1966
Manned Space Flight			
Kennedy Space Center	1,592	2,045	2,045
Manned Spacecraft Center	4,171	4,686	4,686
Marshall Space Flight Center	7,502	7,489	7,489
	13,265	14,220	14,220
Space Science and Applications			
Goddard Space Flight Center	3,610	3,677	3,677
Pacific Launch Operations Office	22	19	19
Wallops Station	516	518	518
	4,148	4,214	4,214
Advanced Research and Technology			
Ames Research Center	2,201	2,185	2,185
Electronics Research Center	25	250	550
Flight Research Center	605	605	605
Langley Research Center	4,279	4,238	4,238
Lewis Research Center	4,851	4,815	4,815
Space Nuclear Propulsion Office	112	116	116
	12,073	12,209	12,509
Supporting Activities			
Headquarters, NASA	2,091	2,156	2,156
North Eastern Operations Office	32	- 0 -	- 0 -
Western Operations Office	375	401	401
	2,498	2,557	2,557
Permanent positions	31,984	33,200	33,500
Positions, other than permanent	515	600	600
TOTAL	32,499	33,800	34,100

Funding

The FY 1966 funding request for Administrative Operations is $36.3 million less than the FY 1965 estimate. This decrease is primarily due to the initial procurement of major automatic data processing equipment in FY 1965, where the procurement of such equipment was more economical than continued rental. The estimate in FY 1966 for the procurement of additional equipment is sharply reduced from FY 1965. The object classification description of resources requested is tabulated below:

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION

(Thousands of Dollars)

		1964	1965	1966
11.	Personnel compensation	288,081	336,696	345,207
12.	Personnel benefits	20,241	23,490	24,193
21.	Travel and transportation of persons	18,536	21,000	21,000
22.	Transportation of things	5,400	5,675	5,049
23.	Rents, communications and utilities	47,230	53,191	49,556
24.	Printing and reproduction	4,387	4,683	4,869
25.	Other services	70,952	93,037	108,023
26.	Supplies and materials	24,203	22,968	23,140
31.	Equipment	22,236	79,152	23,109
32.	Lands and structures	10,339	5,811	5,235
40.	Insurance claims and indemnities	5	18	19
Total		511,610	645,721	609,400

Of the $645.7 million shown for FY 1965, $22.5 million is included as the comparative cost of items formerly provided from the Research and Development appropriation and which are being budgeted as part of the Administrative Operations request for the first time in FY 1966. In FY 1966, $24.8 million is requested for these items which are: housekeeping support of the Merritt Island Launch Area at the Kennedy Space Center, NASA, and at the White Sands Missile Range; the cost at the Jet Propulsion Laboratory of the lease of administrative aircraft and certain contract administration costs.

Personnel Compensation and Benefits

The cost of providing for personnel compensation and benefits is estimated to be $9.2 million more in FY 1966 than in FY 1965. This increased cost is directly related to the increase of 704 manyears of employment, in FY 1966 over FY 1965. Of this increase, 544 manyears are due to the cost of the full year for the 1,300 increase in NASA's strength in FY 1965. The

balance, or 160 manyears, is the manyears derived from the 300 additional positions planned for the Electronics Research Center in FY 1966.

Other Costs

The FY 1966 request for travel and other supporting expenses shows a net reduction of $45.5 million from the FY 1965 estimate. This net reduction includes a decrease of approximately $56 million in the procurement of ADP equipment, which is only partially offset by increases in utilities, other services, and supplies and materials. In general, these increases are the result of additional facilities being completed and becoming operational, a higher level of average employment, and the partial restoration in FY 1966 of items which were deferred in FY 1965 when NASA absorbed the cost of the "Government Employees Salary Reform Act of 1964", approved in August 1964 (PL 88-426). The specific increases as they relate to each installation are explained in the installation presentations contained in this volume.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

SUMMARY OF RESEARCH AND DEVELOPMENT BUDGET PLAN
AS RECONCILED TO FINANCING SCHEDULE

	Fiscal Year 1964	Fiscal Year 1965	Fiscal Year 1966
Budget Activity:			
1. Manned Space Flight:			
(a) Gemini.....	$418,900,000	$308,400,000	$242,100,000
(b) Apollo.....	2,272,952,000	2,606,778,000	2,997,385,000
(c) Advanced mission studies.....	21,200,000	26,000,000	10,000,000
2. Scientific Investigations in Space:			
(a) Physics and astronomy.....	189,118,000	182,546,000	224,300,000
(b) Lunar and planetary exploration.....	267,445,000	281,803,000	294,515,000
(c) Bioscience.....	21,479,000	37,700,000	40,600,000
(d) Launch vehicle development.....	125,100,000	107,900,000	97,500,000
3. Space Applications.....	100,451,000	73,165,000	94,600,000
4. Space Technology.....	298,692,000	283,600,000	235,500,000
5. Aircraft Technology.....	21,795,000	35,240,000	42,200,000
6. Supporting Activities:			
(a) Tracking and data acquisition.....	194,347,000	274,750,000	246,200,000
(b) Sustaining university program.....	40,000,000	46,000,000	46,000,000
(c) Technology utilization.....	3,500,000	4,750,000	5,000,000
Total Budget Plan.....	$3,974,979,000	$4,268,632,000	$4,575,900,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

SUMMARY OF RESEARCH AND DEVELOPMENT BUDGET PLAN AS RECONCILED TO FINANCING SCHEDULE

	Fiscal Year 1964	Fiscal Year 1965	Fiscal Year 1966
Financing:			
Appropriation	$3,926,000,000	$4,363,594,000	$4,575,900,000
Transferred to-			
"Construction of facilities" (77 Stat. 439)	-20,046,300	---	---
"Administrative Operations" (77 Stat. 439)	-15,685,000	---	---
Appropriation (adjusted)	3,890,268,700	4,363,594,000	4,575,900,000
Transferred to "Construction of facilities" in FY 1965	-1,411,000	---	---
Prior year funding applied - available from adjustments to FY 1963 budget plan	2,785,300	---	---
Transfers from prior years "Construction of facilities" funds	17,293,000	---	---
Reprograming to prior year budget plan	72,494,000	-72,494,000	---
Comparative transfer to "Administrative Operations"	-6,451,000	-22,468,000	---
Total financing of budget plan	$3,974,979,000	$4,268,632,000	$4,575,900,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

RESEARCH AND DEVELOPMENT

BUDGET PLAN BY PROGRAM BY COGNIZANT OFFICE

BUDGET ACTIVITY		FY 1964	FY 1965	FY 1966
	MANNED SPACE FLIGHT.....	$2,713,052,000	$2,941,178,000	$3,249,485,000
1a	Gemini.....	418,900,000	308,400,000	242,100,000
1b	Apollo.....	2,272,952,000	2,606,778,000	2,997,385,000
1c	Advanced mission studies.....	21,200,000	26,000,000	10,000,000
	SPACE SCIENCE AND APPLICATIONS.....	$746,879,000	$731,486,000	$797,515,000
2a	Physics and astronomy.	148,623,000	136,814,000	172,100,000
2b	Lunar and planetary exploration.....	205,762,000	206,150,000	215,615,000
6b	Sustaining university program.....	40,000,000	46,000,000	46,000,000
2d	Launch vehicle development.....	111,900,000	96,500,000	63,600,000
*	Launch vehicle procurement.....	129,986,000	154,672,000	194,500,000
2c	Bioscience.....	21,479,000	28,700,000	31,500,000
3	Meteorological satellites.....	63,177,000	31,200,000	42,700,000
3	Communications satellites.....	8,413,000	8,055,000	2,800,000
3	Applications technology satellites.....	17,539,000	23,395,000	28,700,000
	ADVANCED RESEARCH AND TECHNOLOGY.....	$317,201,000	$316,468,000	$277,700,000
4	Basic research.....	22,653,000	21,231,000	22,000,000
4	Space vehicle systems.	45,714,000	44,495,000	35,000,000
4	Electronic systems....	28,700,000	25,422,000	34,400,000
4	Human factor systems..	13,200,000	13,320,000	14,900,000
4	Nuclear-electric systems.....	45,963,000	42,492,000	27,000,000
4	Nuclear-rockets.....	79,176,000	56,731,000	58,000,000
4	Chemical propulsion...	46,000,000	63,792,000	30,000,000

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BUDGET ACTIVITY		FY 1964	FY 1965	FY 1966
	ADVANCED RESEARCH AND TECHNOLOGY (Cont'd)..			
4	Solar and chemical power.....	$14,000,000	$13,745,000	$14,200,000
5	Aeronautics.....	21,795,000	35,240,000	42,200,000
6a	TRACKING AND DATA ACQUISITION.....	$194,347,000	$274,750,000	$246,200,000
6c	TECHNOLOGY UTILIZATION.	$3,500,000	$4,750,000	$5,000,000
	TOTAL PLAN	$3,974,979,000	$4,268,632,000	$4,575,900,000

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

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

(In thousands of dollars)

PROGRAM OFFICE	TOTAL	J. F. KENNEDY SPACE CENTER, NASA	MANNED SPACECRAFT CENTER	MARSHALL SPACE FLIGHT CENTER	GODDARD SPACE FLIGHT CENTER	PACIFIC LAUNCH OPERATIONS OFFICE	WALLOPS STATION	AMES RESEARCH CENTER	ELECTRONICS RESEARCH CENTER	FLIGHT RESEARCH CENTER	LANGLEY RESEARCH CENTER	LEWIS RESEARCH CENTER	SPACE NUCLEAR PROPULSION OFFICE	HEADQUARTERS	WESTERN OPERATIONS OFFICE
Office of Manned Space Flight															
1964	2,713,052	49,881	1,356,036	1,266,424	206	-	-	75	-	-	2,017	2,975	-	35,091	347
1965	2,941,178	48,622	1,397,050	1,437,356	275	-	-	75	-	-	2,900	600	-	54,100	200
1966	3,249,485	69,345	1,465,040	1,656,600	500	-	-	200	-	-	3,700	300	-	53,550	250
Office of Space Science and Applications															
1964	746,879	1,819	3,256	780	235,148	-	-	25,843	-	44	35,168	197,522	-	87,202	160,097
1965	731,486	4,808	7,254	675	183,408	90	1,390	35,085	-	85	59,806	197,323	-	108,994	132,568
1966	797,515	4,225	17,800	13,440	227,712	-	4,500	28,305	-	100	51,860	196,730	-	105,375	147,468
Office of Advanced Research and Technology															
1964	317,201	-	3,702	31,821	8,252	-	-	14,404	-	8,447	38,741	99,759	60,355	25,026	26,694
1965	316,468	-	1,750	28,511	8,127	-	-	17,724	1,873	9,190	32,548	115,825	44,995	34,322	21,603
1966	277,700	-	3,235	18,035	9,300	-	-	16,945	5,200	16,530	42,776	61,595	48,900	33,638	21,546
Office of Tracking and Data Acquisition															
1964	194,347	-	-	2,900	132,817	-	5,100	-	-	1,800	2,450	-	-	7,210	42,070
1965	274,750	-	-	2,000	195,201	-	5,450	-	-	2,200	2,200	-	-	7,900	59,799
1966	246,200	-	-	1,500	173,400	-	5,900	-	-	2,000	2,500	-	-	7,900	53,000
Office of Technology Utilization and Policy Planning															
1964	3,500	-	-	-	-	-	-	-	-	-	-	-	-	3,500	-
1965	4,750	-	-	-	-	-	-	-	-	-	-	-	-	4,750	-
1966	5,000	-	-	-	-	-	-	-	-	-	-	-	-	5,000	-
Total Budget Plan															
1964	3,974,979	51,700	1,362,994	1,301,925	376,423	-	5,100	40,322	-	10,291	78,376	300,256	60,355	158,029	229,208
1965	4,268,632	53,430	1,406,054	1,468,542	387,011	90	6,840	52,884	1,873	11,475	97,454	313,748	44,995	210,066	214,170
1966	4,575,900	73,570	1,486,075	1,689,575	410,912	-	10,400	45,450	5,200	18,630	100,836	258,625	48,900	205,463	222,264

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

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

(In thousands of dollars)

PROGRAM		TOTAL	J. F. KENNEDY SPACE CENTER, NASA	MANNED SPACECRAFT CENTER	MARSHALL SPACE FLIGHT CENTER	GODDARD SPACE FLIGHT CENTER	PACIFIC LAUNCH OPERATIONS OFFICE	WALLOPS STATION	AMES RESEARCH CENTER	ELECTRONICS RESEARCH CENTER	FLIGHT RESEARCH CENTER	LANGLEY RESEARCH CENTER	LEWIS RESEARCH CENTER	SPACE NUCLEAR PROPULSION OFFICE	HEADQUARTERS	WESTERN OPERATIONS OFFICE 1/
OFFICE OF MANNED SPACE FLIGHT, TOTAL	1964	2,713,052	49,881	1,356,036	1,266,424	206	-	-	75	-	-	2,017	2,975	-	35,091	347
	1965	2,941,178	48,622	1,397,050	1,437,356	275	-	-	75	-	-	2,900	600	-	54,100	200
	1966	3,249,485	69,345	1,465,040	1,656,600	500	-	-	200	-	-	3,700	300	-	53,550	250
Gemini	1964	418,900	-	418,900	-	-	-	-	-	-	-	-	-	-	-	-
	1965	308,400	-	308,050	-	-	-	-	-	-	-	-	-	-	350	-
	1966	242,100	-	241,700	-	-	-	-	-	-	-	-	-	-	400	-
Apollo	1964	2,272,952	49,481	933,486	1,257,179	206	-	-	75	-	-	-	2,975	-	29,293	257
	1965	2,606,778	48,172	1,080,800	1,429,406	275	-	-	75	-	-	1,200	600	-	46,050	200
	1966	2,997,385	68,945	1,221,940	1,651,300	500	-	-	200	-	-	2,000	300	-	51,950	250
Advanced mission studies	1964	21,200	400	3,650	9,245	-	-	-	-	-	-	2,017	-	-	5,798	90
	1965	26,000	450	8,200	7,950	-	-	-	-	-	-	1,700	-	-	7,700	-
	1966	10,000	400	1,400	5,300	-	-	-	-	-	-	1,700	-	-	1,200	-
OFFICE OF SPACE SCIENCE AND APPLICATIONS, TOTAL	1964	746,879	1,819	3,256	780	235,148	-	-	25,843	-	44	35,168	197,522	-	87,202	160,097
	1965	731,486	4,808	7,254	675	183,408	90	1,390	35,085	-	85	59,806	197,323	-	108,994	132,568
	1966	797,515	4,225	17,800	13,440	227,712	-	4,500	28,305	-	100	51,860	196,730	-	105,375	147,468
Physics and astronomy	1964	148,623	-	1,020	195	123,753	-	-	605	-	44	2,333	150	-	20,047	476
	1965	136,814	-	2,300	20	107,473	-	1,390	1,764	-	85	2,280	-	-	21,168	334
	1966	172,100	-	2,600	20	133,585	-	4,500	2,255	-	100	1,730	-	-	26,660	650
Lunar and planetary exploration	1964	205,762	-	1,867	505	1,084	-	-	15,382	-	-	20,146	-	-	9,521	157,257
	1965	206,150	-	4,429	535	1,111	-	-	16,054	-	-	43,050	-	-	10,667	130,304
	1966	215,615	-	14,000	300	900	-	-	8,600	-	-	37,300	-	-	9,500	145,015
Sustaining university program	1964	40,000	-	-	-	-	-	-	-	-	-	-	-	-	39,940	60
	1965	46,000	-	-	-	-	-	-	-	-	-	-	-	-	45,965	35
	1966	46,000	-	-	-	-	-	-	-	-	-	-	-	-	45,965	35
Launch vehicle development	1964	111,900	983	-	-	250	-	-	-	-	-	115	109,497	-	1,055	-
	1965	96,500	1,783	-	-	925	-	-	-	-	-	650	91,317	-	1,825	-
	1966	63,600	1,050	-	13,000	550	-	-	-	-	-	300	47,600	-	1,100	-
Launch vehicle procurement	1964	129,986	836	-	-	23,326	-	-	-	-	-	11,930	87,875	-	6,019	-
	1965	154,672	3,025	-	-	19,960	90	-	-	-	-	13,106	106,006	-	12,485	
	1966	194,500	3,175	-	-	23,025	-	-	-	-	-	11,700	149,130	-	7,470	-
Bioscience	1964	21,479	-	234	-	250	-	-	9,856	-	-	-	-	-	9,896	1,243
	1965	28,700	-	475	-	250	-	-	17,267	-	-	-	-	-	9,209	1,499
	1966	31,500	-	1,000	-	250	-	-	17,450	-	-	-	-	-	11,550	1,250
Meteorological satellites	1964	63,177	-	135	80	62,346	-	-	-	-	-	444	-	-	172	-
	1965	31,200	-	50	120	29,575	-	-	-	-	-	420	-	-	1,035	-
	1966	42,700	-	200	120	39,720	-	-	-	-	-	530	-	-	2,130	-
Communication satellites	1964	8,413	-	-	-	7,661	-	-	-	-	-	200	-	-	552	-
	1965	8,055	-	-	-	1,415	-	-	-	-	-	300	-	-	6,340	-
	1966	2,800	-	-	-	1,500	-	-	-	-	-	300	-	-	1,000	-
Applications technology satellites	1964	17,539	-	-	-	16,478	-	-	-	-	-	-	-	-	-	1,061
	1965	23,395	-	-	-	22,699	-	-	-	-	-	-	-	-	300	396
	1966	28,700	-	-	-	28,182	-	-	-	-	-	-	-	-	-	518

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

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

(In thousands of dollars)

PROGRAM		TOTAL	J. F. KENNEDY SPACE CENTER, NASA	MANNED SPACECRAFT CENTER	MARSHALL SPACE FLIGHT CENTER	GODDARD SPACE FLIGHT CENTER	PACIFIC LAUNCH OPERATIONS OFFICE	WALLOPS STATION	AMES RESEARCH CENTER	ELECTRONICS RESEARCH CENTER	FLIGHT RESEARCH CENTER	LANGLEY RESEARCH CENTER	LEWIS RESEARCH CENTER	SPACE NUCLEAR PROPULSION OFFICE	HEADQUARTERS	WESTERN OPERATIONS OFFICE 1/
OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY, TOTAL	1964	317,201	-	3,702	31,821	8,252	-	-	14,404	-	8,447	38,741	99,759	60,355	25,026	26,694
	1965	316,468	-	1,750	28,511	8,127	-	-	17,724	1,873	9,190	32,548	115,825	44,995	34,322	21,603
	1966	277,700	-	3,235	18,035	9,300	-	-	16,945	5,200	16,530	42,776	61,595	48,900	33,638	21,546
Basic Research	1964	22,653	-	-	986	235	-	-	1,692	-	-	1,466	3,464	-	7,831	6,979
	1965	21,231	-	-	916	257	-	-	1,881	-	30	1,861	2,234	-	8,260	5,792
	1966	22,000	-	-	920	260	-	-	1,900	200	30	1,920	2,750	-	8,220	5,800
Space vehicle systems	1964	45,714	-	629	13,569	878	-	-	1,942	-	1,403	15,257	3,186	-	3,282	5,568
	1965	44,495	-	730	16,744	956	-	-	2,922	-	2,020	9,659	2,326	-	5,700	3,438
	1966	35,000	-	855	4,490	930	-	-	2,655	-	1,180	13,461	1,770	-	6,519	3,140
Electronic systems	1964	28,700	-	1,079	4,644	3,274	-	-	2,399	-	1,072	8,848	463	-	4,087	2,834
	1965	25,422	-	475	3,469	2,797	-	-	3,650	1,873	1,103	6,390	445	-	2,493	2,727
	1966	34,400	-	880	4,525	3,035	-	-	3,390	5,000	1,400	9,120	580	-	3,270	3,200
Human factor systems	1964	13,200	-	1,900	235	-	-	-	3,820	-	1,342	1,835	137	-	3,931	-
	1965	13,320	-	445	220	-	-	-	4,113	-	2,000	3,204	230	-	3,108	-
	1966	14,900	-	900	300	-	-	-	4,680	-	1,500	4,450	200	-	2,870	-
Nuclear-electric systems	1964	45,963	-	94	263	1,320	-	-	-	-	-	-	41,719	-	685	1,882
	1965	42,492	-	100	290	1,142	-	-	-	-	-	400	37,038	-	1,186	2,336
	1966	27,000	-	100	400	1,200	-	-	-	-	-	-	22,700	-	1,000	1,600
Nuclear rockets	1964	79,176	-	-	7,153	-	-	-	-	-	-	-	11,330	60,355	-	338
	1965	56,731	-	-	1,280	-	-	-	-	-	-	-	10,450	44,995	-	6
	1966	58,000	-	-	1,300	-	-	-	-	-	-	-	7,800	48,900	-	-
Chemical propulsion	1964	46,000	-	-	3,542	375	-	-	-	-	-	1,144	31,205	-	3,194	6,540
	1965	63,792	-	-	3,592	550	-	-	-	-	-	1,480	45,227	-	8,760	4,183
	1966	30,000	-	500	5,100	800	-	-	-	-	-	1,980	8,095	-	8,825	4,700
Solar and chemical power	1964	14,000	-	-	1,429	2,170	-	-	105	-	-	710	6,403	-	630	2,553
	1965	13,745	-	-	2,000	2,425	-	-	191	-	-	690	4,309	-	1,009	3,121
	1966	14,200	-	-	1,000	3,075	-	-	170	-	-	740	5,000	-	1,109	3,106
Aeronautics	1964	21,795	-	-	-	-	-	-	4,446	-	4,630	9,481	1,852	-	1,386	-
	1965	35,240	-	-	-	-	-	-	4,967	-	4,037	8,864	13,566	-	3,806	-
	1966	42,200	-	-	-	-	-	-	4,150	-	12,420	11,105	12,700	-	1,825	-
OFFICE OF TRACKING AND DATA ACQUISITION	1964	194,347	-	-	2,900	132,817	-	5,100	-	-	1,800	2,450	-	-	7,210	42,070
	1965	274,750	-	-	2,000	195,201	-	5,450	-	-	2,200	2,200	-	-	7,900	59,799
	1966	246,200	-	-	1,500	173,400	-	5,900	-	-	2,000	2,500	-	-	7,900	53,000
Tracking and data acquisition	1964	194,347	-	-	2,900	132,817	-	5,100	-	-	1,800	2,450	-	-	7,210	42,070
	1965	274,750	-	-	2,000	195,201	-	5,450	-	-	2,200	2,200	-	-	7,900	59,799
	1966	246,200	-	-	1,500	173,400	-	5,900	-	-	2,000	2,500	-	-	7,900	53,000
OFFICE OF TECHNOLOGY UTILIZATION AND POLICY PLANNING	1964	3,500	-	-	-	-	-	-	-	-	-	-	-	-	3,500	-
	1965	4,750	-	-	-	-	-	-	-	-	-	-	-	-	4,750	-
	1966	5,000	-	-	-	-	-	-	-	-	-	-	-	-	5,000	-
Technology utilization	1964	3,500	-	-	-	-	-	-	-	-	-	-	-	-	3,500	-
	1965	4,750	-	-	-	-	-	-	-	-	-	-	-	-	4,750	-
	1966	5,000	-	-	-	-	-	-	-	-	-	-	-	-	5,000	-
TOTAL BUDGET PLAN	1964	3,974,979	51,700	1,362,994	1,301,925	376,423	-	5,100	40,322	-	10,291	78,376	300,256	60,355	158,029	229,208
	1965	4,268,632	53,430	1,406,054	1,468,542	387,011	90	6,840	52,884	1,873	11,475	97,454	313,748	44,995	210,066	214,170
	1966	4,575,900	73,570	1,486,075	1,689,575	410,912	-	10,400	45,450	5,200	18,630	100,836	258,625	48,900	205,463	222,264

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

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

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

Budget Activity	Fiscal Year 1964	Fiscal Year 1965	Fiscal Year 1966
1. Manned Space Flight.....	$496,841,600	$213,481,500	$27,825,000
2. Scientific Investigations in Space.....	16,698,700	5,765,000	8,377,000
3. Space Applications.....	3,933,000	---	---
4. Space Technology.....	60,949,700	23,812,000	20,435,000
5. Aircraft Technology.....	2,585,000	4,452,000	762,000
6. Supporting Activities.....	134,442,300	15,370,000	17,301,000
Total Budget Plan.....	$715,450,300	$262,880,500	$74,700,000
Financing:			
Appropriation.....	$680,000,000	$262,880,500	$74,700,000
Transferred from (77 Stat. 439)—			
"Research and development".....	20,046,300	---	---
"Administrative operations".....	13,300,000	---	---
Appropriation (adjusted).....	713,346,300	262,880,500	74,700,000
Transferred from "Research and development" in FY 1965 (77 Stat. 439).....	1,779,000	---	---
Prior year funding applied — available from adjustments to prior year budget plans	325,000	---	---
Total financing of budget plan.....	$715,450,300	$262,880,500	$74,700,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

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

	Fiscal Year 1964	Fiscal Year 1965	Fiscal Year 1966
1. MANNED SPACE FLIGHT.....	$496,841,600	$213,481,500	$27,825,000
John F. Kennedy Space Center, NASA.....	280,520,300	85,377,200	7,295,000
Manned Spacecraft Center	36,142,000	24,443,000	4,400,000
Marshall Space Flight Center.....	30,081,000	14,999,700	4,776,000
Michoud Plant.....	9,058,000	6,313,500	300,000
Mississippi Test Facility.....	96,163,300	54,182,000	2,121,000
Various Locations.....	44,877,000	28,166,100	6,136,000
Facility Planning and Design.....	---	---	2,800,000
2. SCIENTIFIC INVESTIGATIONS IN SPACE.....	$16,698,700	$5,765,000	$8,377,000
Ames Research Center....	96,000	---	2,749,000
Goddard Space Flight Center.....	13,164,500	500,000	2,400,000
Jet Propulsion Laboratory	3,243,200	2,895,000	---
John F. Kennedy Space Center, NASA.....	170,000	1,741,000	1,300,000
Various Locations.....	5,000	---	---
Wallops Station.....	20,000	629,000	1,048,000
Facility Planning and Design.....	---	---	880,000
3. SPACE APPLICATIONS.....	$3,933,000	$ ---	$ ---
Goddard Space Flight Center.....	3,933,000	---	---

	Fiscal Year 1964	Fiscal Year 1965	Fiscal Year 1966
4. SPACE TECHNOLOGY.....	$60,949,700	$23,812,000	$20,435,000
Ames Research Center.....	11,464,000	3,100,000	---
Electronics Research Center.....	4,820,000	10,050,000	10,000,000
Langley Research Center....	9,872,700	3,253,000	7,568,000
Lewis Research Center.....	20,468,000	1,555,000	867,000
Nuclear Rocket Development Station.....	4,190,000	---	---
Various Locations.....	10,135,000	5,854,000	---
Facility Planning and Design.....	---	---	2,000,000
5. AIRCRAFT TECHNOLOGY.....	$2,585,000	$4,452,000	$762,000
Ames Research Center.....	20,000	2,630,000	---
Flight Research Center.....	2,495,000	---	---
Langley Research Center....	70,000	1,322,000	682,000
Lewis Research Center.....	---	500,000	---
Facility Planning and Design.....	---	---	80,000
6. SUPPORTING ACTIVITIES.....	$134,442,300	$15,370,000	$17,301,000
Goddard Space Flight Center	84,000	1,291,000	---
Jet Propulsion Laboratory..	---	725,000	---
John F. Kennedy Space Center, NASA.....	4,000,000	1,955,000	---
Various Locations.....	129,803,300	10,279,000	15,561,000
Wallops Station.....	555,000	1,120,000	---
Facility Planning and Design.....	---	---	1,740,000
TOTAL PLAN.....	$715,450,300	$262,880,500	$74,700,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

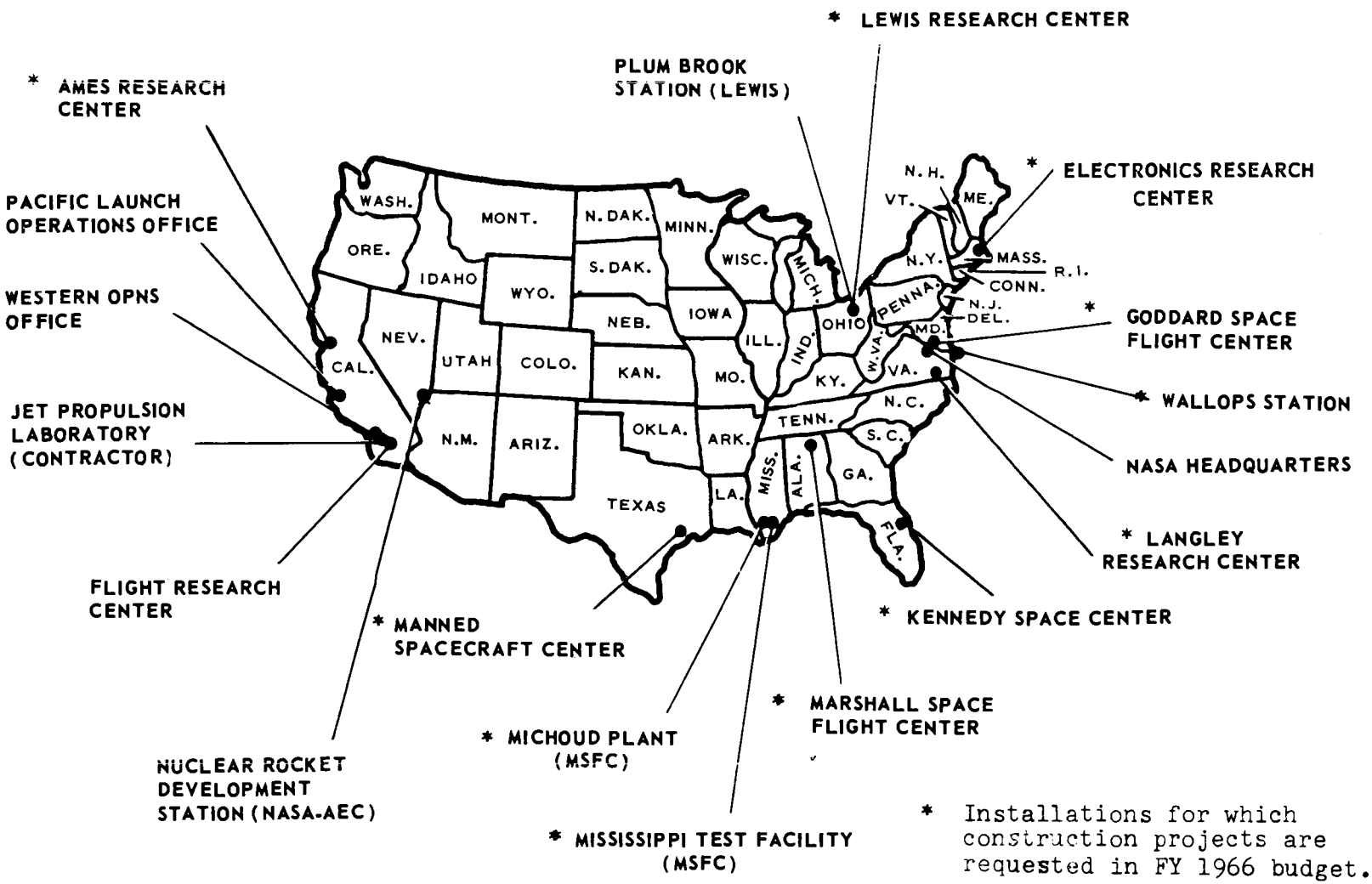
SUMMARY OF CONSTRUCTION OF FACILITIES BUDGET PLAN BY LOCATION

Location	Fiscal Year 1964	Fiscal Year 1965	Fiscal Year 1966
Ames Research Center.....	$11,580,000	$5,730,000	$2,749,000
Electronics Research Center.....	4,820,000	10,050,000	10,000,000
Flight Research Center.....	2,495,000	---	---
Goddard Space Flight Center.....	17,181,500	1,791,000	2,400,000
Jet Propulsion Laboratory.....	3,243,200	3,620,000	---
John F. Kennedy Space Center, NASA.....	284,690,300	89,073,200	8,595,000
Langley Research Center.....	9,942,700	4,575,000	8,250,000
Lewis Research Center.....	20,468,000	2,055,000	867,000
Manned Spacecraft Center.....	36,142,000	24,443,000	4,400,000
Marshall Space Flight Center....	30,081,000	14,999,700	4,776,000
Michoud Plant.....	9,058,000	6,313,500	300,000
Mississippi Test Facility.....	96,163,300	54,182,000	2,121,000
Nuclear Rocket Development Station.....	4,190,000	---	---
Various Locations.....	184,820,300	44,299,100	21,694,000
Wallops Station.....	575,000	1,749,000	1,048,000
Facility Planning and Design[1/]..	---	---	7,500,000
Total Plan.....	$715,450,300	$262,880,500	$74,700,000

1/Amounts appropriated in fiscal year 1964 and 1965 are reflected by location.

A geographic location of NASA installations is shown on the following page. Installations for which construction projects are requested in the fiscal year 1966 budget are identified.

NASA INSTALLATIONS



* Installations for which construction projects are requested in FY 1966 budget.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

ADMINISTRATIVE OPERATIONS

SUMMARY OF OBLIGATIONS BY INSTALLATION

	Fiscal Year 1964	Fiscal Year 1965	Fiscal Year 1966
MANNED SPACE FLIGHT			
John F. Kennedy Space Center, NASA	$34,959,000	$61,616,000	$62,697,000
Manned Spacecraft Center	68,634,000	91,201,000	89,658,000
Marshall Space Flight Center	124,443,000	140,458,000	137,387,000
SPACE SCIENCE AND APPLICATIONS			
Goddard Space Flight Center	62,466,000	85,923,000	69,591,000
Pacific Launch Operations Office	1,037,000	835,000	804,000
Wallops Station	9,715,000	11,442,000	9,800,000
ADVANCED RESEARCH AND TECHNOLOGY			
Ames Research Center	29,886,000	31,698,000	32,300,000
Electronics Research Center	730,000	3,600,000	7,622,000
Flight Research Center	9,514,000	9,750,000	9,600,000
Langley Research Center	52,642,000	57,258,000	61,733,000
Lewis Research Center	61,694,000	70,971,000	63,830,000
Space Nuclear Propulsion Office	1,472,000	1,725,000	1,838,000
SUPPORTING ACTIVITIES			
Northeastern Office	379,000	---	---
Western Operations Office	4,924,000	5,989,000	6,337,000
NASA Headquarters	49,115,000	73,255,000	56,103,000
TOTAL	$511,610,000	$645,721,000	$609,400,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ADMINISTRATIVE OPERATIONS

NUMBER OF POSITIONS BY LOCATION

	Fiscal Year 1964	Fiscal Year 1965	Fiscal Year 1966
MANNED SPACE FLIGHT			
John F. Kennedy Space Center, NASA	1,625	2,082	2,082
Manned Spacecraft Center	4,277	4,811	4,811
Marshall Space Flight Center	7,679	7,658	7,658
SPACE SCIENCE AND APPLICATIONS			
Goddard Space Flight Center	3,675	3,725	3,725
Pacific Launch Operations Office	22	22	22
Wallops Station	530	530	530
ADVANCED RESEARCH AND TECHNOLOGY			
Ames Research Center	2,204	2,205	2,205
Electronics Research Center	25	250	550
Flight Research Center	619	619	619
Langley Research Center	4,330	4,308	4,308
Lewis Research Center	4,859	4,847	4,847
Space Nuclear Propulsion Office	112	116	116
SUPPORTING OPERATIONS			
North Eastern Office	33	---	---
Western Operations Office	376	406	406
NASA Headquarters	2,133	2,221	2,221
TOTAL	32,499	33,800	34,100

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

ADMINISTRATIVE OPERATIONS

DISTRIBUTION OF BUDGET PLAN BY OBJECT CLASSIFICATION BY INSTALLATION

(In dollars)

Object Classification	Total	J.F. Kennedy Space Center, NASA	Manned Spacecraft Center	Marshall Space Flight Center	Goddard Space Flight Center	Pacific Launch Operations Office	Wallops Station	Ames Research Center	Electronics Research Center	Flight Research Center	Langley Research Center	Lewis Research Center	Space Nuclear Propulsion Office	North-eastern Office	Western Operations Office	Headquarters
FISCAL YEAR 1964																
Personnel compensation	288,081,000	13,365,000	34,497,000	72,921,000	32,481,000	193,000	3,806,000	19,042,000	137,000	5,659,000	35,926,000	42,969,000	1,125,000	280,000	3,378,000	22,302,000
Personnel benefits	20,241,000	868,000	2,294,000	4,926,000	2,287,000	12,000	268,000	1,389,000	10,000	410,000	2,654,000	3,112,000	82,000	20,000	231,000	1,678,000
Travel & transp of pers	18,536,000	2,181,000	3,874,000	3,337,000	2,409,000	38,000	140,000	508,000	18,000	234,000	1,288,000	1,461,000	171,000	27,000	243,000	2,607,000
Transportation of things	5,400,000	350,000	1,289,000	583,000	1,458,000	7,000	65,000	59,000	---	31,000	450,000	622,000	11,000	1,000	13,000	456,000
Rents, communications, and utilities	47,230,000	2,575,000	5,114,000	11,786,000	10,790,000	111,000	485,000	4,605,000	---	362,000	4,718,000	4,378,000	---	28,000	315,000	1,969,000
Printing and reproduction	4,387,000	818,000	366,000	1,033,000	622,000	6,000	---	37,000	---	6,000	191,000	58,000	---	4,000	13,000	1,233,000
Other services	54,345,000	4,672,000	9,523,000	13,999,000	5,802,000	70,000	915,000	1,644,000	486,000	1,029,000	2,540,000	2,300,000	---	3,000	456,000	10,906,000
Services of other agencies	16,607,000	4,303,000	1,080,000	2,808,000	438,000	94,000	17,000	112,000	37,000	78,000	533,000	7,000	83,000	3,000	173,000	6,841,000
Supplies and materials	24,203,000	3,284,000	3,427,000	5,911,000	2,228,000	141,000	1,344,000	1,849,000	13,000	600,000	2,718,000	2,865,000	---	10,000	51,000	566,000
Equipment	22,236,000	1,753,000	6,442,000	3,814,000	3,356,000	55,000	1,017,000	614,000	29,000	1,007,000	998,000	2,542,000	---	3,000	51,000	555,000
Lands and structures	10,339,000	790,000	727,000	3,330,000	595,000	310,000	1,658,000	831,000	---	98,000	626,000	1,373,000	---	---	---	1,000
Insurance claims and indemnities	5,000	---	1,000	1,000	---	---	---	---	---	---	---	2,000	---	---	---	1,000
Totals	511,610,000	34,959,000	68,634,000	124,443,000	62,466,000	1,037,000	9,715,000	29,886,000	730,000	9,514,000	52,642,000	61,694,000	1,472,000	379,000	4,924,000	49,115,000
FISCAL YEAR 1965																
Personnel compensation	336,696,000	20,417,000	47,685,000	81,344,000	38,391,000	231,000	4,361,000	20,700,000	1,470,000	6,218,000	38,826,000	45,610,000	1,391,000	---	4,155,000	25,897,000
Personnel benefits	23,490,000	1,364,000	3,164,000	5,475,000	2,707,000	16,000	313,000	1,500,000	110,000	432,000	2,861,000	3,314,000	109,000	---	291,000	1,834,000
Travel & transp of pers	21,000,000	2,113,000	4,908,000	3,759,000	2,730,000	50,000	160,000	610,000	240,000	260,000	1,380,000	1,660,000	200,000	---	296,000	2,634,000
Transportation of things	5,675,000	872,000	1,160,000	550,000	1,195,000	12,000	83,000	58,000	121,000	40,000	440,000	650,000	10,000	---	24,000	460,000
Rents, communications, and utilities	53,191,000	3,973,000	7,967,000	13,231,000	9,936,000	90,000	626,000	4,725,000	389,000	337,000	5,424,000	3,987,000	---	---	448,000	2,058,000
Printing and reproduction	4,683,000	851,000	390,000	1,100,000	317,000	8,000	15,000	35,000	35,000	10,000	200,000	65,000	---	---	17,000	1,640,000
Other Services	80,807,000	19,912,000	12,072,000	20,052,000	4,850,000	166,000	1,233,000	1,355,000	394,000	985,000	2,517,000	2,563,000	15,000	---	567,000	14,126,000
Services of other agencies	12,230,000	5,148,000	665,000	2,918,000	334,000	74,000	50,000	105,000	110,000	---	90,000	45,000	---	---	50,000	2,641,000
Supplies and materials	22,968,000	1,700,000	3,889,000	6,100,000	1,796,000	85,000	1,234,000	1,234,000	154,000	540,000	2,600,000	3,150,000	---	---	65,000	421,000
Equipment	79,152,000	4,333,000	8,453,000	4,928,000	23,201,000	46,000	2,546,000	1,076,000	453,000	762,000	2,419,000	9,325,000	---	---	76,000	21,534,000
Lands and structures	5,811,000	932,000	847,000	1,000,000	466,000	57,000	820,000	300,000	124,000	165,000	500,000	600,000	---	---	---	---
Insurance claims and indemnities	18,000	1,000	1,000	1,000	---	---	1,000	---	---	1,000	1,000	2,000	---	---	---	10,000
Totals	645,721,000	61,616,000	91,201,000	140,458,000	85,923,000	835,000	11,442,000	31,698,000	3,600,000	9,750,000	57,258,000	70,971,000	1,725,000	---	5,989,000	73,255,000
FISCAL YEAR 1966																
Personnel compensation	345,207,000	21,879,000	49,997,000	81,675,000	38,544,000	234,000	4,361,000	20,729,000	4,368,000	6,265,000	38,896,000	45,635,000	1,424,000	---	4,378,000	26,822,000
Personnel benefits	24,193,000	1,465,000	3,328,000	5,531,000	2,716,000	16,000	313,000	1,503,000	332,000	435,000	2,889,000	3,338,000	111,000	---	304,000	1,912,000
Travel & transp of pers	21,000,000	1,538,000	5,417,000	3,825,000	2,740,000	40,000	160,000	600,000	270,000	260,000	1,370,000	1,650,000	200,000	---	303,000	2,627,000
Transportation of things	5,049,000	722,000	944,000	550,000	1,107,000	10,000	83,000	58,000	141,000	40,000	440,000	650,000	3,000	---	20,000	281,000
Rents, communications, and utilities	49,556,000	4,385,000	7,143,000	11,786,000	9,745,000	90,000	465,000	5,205,000	784,000	331,000	4,110,000	2,825,000	---	---	469,000	2,218,000
Printing and reproduction	4,869,000	871,000	390,000	1,150,000	342,000	8,000	15,000	35,000	65,000	10,000	200,000	65,000	---	---	17,000	1,701,000
Other services	96,054,000	23,937,000	15,034,000	21,435,000	6,923,000	160,000	1,633,000	1,488,000	762,000	1,044,000	2,866,000	2,849,000	100,000	---	672,000	17,151,000
Services of other agencies	11,969,000	4,620,000	665,000	2,944,000	443,000	80,000	50,000	112,000	153,000	---	90,000	50,000	---	---	38,000	2,724,000
Supplies and materials	23,140,000	1,579,000	3,889,000	6,100,000	1,974,000	85,000	1,234,000	1,234,000	376,000	540,000	2,600,000	3,050,000	---	---	65,000	414,000
Equipment	23,109,000	1,000,000	2,110,000	1,390,000	4,532,000	46,000	760,000	1,036,000	261,000	524,000	7,821,000	3,315,000	---	---	71,000	243,000
Lands and structures	5,235,000	700,000	740,000	1,000,000	525,000	35,000	725,000	300,000	110,000	150,000	500,000	450,000	---	---	---	---
Insurance claims and indemnities	19,000	1,000	1,000	1,000	---	---	1,000	---	---	1,000	1,000	3,000	---	---	---	10,000
Totals	609,400,000	62,697,000	89,658,000	137,387,000	69,591,000	804,000	9,800,000	32,300,000	7,622,000	9,600,000	61,783,000	63,880,000	1,838,000	---	6,337,000	56,103,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

COMPUTATION OF PERSONNEL COSTS BY INSTALLATION AND FISCAL YEAR

(In thousands of dollars)

FISCAL YEAR 1964 ACTUAL	TOTAL NASA	J. F. KENNEDY SPACE CENTER, NASA	MANNED SPACECRAFT CENTER	MARSHALL SPACE FLIGHT CENTER	GODDARD SPACE FLIGHT CENTER	PACIFIC LAUNCH OPERATIONS OFFICE	WALLOPS STATION	AMES RESEARCH CENTER	ELECTRONICS RESEARCH CENTER	FLIGHT RESEARCH CENTER	LANGLEY RESEARCH CENTER	LEWIS RESEARCH CENTER	SPACE NUCLEAR PROPULSION OFFICE	HEADQUARTERS	NORTHEASTERN OPERATIONS OFFICE	WESTERN OPERATIONS OFFICE
Personnel Compensation:																
Permanent positions	$289,440	$14,468	$37,237	$68,967	$33,986	$194	$3,586	$19,528	$277	$5,320	$35,966	$42,557	$1,249	$22,249	$305	$3,551
Pay above the stated annual rate	2,334	113	269	576	270	2	28	164	2	42	305	361	9	160	2	31
Lapses (deduct)	-25,316	-2,904	-7,116	-4,919	-3,059	-13	-235	-1,045	-143	-205	-1,606	-1,950	-136	-1,448	-39	-498
Net cost of permanent positions	$266,458	$11,677	$30,390	$64,624	$31,197	$183	$3,379	$18,647	$136	$5,157	$34,665	$40,968	$1,122	$20,961	$268	$3,084
Other personnel compensation	22,102	1,688	4,107	8,302	1,758	10	427	395	1	502	1,261	2,001	3	1,341	12	294
Total personnel compensation	$288,560	$13,365	$34,497	$72,926	$32,955	$193	$3,806	$19,042	$137	$5,659	$35,926	$42,969	$1,125	$22,302	$280	$3,378
Reimbursable	479	---	---	5	474	---	---	---	---	---	---	---	---	---	---	---
NASA funded	288,081	13,365	34,497	72,921	32,481	193	3,806	19,042	137	5,659	35,926	42,969	1,125	22,302	280	3,378
Total personnel benefits	$20,262	$868	$2,294	$4,926	$2,308	$12	$268	$1,389	$10	$410	$2,654	$3,112	$82	$1,678	$20	$231
Reimbursable	21	---	---	---	21	---	---	---	---	---	---	---	---	---	---	---
NASA funded	20,241	868	2,294	4,926	2,287	12	268	1,389	10	410	2,654	3,112	82	1,678	20	231
Total Personnel Costs	$308,822	$14,233	$36,791	$77,852	$35,263	$205	$4,074	$20,431	$147	$6,069	$38,580	$46,081	$1,207	$23,980	$300	$3,609
Reimbursable	500	---	---	5	495	---	---	---	---	---	---	---	---	---	---	---
NASA funded	308,322	14,233	36,791	77,847	34,768	205	4,074	20,431	147	6,069	38,580	46,081	1,207	23,980	300	3,609
FISCAL YEAR 1965 ESTIMATED																
Personnel Compensation:																
Permanent positions	$320,264	$19,652	$44,456	$74,262	$36,939	$208	$3,904	$20,220	$2,799	$5,671	$37,424	$43,611	$1,389	$25,652	---	$4,077
Pay above the stated annual rate	1,260	70	163	298	134	1	15	78	10	22	175	173	6	99	---	16
Lapses (deduct)	-9,592	-1,556	-2,488	-1,565	-376	-6	-81	-39	-1,411	-122	-216	-219	-10	-1,272	---	-231
Net cost of permanent positions	$311,932	$18,166	$42,131	$72,995	$36,697	$203	$3,838	$20,259	$1,398	$5,571	$37,383	$43,565	$1,385	$24,479	---	$3,862
Other personnel compensation	25,277	2,251	5,554	8,352	2,204	28	523	441	72	647	1,443	2,045	6	1,418	---	293
Total personnel compensation	$337,209	$20,417	$47,685	$81,347	$38,901	$231	$4,361	$20,700	$1,470	$6,218	$38,826	$45,610	$1,391	$25,897	---	$4,155
Reimbursable	513	---	---	3	510	---	---	---	---	---	---	---	---	---	---	---
NASA funded	336,696	20,417	47,685	81,344	38,391	231	4,361	20,700	1,470	6,218	38,826	45,610	1,391	25,897	---	4,155
Total personnel benefits	$23,533	$1,364	$3,164	$5,475	$2,750	$16	$313	$1,500	$110	$432	$2,861	$3,314	$109	$1,834	---	$291
Reimbursable	43	---	---	---	43	---	---	---	---	---	---	---	---	---	---	---
NASA funded	23,490	1,364	3,164	5,475	2,707	16	313	1,500	110	432	2,861	3,314	109	1,834	---	291
Total Personnel Costs	$360,742	$21,781	$50,849	$86,822	$41,651	$247	$4,674	$22,200	$1,580	$6,650	$41,687	$48,924	$1,500	$27,731	---	$4,446
Reimbursable	556	---	---	3	553	---	---	---	---	---	---	---	---	---	---	---
NASA funded	360,186	21,781	50,849	86,819	41,098	247	4,674	22,200	1,580	6,650	41,687	48,924	1,500	27,731	---	4,446
FISCAL YEAR 1966 ESTIMATED																
Personnel Compensation:																
Permanent positions	$323,702	$19,767	$44,674	$74,358	$36,936	$211	$3,904	$20,220	$5,716	$5,744	$37,424	$43,610	$1,415	$25,645	---	$4,078
Pay above the stated annual rate	1,284	75	208	258	137	1	15	78	22	22	175	173	6	99	---	15
Lapses (deduct)	-4,058	-300	-511	-863	-102	-1	-81	-10	-1,527	-44	-80	-90	-3	-355	---	-1
Net cost of permanent positions	$320,928	$19,542	$44,371	$73,753	$36,881	$211	$3,838	$20,288	$4,211	$5,722	$37,519	$43,693	$1,418	$25,389	---	$4,092
Other personnel compensation	24,995	2,337	5,626	7,925	2,376	23	523	441	157	543	1,377	1,942	6	1,433	---	286
Total personnel compensation	$345,923	$21,879	$49,997	$81,678	$39,257	$234	$4,361	$20,729	$4,368	$6,265	$38,896	$45,635	$1,424	$26,822	---	$4,378
Reimbursable	716	---	---	3	713	---	---	---	---	---	---	---	---	---	---	---
NASA funded	345,207	21,879	49,997	81,675	38,544	234	4,361	20,729	4,368	6,265	38,896	45,635	1,424	26,822	---	4,378
Total personnel benefits	$24,243	$1,465	$3,328	$5,531	$2,766	$16	$313	$1,503	$332	$435	$2,889	$3,338	$111	$1,912	---	$304
Reimbursable	50	---	---	---	50	---	---	---	---	---	---	---	---	---	---	---
NASA funded	24,193	1,465	3,328	5,531	2,716	16	313	1,503	332	435	2,889	3,338	111	1,912	---	304
Total Personnel Costs	$370,166	$23,344	$53,325	$87,209	$42,023	$250	$4,674	$22,232	$4,700	$6,700	$41,785	$48,973	$1,535	$28,734	---	$4,682
Reimbursable	766	---	---	3	763	---	---	---	---	---	---	---	---	---	---	---
NASA funded	369,400	23,344	53,325	87,206	41,260	250	4,674	22,232	4,700	6,700	41,785	48,973	1,535	28,734	---	4,682

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SUM 4

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

DISTRIBUTION OF PERSONNEL POSITIONS BY INSTALLATION AND FISCAL YEAR

FISCAL YEAR 1964 ACTUAL	TOTAL NASA	J. F. KENNEDY SPACE CENTER, NASA	MANNED SPACECRAFT CENTER	MARSHALL SPACE FLIGHT CENTER	GODDARD SPACE FLIGHT CENTER	PACIFIC LAUNCH OPERATIONS OFFICE	WALLOPS STATION	AMES RESEARCH CENTER	ELECTRONICS RESEARCH CENTER	FLIGHT RESEARCH CENTER	LANGLEY RESEARCH CENTER	LEWIS RESEARCH CENTER	SPACE NUCLEAR PROPULSION OFFICE	HEADQUARTERS NASA	NORTHEASTERN OPERATIONS OFFICE	WESTERN OPERATIONS OFFICE
TOTAL EXCEPTED POSITIONS a/	415	14	35	56	40	-	1	26	-	6	36	35	3	158	2	3
General Schedule Positions:																
GS-16	4	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-
GS-15	1,612	51	191	351	190	1	5	112	6	15	137	155	20	365	3	10
GS-14	2,463	102	314	658	347	4	8	146	5	29	219	294	20	271	5	41
GS-13	3,677	243	596	942	535	1	19	193	3	41	304	536	23	180	2	59
GS-12	3,663	302	560	996	480	3	25	153	2	58	357	512	7	123	2	83
GS-11	3,179	206	485	875	467	3	27	139	-	52	411	398	3	70	1	42
GS-10	23	1	-	1	-	-	3	2	-	-	-	12	-	4	-	-
GS-9	2,463	99	396	422	391	-	22	180	1	50	448	372	2	70	3	7
GS-8	51	3	-	4	8	-	-	-	-	2	2	9	-	22	-	1
GS-7	1,693	83	341	288	223	-	41	119	1	27	215	200	2	146	2	5
GS-6	670	44	54	72	79	2	4	35	1	11	69	58	4	223	-	14
GS-5	1,816	106	296	379	250	1	40	121	3	21	179	127	14	214	2	63
GS-4	1,971	150	371	507	226	5	32	119	1	25	153	206	11	122	8	35
GS-3	1,290	94	219	402	103	1	16	58	1	5	155	149	3	73	2	9
GS-2	155	3	5	68	5	1	12	7	1	-	23	16	-	11	-	3
TOTAL GENERAL SCHEDULE POSITIONS	24,730	1,487	3,828	5,969	3,304	22	254	1,384	25	336	2,672	3,044	109	1,894	30	372
TOTAL WAGE BOARD POSITIONS	6,839	91	308	1,477	266	-	261	791	-	263	1,571	1,772	-	39	-	-
TOTAL PERMANENT POSITIONS	31,984	1,592	4,171	7,502	3,610	22	516	2,201	25	605	4,279	4,851	112	2,091	32	375
OTHER TEMPORARY POSITIONS	515	33	106	177	65	-	14	3	-	14	51	8	-	42	1	1
GRAND TOTAL POSITIONS - FY 1964	32,499	1,625	4,277	7,679	3,675	22	530	2,204	25	619	4,330	4,859	112	2,133	33	376
FISCAL YEAR 1965 ESTIMATED																
TOTAL EXCEPTED POSITIONS a/	439	15	35	54	40	-	1	29	10	6	38	35	3	170	-	3
General Schedule Positions:																
GS-16	183	9	15	41	21	-	1	17	-	3	16	17	3	39	-	1
GS-15	1,694	62	222	390	190	1	4	97	16	13	129	155	16	384	-	13
GS-14	2,707	108	398	663	383	4	8	150	50	31	222	319	20	302	-	49
GS-13	4,217	382	736	1,040	554	3	27	219	50	49	318	537	33	207	-	62
GS-12	4,024	369	664	1,052	568	5	42	169	20	54	372	490	5	132	-	82
GS-11	3,454	269	594	899	502	1	31	151	14	56	421	398	3	71	-	44
GS-10	31	1	-	1	-	-	2	5	-	-	-	12	-	10	-	-
GS-9	2,495	131	479	412	380	-	21	145	4	40	443	358	-	74	-	8
GS-8	59	3	1	4	9	-	-	-	-	-	2	11	-	28	-	1
GS-7	1,591	116	332	279	155	-	21	105	1	20	191	212	4	149	-	6
GS-6	726	47	63	75	103	1	9	34	11	16	69	58	4	223	-	13
GS-5	1,833	141	311	391	170	3	49	110	38	22	175	129	16	213	-	65
GS-4	1,889	193	339	516	180	1	26	106	34	24	152	180	8	91	-	39
GS-3	999	91	174	223	112	-	8	52	2	8	135	146	1	35	-	12
GS-2	149	7	1	69	38	-	-	6	-	-	8	10	-	9	-	1
TOTAL GENERAL SCHEDULE POSITIONS	26,051	1,929	4,329	6,055	3,365	19	249	1,366	240	336	2,653	3,032	113	1,967	-	398
TOTAL WAGE BOARD POSITIONS	6,710	101	322	1,380	272	-	268	790	-	263	1,547	1,748	-	19	-	-
TOTAL PERMANENT POSITIONS	33,200	2,045	4,686	7,489	3,677	19	518	2,185	250	605	4,238	4,815	116	2,156	-	401
OTHER TEMPORARY POSITIONS	600	37	125	169	48	3	12	20	-	14	70	32	-	65	-	5
GRAND TOTAL POSITIONS - FY 1965	33,800	2,082	4,811	7,658	3,725	22	530	2,205	250	619	4,308	4,847	116	2,221	-	406
FISCAL YEAR 1966 ESTIMATED																
TOTAL EXCEPTED POSITIONS a/	439	15	35	54	40	-	1	29	11	6	38	35	3	169	-	3
General Schedule Positions:																
GS-16	183	9	15	41	21	-	1	17	-	3	16	17	3	39	-	1
GS-15	1,724	62	222	390	190	1	4	97	46	13	129	155	16	384	-	15
GS-14	2,767	108	398	663	383	4	8	150	110	31	222	319	20	302	-	49
GS-13	4,299	382	736	1,068	554	3	27	210	114	49	318	537	33	208	-	62
GS-12	4,101	369	664	1,081	568	5	42	182	55	54	372	490	5	132	-	82
GS-11	3,475	269	594	909	502	1	31	157	19	56	421	398	3	71	-	44
GS-10	31	1	-	1	-	-	2	5	-	-	-	12	-	10	-	-
GS-9	2,541	131	479	433	380	-	21	165	9	40	443	358	-	74	-	8
GS-8	59	3	1	4	9	-	-	-	-	-	2	11	-	28	-	1
GS-7	1,578	116	332	279	155	-	21	72	21	20	191	212	4	149	-	6
GS-6	738	47	63	76	103	1	9	33	21	16	69	58	6	223	-	13
GS-5	1,865	141	311	391	170	3	49	114	54	22	175	129	18	213	-	65
GS-4	1,932	193	339	528	180	1	26	106	69	24	152	180	4	91	-	39
GS-3	1,008	91	174	224	112	-	8	52	2	8	135	146	1	35	-	12
GS-2	150	7	1	69	38	-	-	7	-	-	8	10	-	9	-	1
TOTAL GENERAL SCHEDULE POSITIONS	26,451	1,929	4,329	6,155	3,365	19	249	1,366	539	336	2,653	3,032	113	1,968	-	398
TOTAL WAGE BOARD POSITIONS	6,610	101	322	1,280	272	-	268	790	-	263	1,547	1,748	-	19	-	-
TOTAL PERMANENT POSITIONS	33,500	2,045	4,686	7,489	3,677	19	518	2,185	550	605	4,238	4,815	116	2,156	-	401
OTHER TEMPORARY POSITIONS	600	37	125	169	48	3	12	20	-	14	70	32	-	65	-	5
GRAND TOTAL POSITIONS - FY 1966	34,100	2,082	4,811	7,658	3,725	22	530	2,205	550	619	4,308	4,847	116	2,221	-	406

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

ADMINISTRATIVE OPERATIONS

ANALYSIS OF REQUIREMENTS FOR PASSENGER-CARRYING MOTOR VEHICLES

The appropriation language provides for the purchase of 30 passenger motor vehicles, of which 6 are for augmentation to the fiscal year 1965 ending inventory and 24 are for replacement. All vehicles scheduled for replacement meet, or will meet, the criteria established by the General Services Administration for replacement of vehicles due either to age, mileage, annual maintenance costs, or a combination of these factors.

A summary analysis and planned procurement by class of vehicle in fiscal year 1966 is as follows:

	Total	Medium Sedans	Sedans	Station Wagons	Ambulances	Buses
On hand July 1, 1965..	183	1	47	113	11	11
Total to be procured:	30	-	7	15	-	8
(For replacement)...	(24)	-	(4)	(15)	(-)	(5)
(Disposed - not replaced).....	(3)	-	(2)	(1)	(-)	(-)
On hand June 30, 1966.	186	1	48	112	11	14

OFFICE OF SPACE SCIENCE AND APPLICATIONS — PHYSICS AND ASTRONOMY PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of the Physics and Astronomy Program is to increase our knowledge of the space environment of the Earth, the Sun and its relationships to the Earth and the interplanetary medium, the geodetic properties of the Earth, and the fundamental physical nature of the universe. To achieve this objective, research is carried out with respect to the upper atmosphere and the ionosphere, the region included in the Earth's magnetic field or magnetosphere, the region of interplanetary space beyond the boundaries of the magnetosphere, the solar radiations in these regions and their interactions with the regions, the Sun and its emission of radiations, stars and other celestial bodies, galactic and solar cosmic rays, and the geodesy of the Earth. Research is carried on with experimental apparatus carried by balloons, airplanes, sounding rockets, earth satellites, and space probes.

Increased knowledge of the space environment surrounding the Earth is important to the continued advancement of man's efforts to understand and control his environment. Knowledge of the structure and dynamics of the upper atmosphere is basic to an improved understanding of meteorology. It is also important in understanding the problems of spacecraft reentry. An improved understanding of the characteristics of the ionosphere will advance radio communications between points on the surface of the earth as well as communications with spacecraft. A more complete understanding of the characteristics of the radiation belts and the earth's magnetic field will help us to understand the phenomena of the atmosphere and ionosphere and will also provide an improved assessment of the radiation hazard to manned space flight. These studies of the environment of the Earth also provide a frame of reference for studies of other planets.

The Sun exerts a dominant influence over the entire solar system. Any effort to understand our space environment or to explore the moon and planets without understanding the characteristics of the sun would be impossible. The low energy solar plasma and the energetic cosmic rays emitted by the Sun control the environments of the Earth, the Moon and the other planets. They also provide the environment through which man must travel in interplanetary space. The environment created by the Sun varies not only with the eleven year solar cycle but also with the individual solar flare events. The mechanisms which produce these phenomena are not understood. A comprehensive study of the Sun and its influence involves ground based observations, observations of the Sun's electromagnetic radiations from above the Earth's atmosphere, and measurements of the particles, plasma and magnetic fields in the vicinity of the Earth and in interplanetary space.

The Earth is approximately an oblate spheroid, but its surface is neither smooth nor regular and the exterior shape of the Earth does not define exactly the distribution of the mass in the interior. Satellites provide a unique opportunity to learn more about these geodetic properties than can be learned from the surface of the Earth. Accurate measurement of satellite positions and orbits permits tying points on the surface of the Earth into a complete world geodetic net with an accuracy not possible before. The orbits of earth satellites are perturbed by irregularities of the distribution of mass within the Earth. A National Geodetic Satellite Program is now in progress to meet the requirements of the Department of Defense, the Coast and Geodetic Survey, and NASA for geodetic data and to provide for exchange of geodetic data on an international basis.

From the earliest days of recorded history man has raised questions concerning the stars and the fundamental physical nature of the universe. While our own solar system naturally attracts the preponderance of the effort in the NASA program, space technology also provides a new opportunity for gaining knowledge about the rest of the universe. The ability to place astronomical instrumentation above the atmosphere makes it possible to view the stars, nebulae, interstellar dust and gas, and galaxies in wavelengths not accessible from the surface of the Earth. It also eliminates the distortion caused by the Earth's atmosphere in those wavelengths that penetrate the atmosphere. In the future, deep space probes will present opportunities to make direct observations of interstellar conditions in the regions beyond the primary influence of the solar wind. These studies of the rest of the universe, when considered in context with studies of our own solar system, broaden our opportunity to learn about the behavior of matter and energy and present important clues to the nature and evolution of the universe.

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Supporting research and technology	$17,666,000	$20,100,000	$25,200,000
Solar observatories	20,005,000	17,303,000	37,000,000
Astronomical observatories	35,608,000	31,210,000	32,500,000
Geophysical observatories	42,868,000	30,242,000	31,700,000
Explorers	15,526,000	21,959,000	25,700,000
Sounding rockets	16,950,000	16,000,000	17,000,000
Data analysis	---	---	3,000,000
Total	$148,623,000	$136,814,000	$172,100,000

Distribution of Program Amount by Installation:

Manned Spacecraft Center.....	$1,020,000	$2,300,000	$2,600,000
Marshall Space Flight Center.	195,000	20,000	20,000
Goddard Space Flight Center..	123,753,000	107,473,000	133,585,000
Jet Propulsion Laboratory....	476,000	334,000	650,000
Wallops Station.....	---	1,390,000	4,500,000
Ames Research Center.....	605,000	1,764,000	2,255,000
Flight Research Center.....	44,000	85,000	100,000
Langley Research Center.....	2,333,000	2,280,000	1,730,000
Lewis Research Center.....	150,000	---	---
NASA Headquarters.....	20,047,000	21,168,000	26,660,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

	1964	1965	1966
Particles and fields.....	$4,173,000	$5,300,000	$6,900,000
Ionosphere and radio physics...	879,000	1,100,000	1,400,000
Planetary atmospheres and space chemistry.....	3,154,000	---	---
Interplanetary dust and cometary physics.....	864,000	1,110,000	1,400,000
Solar physics.....	2,420,000	2,700,000	3,100,000
Astronomy and geodesy.....	3,007,000	3,145,000	3,600,000
Spacecraft technology.....	---	300,000	600,000
Interdisciplinary space science.....	1,503,000	2,145,000	1,700,000
Manned space science.....	1,666,000	3,700,000	5,600,000
Advanced studies.....	---	600,000	900,000
Total.....	$17,666,000	$20,100,000	$25,200,000

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

The FY 1965 and FY 1966 programs reflect a minor reorganization of the Supporting Research and Technology program. Work in the disciplines of Planetary Atmospheres, Space Chemistry and Planetary Astronomy was transferred to the Lunar and Planetary Program. Work in the disciplines of Particles and Fields, Solar Physics, Interplanetary Dust and Cometary Physics, and Interplanetary Spacecraft Technology was transferred to the Physics and Astronomy Program.

Particles and Fields

Work in this area concerns the development of new instruments for measuring the direction, magnitude and time variations of magnetic fields and for measuring the energy, direction and mass of charged particles. It also consists of theoretical research and ground and balloon borne observations which will aid in the interpretation of space measurements. The major areas of increased emphasis in FY 1966 will be research in very high energy cosmic rays and development of a new type of magnetometer based on plasma resonances which were discovered by the Alouette satellite. Recently developed research techniques have made it practical to conduct research on high energy particles in the energy range above 100 billion electron volts. Laboratory particles accelerators will not be available in this energy range for several years, but by using balloons to carry spark chambers and counters above the lower atmosphere, it is possible to study the interactions between high energy cosmic rays and hydrogen, and to measure the energy and direction of the high energy particles. This information can be expected to make important contributions to the science of nuclear physics and to aid astronomers in their understanding of conditions in interstellar and intergalactic space.

Ionospheres and Radio Physics

Ionospheres and Radio Physics involves ground based observations, theoretical studies and instrument development relating to the ionized regions of the atmospheres of the earth and other planets and of interplanetary space. The increased budget in FY 1966 will provide for additional theoretical and laboratory plasma studies and for attempts to interpret recent discoveries concerning the diurnal, seasonal and latitudinal variations in the structure and composition of the topside of the ionosphere.

Planetary Atmospheres and Space Chemistry

Planetary Atmospheres and Space Chemistry was transferred to the Lunar and Planetary Program.

Interplanetary Dust and Cometary Physics

Interplanetary Dust and Cometary Physics involves the study of extra terrestrial particulate matter; its behavior, structure, composition, origins; and its significance in providing information on the physical properties of the solar system and the galaxy. New efforts in FY 1966 will include studies of the formation of aggregates of particulate matter and of the condensation processes of cometary and interstellar gases.

Solar Physics

Solar Physics involves ground, aircraft, and balloon borne observations; theoretical studies; and instrumentation development related to orbital observations of the Sun. Primary emphasis in FY 1966 will be on the development of advanced instrumentation capable of obtaining better spacial and spectroscopic resolution of the Sun's structure and activity.

Astronomy and Geodesy

Astronomical research and technology efforts include theoretical studies of stellar astrophysics; laboratory spectroscopy; research on optical materials; advanced development of instruments; and ground based, balloon, and aircraft observations. Work is also being done leading to the development of extremely precise gyroscopes which could be used in a zero G satellite for tests of Einstein's theory of relativity. Theoretical studies in celestial mechanics and geodesy are also included. These efforts will be continued in FY 1966 and some preliminary investigations will be started on optics and subsystems suitable for a large orbiting telescope which would be erected and maintained by men in space.

Spacecraft Technology

Studies of materials and techniques suitable for future interplanetary spacecraft, which would make close approaches to the Sun or operate at great distances from the Earth, are being initiated in FY 1965 and will be continued in FY 1966. In addition, work will be initiated on improved electronic and power supply components for Explorer satellites.

Manned Space Science

This area involves the preparation of scientific experiments and equipment for flight on manned space missions, training of the astronauts in space physics and astronomy, and environmental data support for the Apollo program.

Five experiments, making use of man's unique visual and manual capabilities during flight to achieve the desired scientific data, are nearing readiness for flight during calendar years 1965 and 1966 on Gemini missions. Development of about 15 additional experiments for Apollo Earth Orbital flights will be initiated before the end of FY 1965, with principal flight hardware costs anticipated in FY 1966. Studies are underway to define the instrumentation, procedures and support requirements necessary to carry out more advanced investigations on potential future manned space missions, with the planned level of effort in FY 1966 for these activities approximately the same as in FY 1965.

During FY 1965 the enlistment of promising young scientists as astronauts was actively initiated. Scientific training of the present astronauts and the new "scientist astronauts" will be continued in FY 1966, including both classroom instruction and the practice of investigatory procedures under simulated space environment conditions.

Environmental data is supplied for the Apollo program, including information regarding solar flares and the resulting solar proton radiation, other space radiation, meteoroids, and micrometeoroids. Theoretical and laboratory studies are conducted to evaluate the potential hazard which these space phenomena may present to manned space flight.

Advanced Studies

Advanced Studies are being initiated in FY 1965 to formulate basic mission requirements and characteristics, explore the feasibility of specific spacecraft and ground equipment designs, and define the scope and technical plans for future projects.

Studies leading to the development of standardized modules for Explorer spacecraft are under consideration. These studies, if successful, can be expected to reduce the cost of future missions and increase reliability and spacecraft lifetime. FY 1966 studies will include feasibility studies for Explorers to conduct gravitational and relativity experiments.

Observatory studies will include the development of concepts for manned orbiting telescopes to be assembled and maintained by men in space. Preliminary studies will be conducted of several types of instruments for highly detailed studies of the solar structure and activity, and large diameter telescopes for studies of stars and interstellar matter. In addition, studies of advanced radio astronomy observatories are planned.

Studies leading to interplanetary, solar and galactic probes are also planned for FY 1965 and FY 1966. These include feasibility studies for relatively small spacecraft capable of making measurements in the interplanetary medium to within 0.1 astronomical unit of the Sun, and studies of the feasibility of launching spacecraft to the outer reaches of the solar system to measure the extent of the Sun's influence on interplanetary and galactic space.

Solar Observatories

	1964	1965	1966
Orbiting Solar Observatory (OSO):			
Spacecraft	$8,476,000	$5,624,000	$6,100,000
Experiments	5,317,000	4,279,000	5,300,000
Subtotal OSO	$13,793,000	$9,903,000	$11,400,000
Advanced Orbiting Solar Observatory (AOSO):			
Spacecraft	$4,705,000	$5,766,000	$19,200,000
Experiments	1,472,000	1,571,000	5,900,000
Ground operations	35,000	63,000	500,000
Subtotal AOSO	$6,212,000	$7,400,000	$25,600,000
Total OSO and AOSO Spacecraft and Support	$20,005,000	$17,303,000	$37,000,000

	1964	1965	1966
Delta (Launch Vehicle Procurement Program).....	($3,650,000)	($361,000)	($1,400,000)
Total (including launch vehicles).....	($23,655,000)	($17,664,000)	($38,400,000)

The objective of the Orbiting Solar Observatories is to support the program in Solar Physics in NASA by providing stabilized platforms which will carry into space scientific instrumentation to study the solar ultraviolet light, gamma rays, and X-rays which are absorbed in the Earth's atmosphere. The last flight of the presently planned Orbiting Solar Observatory (OSO) missions and the first flight of the initial Advanced Orbiting Solar Observatory (AOSO) missions are scheduled in 1969. This will give reasonable insurance of continuous coverage of solar phenomena during the period of maximum solar activity.

The OSO program, which now contemplates a total of eight missions, will provide solar astronomers with their first opportunity to study the sun over long periods of time by placing instrumentation above the Earth's absorbing and obscuring atmosphere so that measurements of solar electromagnetic radiations can be made.

The first solar observatory, OSO-I, was launched on March 7, 1962, into a circular orbit of approximately 300 nautical miles in altitude at an inclination of 33 degrees to the equator by a Delta launch vehicle.

OSO-I provided over 2,000 hours of observation of the solar spectrum in the ultraviolet and X-ray regions. These data showed a systematic variation in the intensity of emission lines of radiation generated in the high solar atmosphere with the passage of active regions across the visible disk of the Sun; extremely rapid fluctuations in the X-ray flux emitted by the Sun; and a direct correlation of the temperature of the Earth's upper atmosphere with the intensity of the ultraviolet radiation from the Sun. These results provide important clues for the study of solar processes and will be used as a basis for the design of experiments for future solar observatories. The remaining seven OSOs, each of which will carry different instrumentation, will be generally similar in spacecraft appearance and capability. Experimentation through the fifth mission has been selected and the selection process for the sixth mission is currently underway.

The OSO spacecraft consists of two sections: the upper fan shaped section, which carries the solar cells for spacecraft power and scientific instrumentation, continually points at the center of the solar disc with an accuracy of approximately one minute of arc. Beneath this pointing section, and attached to it by a shaft, is a nine sided wheel which continually rotates to give the satellite its stability. This section carries scientific instrumentation which does not need to be continuously pointed at the Sun and carries the spacecraft "housekeeping" components, such as the batteries

and telemetry system. In addition to the spacecraft's ability to point instrumentation at the center of the solar disc, it has the capability of performing a raster scan across the whole disc so that maps of the entire Sun may be made.

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

FY 1964 funds provided for rebuilding the second observatory (OSO-B), which was heavily damaged in an accident during launch preparations in April 1964; for continuing work on the third observatory (OSO-C), scheduled for launch in 1965; and for the initiation of hardware development for the next observatories. With FY 1965 funds, these efforts are being continued as well as the start of experiment development for the sixth observatory.

FY 1966 funds will provide for completion of data analysis for OSO-I and for analysis of data from OSO-B and C. These funds will also provide for the continuing development of OSO spacecraft and experiments and for the field operations associated with the launching of OSO-D.

The FY 1963 and prior years funding for this eight flight program including launch vehicles amounted to $21,622,000. Funding requirements for FY 1967 to completion are estimated to be $29,115,000.

While OSO has opened a new era in solar astronomy, the spacecraft does not have the capability of carrying large instruments with high spectral and spatial resolution which is necessary in order to provide detailed study of specific regions on the Sun. Recognizing these limitations, NASA initiated studies in 1962 leading to the development of an advanced Orbiting Solar Observatory (AOSO). This spacecraft, which is in its final phase of design, will enable scientists to gain a better understanding of the mechanisms of the Sun by providing a stabilized platform which will be able not only to look at the whole solar disc but also to direct the instruments on command to specific regions of the Sun. Because of its larger size, instrumentation of greater focal length can be carried which will provide for higher resolution. It is planned to place the AOSO into a retrograde polar orbit which will enable the satellite to view the Sun continuously for up to nine months at a time.

The spacecraft consists of a cylindrically shaped structure, at the base of which are eight solar paddles providing an average of 300 watts of power. A tube in the center of the cylinder is used to mount the scientific payload and acts to maintain spacecraft rigidity. Drawing upon previous experience, many of the subsystems, such as the tape recorders, star trackers and inertial controls, will utilize designs developed in other observatory programs. This will increase AOSO's reliability while reducing cost. A fine Sun sensor is being developed which will enable AOSO to point at the Sun with precision to an order of magnitude greater than OSO. And finally, unique instruments are being developed which are expected to reveal details of solar phenomena never before seen.

Management responsibility for the AOSO project has been assigned to the Goddard Space Flight Center. The spacecraft is being developed under a prime contract with Republic Aviation Corporation.

FY 1964 funds provided for a Phase I project definition and system detail design, and for initiation of experiment development. FY 1965 funds provide for the completion of this effort and for initiation of hardware development. FY 1966 funding will allow the start of full-scale flight unit development in addition to continuation of the on-going work. It is presently planned to procure four flight spacecraft with the first AOSO scheduled for launch during 1969.

The FY 1963 and prior years funding for this four flight program amounted to $1,700,000. Funding requirements for FY 1967 to completion including launch vehicles are estimated to be $126,510,000.

Astronomical Observatories

	1964	1965	1966
Spacecraft	$25,098,000	$21,890,000	$25,600,000
Experiments	10,510,000	9,320,000	6,900,000
Total Spacecraft and Support	$35,608,000	$31,210,000	$32,500,000
Atlas Agena (Launch Vehicle Procurement Program)	(5,626,000)	(9,039,000)	(15,100,000)
Total (including Launch Vehicles)	($41,234,000)	($40,249,000)	($47,600,000)

Development of the Orbiting Astronomical Observatory (OAO) was initiated in 1960. It is designed to provide a precisely stabilized observatory above the atmosphere for astronomical observations in the extensive regions of the electromagnetic spectrum which do not penetrate the atmosphere and for high resolution observations in the visible and other regions of the electromagnetic spectrum which are disturbed as they penetrate the atmosphere. It was recognized that this development would require a major advancement of the state-of-the-art, especially in the fields of stabilization and control, command and data handling, and image tube development. The technical difficulties have been great; but the major development problems have been solved, and the first OAO will be launched in late 1965 or early 1966.

The first OAO (OAO-A) will contain the broadband ultraviolet photometers and the spectrometers developed by the University of Wisconsin for studies of individual stars and nebulae. The four broadband television photometers being developed by the Smithsonian Astrophysical Observatories to perform a sky survey in the ultraviolet will not be ready for the first observatory because of problems encountered in the production of the image tubes. In its place will be a backup package of astronomical instruments designed to conduct

soft X-ray, hard X-ray, and gamma ray surveys of the sky. These instruments, being developed by the Lockheed Research Laboratories, the Goddard Space Flight Center, and the Massachusetts Institute of Technology will provide an opportunity to exploit recent important discoveries of stellar X-ray and gamma ray sources.

The second OAO, scheduled for flight in 1966, will carry a fast 36 inch Cassegrain reflecting telescope combined with a large aperture spectrophotometer. It is designed to obtain absolute spectrophotometric data on stars, nebulae, and galaxies in the ultraviolet region of the spectrum.

The third and fourth observatories will be launched in 1967 and 1968; one consisting of the prototype spacecraft, refurbished after completion of the prototype tests, carrying the Smithsonian and Wisconsin experiments; and the other a telescope developed by Princeton University. The prototype spacecraft has been added to the schedule to provide a flight opportunity for the Smithsonian experiment which was delayed beyond OAO-A by the difficulties in producing image tubes.

The Princeton experiment consists of a 32 inch reflecting telescope combined with a grating spectrograph. The objectives are to study the composition and physical condition of the clouds of interstellar gas which may be the beginning of stellar evolution, and to obtain high dispersion ultraviolet spectral studies of the stars. This observatory will also carry telescopes developed by the University College, London to study the X-ray emission of stars and nebulae.

The fifth observatory, to be launched in 1969, will carry an experiment employing optics and spectrometry similar to those developed for earlier spacecraft. It is probable that guest observers will propose a majority of the observations to be conducted with this observatory. The OAO program aims to develop long-lived, high performance observatories that will be used for many years in a variety of programs as ground observatories are used. Thus, both United States and foreign astronomers can propose relatively short term viewing programs in their individual areas of interest. A similar observing program, but with a more limited number of guests, is planned for the first four OAOs.

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

FY 1964 and FY 1965 funds provide for continuation of work on the first three observatories and the prime experiment for the fourth observatory. They also provide for the initiation of the procurement of the spacecraft for the fourth observatory. FY 1966 funds will provide for the continuing development and procurement of subsequent observatories, for the support of OAO-A launch and for initial OAO-A data analysis.

The FY 1963 and prior years funding including launch vehicles amounted to $87,346,000. Funding requirements for five OAO missions for FY 1967 to completion are estimated to be $86,500,000.

Geophysical Observatories

	1964	1965	1966
Spacecraft	$34,536,000	$17,017,000	$18,800,000
Experiments	7,452,000	12,362,000	12,200,000
Ground operations	880,000	863,000	700,000
Total Spacecraft and Support	$42,868,000	$30,242,000	$31,700,000
Atlas Agena (Launch Vehicle Procurement Program)	(6,959,000)	(3,672,000)	(13,598,000)
Thor Agena (Launch Vehicle Procurement Program)	(3,213,000)	(4,454,000)	(802,000)
Total (including Launch Vehicles)	($53,040,000)	($38,368,000)	($46,100,000)

The Orbiting Geophysical Observatory (OGO) program was initiated in 1960 to meet the need of a spacecraft larger than the Explorer with stabilized orientation, more experiment power, and higher data rates that would be uniquely capable of performing many simultaneous, detailed, high resolution correlative measurements of the space environment. Since simultaneous observation of significant phenomena occurring in the Earth's environment is not possible from one satellite, two types of orbits are combined in a two-fold program of correlative measurements. Missions placed in highly elliptical orbits are intended to concentrate on measurements in the outer reaches of the magnetosphere and in the interplanetary medium; while low polar orbits concentrate on near earth measurements. Together these OGO missions represent a comprehensive, coherent approach to the investigation of Earth-Sun relationships.

The first OGO, OGO-I, was launched on September 4, 1964, into the highly elliptical orbit with an apogee of 92,721 miles. The mission is officially listed as a failure because the satellite failed to secure the planned stabilization in orbit when the horizon scanners failed to acquire the earth. Fortunately, the satellite went into a spin-stabilized mode in which the spin axis is fixed in inertial space.

In the months since launch, the apogee of the OGO-I orbit has rotated from a point well within the tail of the magnetosphere to a point outside the magnetosphere on the sunward side. OGO-I has made measurements of both the magnitude and fluctuations of magnetic fields and of the flux of energetic and thermal particles associated with the magnetosphere, the transition boundary, and interplanetary space. Within the magnetosphere, extensive data on

trapped radiation have been obtained, particularly with regard to energetic electrons in a large energy range. Ion and electron data have been recorded by on-board instrumentation, and electron densities have been studied by the transmission of radio signals from distances extending to apogee. Although further evaluation will be required, preliminary data indicates the existence of very low frequency noise at apogee distances within the tail of the magnetosphere and of unusual solar radio bursts.

In spite of the mechanical failure, OGO-I, has demonstrated that a large number of sensitive scientific instruments can be operated simultaneously aboard a single satellite to make an integrated survey of the space environment. In addition, it has dramatically illustrated the importance of diagnostic instrumentation and extensive command capability in rescuing failing satellites.

The second OGO will be launched in 1965 into a low altitude, near circular polar orbit. It will carry twenty experiments to make related measurements of the Earth's atmosphere, ionosphere, and magnetic field; cosmic radio noise; trapped radiation and aurora; airglow; micrometeorites; and solar radiations. An important aspect of this mission is a comprehensive survey of the Earth's magnetic field. This survey is expected to be a major contribution to the World Magnetic Survey. Modifications are being incorporated into this spacecraft, and additional tests are planned to avoid the difficulties experienced with OGO-I and to provide greater assurance of the success of this mission.

The third OGO, to be launched in 1966, will continue, in general, the investigations currently being conducted by OGO-I. Experiments will be updated by functional and operational modifications based on OGO-I results. The fourth OGO is also to be launched in 1966 to continue the near earth studies of the second OGO.

The fifth OGO, scheduled for 1967, will carry a new group of highly advanced scientific instruments. Along with other scientific objectives, this mission will investigate the role of electrons in the near earth and interplanetary medium. Twelve of the twenty-two experiments under development for this flight will be combined to study electrons over the complete energy range from thermal to cosmic ray levels.

Experiments for the sixth OGO, which will have a circular polar orbit, are to be selected in FY 1965. This observatory, which will also be launched in 1967, will make use of the prototype spacecraft but will have a set of new experiments.

The seventh OGO is planned for launch into a highly elliptical orbit in 1968. Experiments for this mission will be selected in FY 1966. Additional observatories in highly elliptical and circular polar orbits are planned during the 1968-1970 time period with the objective of continuous observation during maximum solar activity.

Management responsibility for the OGO project has been assigned to the Goddard Space Flight Center. The spacecraft are being developed under contract with Space Technology Laboratories.

FY 1964 funds provided for preparations for launching OGO-I and for continuation of the development of the second and third observatories. Procurement of the fourth and fifth observatories was also initiated with FY 1964 funds. Development of the experiments for the fifth observatory has been initiated with FY 1965 funds as well as the initial data analysis for OGO-I. FY 1966 funds will continue these efforts, provide for subsequent observatories, and for launch support and initial data analysis for OGOs B and C.

The FY 1963 and prior years funding including launch vehicles amounted to $69,231,000. Funding requirements for these seven OGO missions for FY 1967 and to completion are estimated to be $68,450,000.

Explorers

	1964	1965	1966
Geophysical and interplanetary explorers	$13,316,000	$16,774,000	$15,600,000
Astronomy explorers	---	1,100,000	6,100,000
Geodetic explorers	2,210,000	4,085,000	4,000,000
Total Explorers	$15,526,000	$21,959,000	$25,700,000
Scout (Launch Vehicle Procurement Program)	(6,600,000)	(4,296,000)	(7,700,000)
Delta (Launch Vehicle Procurement Program)	(11,750,000)	(12,350,000)	(9,500,000)
Thor Agena (Launch Vehicle Procurement Program)	(2,697,000)	(11,560,000)	(4,100,000)
Total (including launch vehicles)	($36,573,000)	($50,165,000)	($47,000,000)

The Explorer class of satellites has produced a large percentage of the scientific data acquired in the NASA program. Explorers still provide the most efficient and economical means of accomplishing certain scientific missions. These smaller spacecraft, most of which can be launched by the relatively inexpensive Scout and Delta vehicles, are specifically designed to accomplish a particular scientific investigation. They are flown in orbits peculiar to the type of investigation planned.

The spacecraft are developed by NASA Installations, universities, industry, or cooperating countries. Because of their relative simplicity, they make

it possible for smaller organizations to participate in spacecraft development efforts. They provide an opportunity for a research group to conceive an idea for space research, develop the complete system for conducting the research, and complete the investigation within a relatively short period of time. Once the system is developed, it is often used again for additional investigations by the same investigators or others.

Explorers are being used for studies of the environment of the Earth and solar, terrestrial, and interplanetary relationships; for astronomical observations; and for geodetic investigations.

Geophysical and Interplanetary Explorers

Most of the Explorers developed have studied the Earth's environment including the atmosphere, the ionosphere, the radiation belts, and the Earth's magnetic field. As a result of these efforts and other related investigations, the picture of the interactions between solar activity, the interplanetary medium, and the immediate environment of the Earth is beginning to come into focus.

By tracking Explorers and from direct measurements made by Explorers, many solar interactions with the atmosphere have been discovered. The atmosphere expands and bulges out on the dayside in a direction toward the sun. The density in the exosphere increases nearly ten times in the bulge. The solar rotation induces a 27 day cycle on atmospheric density. The entire exospheric atmosphere expands out to several times its volume at solar maximum compared to solar minimum. Solar flares and geomagnetic storms increase the temperature and density of the atmosphere within a few hours. The composition at satellite altitudes is predominantly the atomic species of oxygen, hydrogen, and helium. Helium is mainly important where the atmosphere is at high temperatures.

Explorers have made substantial contributions to the study of the Earth's ionosphere and its relationship to other geophysical phenomena. The instrumentation on Alouette has produced data on the spatial distribution and velocities of the free electrons in the upper portion of the ionosphere which could not be obtained from ground based observatories. The observed velocities of the electrons are much higher than the velocities of the molecules in the surrounding neutral atmosphere. The composition of the ionized atoms and molecules in the ionosphere is observed to vary with latitude.

The spatial and mass distribution and penetration probability of micrometeorites have been measured from Explorers. It was discovered that near the Earth, an extremely high flux of dust particles exists which is more than 1,000 times greater than fluxes in interplanetary space. Several dust streams were detected by the satellites. The high impact rate of particles near the Earth has not been explained. Experimental penetration measurements have shown that the likelihood of penetrating a space vehicle is much smaller than many estimates used in the design of manned spacecraft and accordingly the weights previously believed to be required for shielding may be utilized for other purposes.

Explorers have provided most of the data obtained in the space program on the radiation and magnetic environment of the Earth. They were used to discover the radiation belts. They have provided data on the artificial radiation belts created by high altitude nuclear explosions. They have made definitive measurements of the lower end of the energy spectrum of solar protons. They have provided the data used to establish the shielding requirements for the Apollo spacecraft.

A picture is beginning to emerge about the properties of the solar wind and its interaction with the geomagnetic field. Two boundaries are produced in this interaction. Explorers XII and XIV observed one magnetospheric boundary about 40,000 miles away from the Earth in the solar direction. Explorer XVIII found a second boundary at 55,000 miles which constitutes a shock front and separates the region of the undisturbed solar wind from the largely disordered flow produced by the interaction of the solar wind with the Earth's magnetic field. The properties of this transition region are being measured by Explorers XVIII and XXI.

The Earth's magnetic field is swept out behind the Earth by the solar wind. Explorer XVIII has mapped this magnetospheric tail out to 130,000 miles, or more than half the distance to the moon. Indications are that this tail extends well beyond the moon and resembles in many respects the tail of a comet.

Explorers have also made observations of galactic cosmic rays in the energy range from about 20 million to several hundred million electron volts. Only a small fraction of these cosmic rays penetrate the solar system down to the Earth because the interplanetary magnetic field provides an effective shield. An actual cut-off in the flux at the lower energies was observed, and intensity modulations in the flux can be related to the variable properties of the solar wind.

The level of effort in this area is being increased in FY 1965 and FY 1966 to provide for extension of the exploration of the magnetospheric boundary to include Explorers anchored in an orbit around the moon. This orbit will make it possible for the spacecraft to remain in the interplanetary medium or in the magnetospheric boundary area all of the time and to complete a circle around the earth every twenty-eight days. Atmospheric and ionospheric investigations and studies of cosmic dust will also be continued, and emphasis will be placed on the polar and equatorial regions and on the interactions with solar radiation and the trapped radiation in the Earth's magnetic field. International cooperative efforts in this area are underway with the United Kingdom, Canada, France, Italy, and the European Space Research Organization (ESRO). Other nations are involved in acquiring data and conducting research based on signals received from these satellites.

Astronomy Explorers

Experiments conducted with sounding rockets have demonstrated the feasibility of conducting astronomical observations in the radio and X-ray

regions of the electromagnetic spectrum using small spacecraft. In the radio region, it is necessary to place the spacecraft above the ionosphere to make measurements in those wavelengths which do not penetrate this ionized region of the Earth's upper atmosphere. Development of a satellite especially designed for this purpose is being initiated in FY 1965. It will be placed in a high altitude circular orbit to optimize the measurements. In addition to continuing the development of Radio Astronomy Explorers in FY 1966, it is planned to initiate the development of a small X-ray Astronomy Explorer to exploit recent discoveries of stellar X-ray sources.

Geodetic Explorers

Accurate tracking of satellite orbits provides data which can be used for geodetic investigations. Satellites developed for geophysical studies have been equipped with reflectors and beacons which facilitated accurate measurements of positions.

The optimization of geodetic investigations, however, requires orbits and equipment especially selected for the mission. The ANNA satellite launched by the Department of Defense was the first satellite especially tailored to this mission. Building on the ANNA experience, a program has been developed, in coordination with the Department of Defense and the Coast and Geodetic Survey, which involves the launching of active and passive satellites into orbits selected for these missions. The program involves participation by universities and other research organizations in the United States and in cooperating countries. Active satellites will be launched in 1965 and 1966 employing a variety of optical and electronic techniques. Passive satellites consisting of Echo type balloons with beacons will be launched into high altitude circular orbits in 1966 to supplement the active satellite program. Comparison studies are planned to evaluate the various techniques employed and to provide a check on the accuracy of individual measurements. The program is planned to continue with flights beyond 1966, with additional active satellites tentatively scheduled. The specific equipment to be incorporated in the later missions will be dependent upon the results obtained from the earlier missions.

Sounding Rockets

	1964	1965	1966
Experiments	$ 8,797,000	$ 7,790,000	$ 8,200,000
Rocket development	601,000	644,000	700,000
Attitude control systems	1,406,000	1,098,000	1,500,000
Engineering support	470,000	347,000	500,000
Test and evaluation	100,000	221,000	200,000
Ground instrumentation	3,123,000	2,800,000	2,800,000
Rocket procurement	2,453,000	3,100,000	3,100,000
Total	$16,950,000	$16,000,000	$17,000,000

Sounding rockets are small vehicles that are particularly well adapted for studies at altitudes between those reached by balloons and the perigees of low Earth satellites. They are used for studies of the atmosphere, ionosphere, and radiation that reaches the vicinity of the Earth, either as energetic particles or as electromagnetic radiation. They serve as inexpensive carriers to test instrumentation being designed for use on satellites. The usefulness of sounding rockets, particularly for solar and other astronomical observations, has been greatly increased by the development of attitude control systems.

Profiles of atmospheric density and temperature have been made with sounding rockets in various parts of the world and at frequent intervals for a number of years. It has been found that there is little variation in atmospheric temperature and density throughout the solar cycle at altitudes near 60 miles. However, there are large variations in temperature and density in the auroral regions and considerable heating near 50 miles altitude during solar disturbances.

Sounding rockets have been used to measure the amounts of molecular and atomic oxygen, atomic nitrogen, nitric oxide, hydrogen and helium at various levels of the atmosphere. Studies have been made of airflow and its effects on astronomy and astronaut seeing.

The dynamics of the ionospheric region of the atmosphere have been measured by vapor releases from sounding rockets. Turbulence, mixing, extreme wind shears, and large scale motions and global patterns have been discovered.

Sounding rockets with recovery devices have been used for successful recovery of dust of cometary and astrodial origin. Noctilucent clouds formed by cosmic dust surrounded by an ice condensate have been studied in Sweden. The composition of various meteor streams has been probed.

Sounding rocket experiments have related the causative solar flux to the resultant electron densities in the lower ionosphere. They have shown a relationship between the thin, dense, sporadic E layer and wind shears. Progress has been made in developing mass spectrometers, for both ionized and neutral constituents, and composite payloads are being developed to measure a variety of parameters from the same rocket. The currents in the E region have now been directly measured with magnetometer payloads, launched both at the magnetic equator and at medium latitudes. More such flights are needed to define this current system better in time and latitude and to relate it to the dynamics of the ionosphere.

Sounding rockets have made important astronomical observations. The first solar ultraviolet spectra were obtained from sounding rockets; X-ray emission from the sun was found with sounding rockets; and stellar X-ray sources have also been discovered. Ultraviolet observations of the planets Venus, Mars and Jupiter have been made.

Management responsibility for sounding rocket experiments is assigned to each participating Installation, with NASA Headquarters retaining responsibility for managing the development of experiments by other research organizations.

One hundred sounding rockets were launched in 1964 from sites in the United States, Canada, Pakistan, India, Norway, Sweden, and from a converted Navy aircraft transport ship. The shipboard launchings were conducted as a part of a shakedown cruise for an expedition planned for 1965. This expedition, which is part of the international cooperative effort for the International Quiet Sun Year, will involve launchings through areas of the upper atmosphere and ionosphere which cannot be reached by land based rockets. The launchings will take place in the South Pacific Ocean near the west coast of South America near the geomagnetic equator and south to as far as 60 degrees south latitude. Of primary interest on this expedition will be studies of the "equatorial electrojet", a system of electrical currents circulating in the ionosphere in the region of the magnetic equator.

Future use of sounding rockets is expected to follow the pattern of past usage. Several types of experiments that are already begun will be continued; such as measurements in the atmosphere and ionosphere, collection of cosmic dust, atmospheric motions and winds observed through chemical releases, and observations of the Sun, planets, stars, and other celestial bodies in the ultraviolet, X-ray and radio frequencies. The relatively small cost and the comparatively short lead-time for rockets will continue their use for pioneering experiments as new ideas are developed by scientists.

The decrease in the sounding rocket program costs for FY 1965 is primarily the result of decreasing the number of new experiments started. Emphasis in FY 1965 is being placed on completion of development efforts started in FY 1964 and prior years. FY 1966 funds will provide for an increased number of new experiments in preparation for an expanded program of solar terrestrial investigation during the period of the active sun.

Data Analysis

	1964	1965	1966
Data center operation	---	---	$ 600,000
Support of research tasks	---	---	2,400,000
Total	---	---	$3,000,000

NASA has the obligation to make available to the public the information gained from space exploration. The accumulation of data from flight programs provides a pool of scientific data that will be useful to scientists, particularly as it permits the use of data from a number of satellite, sounding rocket, and space probe experiments.

A scientific data center is being established at Goddard Space Flight Center to catalog these data and make them available to interested researchers

in a form which can be readily used. The initial contract for operation of the data center was funded under the FY 1965 Supporting Research and Technology Program. This new project will provide for continued operation of the data center and for support of promising research proposals that would make use of the data in storage.

The initial analysis of data from a flight experiment is funded under the flight project. The experimenter prepares a plan for analysis of the data from his experiment. As the data becomes available from the spacecraft, it is processed to provide the necessary information to establish the circumstances, such as time and spacecraft position, under which the data was taken. The experimenter has an agreed upon period of exclusive use of the data during which time he makes the initial analysis and reduces the data to a form which has scientific meaning. In some cases arrangements are made for immediate exchange of data between experimenters, so that they may correlate the results of simultaneous measurements. After expiration of the agreed upon period of exclusive use, the data passes into the public domain. Meanwhile, the experimenter publishes the results of his experiment.

After these initial results have been obtained, additional analysis of these data will, in many cases, produce further useful scientific information. The experimenter or another interested scientist may then propose a new research task which will involve additional correlative computations and evaluation. In the past, such efforts have been funded primarily under the flight projects; but, beginning in FY 1966, the funding of the flight projects will include only first run data analysis.

This new approach to the management of the data analysis is expected to produce a greater scientific return for the investment made in the flight program. It will broaden the participation of scientists throughout the nation and encourage them to use all of the available information in their theoretical research. Meanwhile, it will free the managers of individual flight projects from continuing data reruns on completed flights, since now their responsibility for a mission will terminate after first run data analysis is completed.

The responsibility for overall management of the Data Analysis Project will be retained in the NASA Headquarters. The Goddard Space Flight Center has been assigned responsibility for management of the data center.

OFFICE OF SPACE SCIENCE AND APPLICATIONS

LUNAR AND PLANETARY EXPLORATION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The primary objective of the Lunar and Planetary Exploration program is to carry out the scientific exploration of the solar system by both unmanned space flights and Earth based research. This requires the extension of spacecraft technology vital to future manned and unmanned missions. The program supports the manned space flight effort by measuring the environment in space and the characteristics of the Moon and the planets.

The primary objectives of the lunar program are to obtain data on the structure and topography of the lunar surface, the lunar environment and the physical, chemical, geodetic, and gravitational properties of the Moon. The data gathered as a result of these investigations will be of importance in seeking to understand the origin of the solar system and in determining accurately the environment in which manned spacecraft must operate. Another objective of lunar exploration is to search for extant or extinct life forms on the Moon, evidence of which would contribute to the overall theory of the origin of life in the solar system.

The lunar program includes three types of mission. The Ranger is providing initial visual data about the surface of the Moon. Surveyor missions will be aimed initially at selecting suitable landing areas for manned flights. The Lunar Orbiter will complement the Ranger and Surveyor missions by providing data obtained from the vantage point of an orbiting spacecraft.

The planets present an interesting attraction because they all differ markedly from the Earth. In these differences may lie clues to the nature, origin and evolution of the solar system. Therefore, our objective is to explore the planets, their moons and other interplanetary phenomena with unmanned spacecraft in conjunction with ground based research. The successful Mariner II flight added significantly to scientific knowledge of the planet Venus. The planet Mars is the next objective. The Mariner IV spacecraft, currently on a trajectory that will pass close to Mars, is expected to provide invaluable scientific information including relatively close-up photographs of the planet's surface. During the remainder of this decade and into the next, emphasis will be placed on the unmanned exploration of Mars.

The definition of the next series of flight missions to Mars is being initiated to meet the opportunities in 1971 and subsequent years. The spacecraft for these missions would be much larger and more sophisticated than previous planetary spacecraft and would be designed to perform experiments on

the surface and in orbit about the planet. This effort is identified as the Voyager Program, and will be the first program to concentrate on studying the evidence of the existence and nature of extraterrestrial life.

Interplanetary investigations will continue with Pioneer missions scheduled to begin the latter part of 1965.

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Supporting research and technology/advanced studies	$22,000,000	$28,749,000	$36,800,000
Ranger	30,306,000	15,251,000	1,415,000
Surveyor	70,704,000	76,000,000	85,600,000
Lunar orbiter	20,000,000	42,400,000	37,000,000
Mariner	49,152,000	21,000,000	3,800,000
Voyager	---	7,750,000	43,000,000
Pioneer	13,600,000	15,000,000	8,000,000
Total	$205,762,000	$206,150,000	$215,615,000

Distribution of Program Amount by Installation:

Marshall Space Flight Center	$505,000	$535,000	$300,000
Manned Spacecraft Center	1,867,000	4,429,000	14,000,000
Goddard Space Flight Center	1,084,000	1,111,000	900,000
Ames Research Center	15,382,000	16,054,000	8,600,000
Langley Research Center	20,146,000	43,050,000	37,300,000
NASA Headquarters	9,521,000	10,667,000	9,500,000
Western Operations Office	157,257,000	130,304,000	145,015,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

	1964	1965	1966
Lunar and planetary science	$12,145,000	$12,486,000	$12,000,000
Advanced technical development	4,700,000	7,513,000	7,000,000
Advanced studies	2,236,000	2,390,000	2,300,000
Manned lunar science	2,919,000	6,360,000	15,500,000
Total	$22,000,000	$28,749,000	$36,800,000

Supporting Research and Technology provides the capability to carry out vital work associated with but not specifically a part of currently approved flight missions.

The science program provides scientific data necessary for the design and calibration of flight experiments and the basic data for the analyses and interpretation of the results of flight experiments. The program provides the means of exploring new concepts and ideas, and of developing those of high potential to the stage where they can be proposed for flight experiments. Scientists at NASA Research Centers, Universities, Industrial Research Laboratories, and other Government Laboratories throughout the country carry out this program of laboratory, theoretical, and observational research. The observational program in optical and radio astronomy is limited to investigations of the moon and the planets and has the objective of supplying information essential to the scientific flight program. It also provides information essential to the design of spacecraft and the selection of experiments for lunar and planetary investigations. The most important problems being investigated in this area are the nature and bearing-strength of the lunar surface, and the variation of pressure with altitude in the Martian atmosphere. Increased knowledge of lunar surface characteristics is desirable for safe exploration by man, and for the successful performance of soft landing scientific payloads. The characteristics of the Martian atmosphere have become of major concern in the past year when recent ground observational investigations indicated that the surface pressure of the Martian atmosphere may be one-half or less of the formerly accepted value of 85 millibars. In the 25 to 80 millibar pressure range, the efficiency of an entry capsule in carrying useful scientific payload decreases drastically with smaller atmospheric pressure values. Further studies of the Martian atmosphere by astronomical spectroscopic techniques will be conducted during 1965 to provide more precise values and permit the design of efficient entry capsules.

A contribution of knowledge concerning the environment in which the Apollo astronaut must function was made by field study of terrestrial counterparts of lunar processes and features, such as meteor craters, and by laboratory experiments with lunar surface simulation. Studies were made of the behavior of possible lunar surface materials under hypervelocity bombardment by meteorites and micrometeorites, and under conditions of wide temperature fluctuation, solar radiation, low lunar gravity and near vacuum atmosphere. Topographic and geologic maps of the visible portions of the moon are being prepared. The equatorical belt, which includes the initial target areas for Ranger, Surveyor, Orbiter, and Apollo, is scheduled for completion about mid-year.

New or improved theories, techniques, and instrumentation for scientific observation and measurement of the moon and planets, both from the Earth and from the spacecraft are developed by the supporting research program. The X-ray diffractometer, gamma ray spectrometer, neutron and alpha particle sensors, seismometer, magnetometer, and gas chromatograph are among those in various stages of development.

The Advanced Technical Development Program is directed principally toward the development of equipment and technology for flyby, orbiting, and landing

missions to Mars. These missions impose stringent requirements for the development of reliable equipment that will survive the rigors of sterilization and long time exposure to deep space, and will take fullest advantage of the improved capability of launch vehicles to be available a few years hence. In the FY 1965 program, principal emphasis was in the areas of communications and guidance and control. Under FY 1966 funds requested, emphasis on communications will continue toward a system that will transmit large quantities of scientific data over the immense interplanetary distances. Increased attention will be given to landing capsule technology, particularly to insure safe passage through the atmosphere of Mars and landing on its surface. To permit the recognition and identification of extraterrestrial life, planetary landers must be made sterile. The sterilizing procedures required, drastically compromise the reliability and operational life of much of the current state-of-the-art spacecraft equipment. FY 1965 and prior year funds began the development of equipment that will operate reliably after sterilization. Funding in FY 1966 will continue development and testing of these items, and initiate work on other equipment needed for planetary landers.

The advanced studies effort is essential to future lunar and planetary mission planning. Studies of space flight mechanics and planetary trajectories identify favorable launch opportunities and establish the energies required. Comparing these energy requirements with launch vehicle performance yields control weights for spacecraft planning. Preliminary mission flight profiles were generated for unmanned missions to the Moon, Jupiter, Venus, Mercury, comets and asteroids with FY 1965 funds, which also provided for conceptual designs of spacecraft for missions to Mars (Voyager). The FY 1966 effort will include additional mission profile studies of Jupiter, Mercury, comets and asteroids, as well as spacecraft conceptual designs for missions to Venus, Jupiter, Mercury, comets and asteroids. Primary emphasis will be on the Venus and Jupiter missions.

The Manned Lunar Science program objective is to maximize the scientific benefits derived from man's ability to explore the moon. It provides the space science activities which relate directly to the manned lunar missions of the Apollo program. The initial lunar manned missions will undertake investigations in the disciplines of geology, geochemistry, geophysics, atmospheric physics, particles and fields, and the biosciences. Initial development of investigations and supporting equipment began in FY 1964. Procurement of test and flight hardware for the earliest Apollo missions accounts for most of the difference between FY 1965 and FY 1966 requirements. This hardware includes both remote sensing instrumentation for observation of the moon from lunar orbit and instrumentation for lunar surface exploration, sample collection, and analysis.

Earth based support for Apollo science encompasses training of the astronauts in the general scientific disciplines and specific experiments in which they will be participating, compilation of plans of overall scientific activities to be carried out on each mission, testing investigatory procedures

and equipment to train the astronauts under the simulated lunar conditions, and development of facilities, equipment, and procedures for the analysis of the samples which will be returned from the moon.

Ranger

	1964	1965	1966
Spacecraft	$19,520,000	$8,362,000	$500,000
Experiments	3,926,000	4,142,000	315,000
Ground operations	6,860,000	2,747,000	---
Total Spacecraft and Support	$30,306,000	$15,251,000	$1,415,000
Atlas-Agena (Launch Vehicle Procurement Program)	(14,863,000)	(3,136,000)	(200,000)
Total (including launch vehicles)	($45,169,000)	($18,387,000)	($1,615,000)

The objective of the two remaining Ranger flights is to obtain television pictures of the lunar surface which will be of benefit to both the scientific program and the United States manned lunar program. These two Rangers will photograph different areas of the Moon and under different lighting conditions than those of the successful Ranger VII.

The pictures obtained from Ranger VII provided a final resolution more than 2,000 times better than any previously available Earth based photography. The pictures which will be acquired from the two remaining flights are expected to be of the same resolution as those obtained from Ranger VII.

Overall management of the Ranger Program is the responsibility of the Office of Space Science and Applications, NASA Headquarters. Project management is the responsibility of the Jet Propulsion Laboratory. Design and fabrication of the spacecraft is a laboratory in-house effort while the television system is procured from the Astro-Electronics Division of the Radio Corporation of America.

FY 1964 funds were used primarily for the assembly, test, and launching of Rangers VI and VII. Included in this were the test and rework efforts required to correct faulty electronics components (diodes) discovered late in 1963 on Ranger VI, as well as the retest and redesign efforts to insure against a recurrence of the failure of the TV system on Ranger VI. The FY 1965 funds are being used for the assembly, test, and launching of Rangers C and D as well as the post-flight analysis of the photographic data. The FY 1966 funds will be used primarily for the post-flight evaluation of engineering data (spacecraft) and the interpretation and analysis of the photographs obtained which will directly support both the Surveyor urmanned lunar program and the Apollo manned lunar program.

The FY 1963 and prior years funding for this nine-flight program, including launch vehicles, amounted to $198,616,000. The FY 1966 request will complete the funding for Ranger.

Surveyor Lander

	1964	1965	1966
Spacecraft	$61,904,000	$64,460,000	$64,370,000
Experiments	3,600,000	6,890,000	15,970,000
Ground operations	5,200,000	4,650,000	4,760,000
Total Spacecraft and Support	$70,704,000	$76,000,000	$85,600,000
Atlas-Centaur (Launch Vehicle Procurement Program)	(32,000,000)	(47,814,000)	(50,400,000)
Total (including launch vehicles)	($102,704,000)	($123,814,000)	($136,000,000)

The Surveyor spacecraft is being developed to accomplish the first soft landings on the Moon. On the lunar surface, these spacecraft will survey various landing areas of interest as possible sites for later manned landings and make measurements to improve our understanding of the nature of the Moon. Landed Surveyors will transmit to Earth a variety of data, such as high resolution television pictures of the lunar terrain, measurements of the surface texture, hardness, and other physical and chemical properties, lunar seismic activity, and the meteorite environment near the surface. The Surveyor mission requires the development of a technology far more advanced than that employed in the Mariner II and Ranger spacecraft. Not only must Surveyor navigate through the space between the Earth and the moon, but it must land softly on the moon, essentially by backing down a multi-stage rocket to a landing 240,000 miles and 66 hours removed from the launching site.

The prime purpose of Surveyor is to provide information on lunar surface characteristics which will assure the high confidence required before manned landings are attempted. A great deal of study effort has been expended to determine the best strategy by which Apollo landing sites can be verified, considering both the safety aspects and economics. The results of these studies indicate that the most timely and economical method for site verification is through the combined efforts of the Surveyor and the Lunar Orbiter. The operational plan calls for Surveyor landing attempts in different regions with "aerial survey" of the Surveyor landing sites and surrounding areas by the Lunar Orbiter. This combination will provide for detailed analyses of small areas through the Surveyors which then can be extended to the much larger area coverage of the Orbiter photographs.

In addition to direct manned flight support, unmanned spacecraft offer a distinct complementary function to the manned missions. Many regions of interest on the moon (such as the Crater Aristarchus where gaseous emissions have been observed) are likely to be inaccessible to man because of the hazards of landing. Landings on the backside of the moon, for example, would be of extreme interest to our total lunar exploration program. Surveyor landings on the backside with a communication link through the Orbiter would not involve the risks which would result if a manned landing were made without direct communication to Earth except through an orbiting spacecraft.

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

FY 1965 funds are being used to complete spacecraft system functional testing, environmental testing (thermal vacuum, shock, and vibration), mission simulation testing, field crew training by mock operations, and tests of dynamic models on Centaur Development flights. Program definition effort and long lead time procurements in the spacecraft and payload areas for the follow-on Surveyors are also being provided for with current year funds.

The funds requested for FY 1966 will provide for the completion of ground based development testing of the basic Surveyor spacecraft system and for the initiation of test flights early in the fiscal year. The funding during FY 1963 and prior years for this seventeen flight program, including launch vehicles, amounted to $111,641,000. Funding requirements for spacecraft and launch vehicles from FY 1967 to completion are estimated to be about $290,000,000.

Lunar Orbiter

	1964	1965	1966
Spacecraft	$20,000,000	$40,600,000	$32,900,000
Experiments	---	---	500,000
Ground operations	---	1,800,000	3,600,000
Total Spacecraft and Support	$20,000,000	$42,400,000	$37,000,000
Atlas-Agena (Launch Vehicle Procurement Program)	(170,000)	(2,335,000)	(22,200,000)
Total (including launch vehicles)	($20,170,000)	($44,735,000)	($59,200,000)

The Lunar Orbiter will complement the Surveyor Lander as part of the unmanned lunar reconnaissance team. The Orbiter will take wide area photographs from an orbit 30 miles above the surface while the landed Surveyor conducts its investigations on the surface of the moon itself. The Lunar Orbiter camera system will take high and medium resolution photographs simultaneously. The medium resolution photographs provide stereo coverage of broad areas, while those of high resolution will show detail comparable to the final Ranger pictures but of hundreds of thousands of times as much area. The combination of such pictures will permit topographic mapping of considerable regions of the lunar surface. The information gained from the Orbiter photography will be used to screen out obviously undesirable sites for Surveyors, improving the probability of successful landings. The Orbiter and successfully landed Surveyor can then team to verify suitable sites for Apollo manned landings.

In addition to the photographs, the Lunar Orbiter will yield, as a by-product, information on the lunar gravitational field which will greatly benefit all subsequent lunar missions. Analysis of the orbit will help determine the mass distribution of the moon far more precisely than it is known at present; consequently, guidance calculations for Apollo will be much improved. The irregularities in lunar mass distribution these orbital analyses will reveal are closely linked with questions of seismic activity of the moon, its radioactivity, and the character of the lunar surface, which are basic to any discussion of the origin of the Earth-moon system. Once the primary photographic mission of the Lunar Orbiter has been accomplished, later spacecraft may include other instrumentation, within the available weight and power, to make other measurements in cislunar space.

Project management responsibility has been assigned to Langley Research Center and launch vehicle system management to Lewis Research Center. The prime contractor for design, fabrication and test of the 800 pound, attitude stabilized spacecraft is the Boeing Company. Major subcontractors are Eastman Kodak for the photo subsystem and the Radio Corporation of America for power and communications.

Current year funds have been devoted to completing the design of the spacecraft and all of the its subsystems; construction and testing of developmental test models to verify the design data; fabrication of test and flight hardware in accordance with the final design; and assembly of ground test spacecraft.

FY 1966 funds will be used to assemble the flight spacecraft, test and prepare them for launch, install the ground support equipment, train the launching and operating personnel, and conduct the first launch.

FY 1963 and prior year fundings for a five flight program, including launch vehicles, amounted to $10,098,000. Funding requirements for spacecraft and launch vehicles from FY 1967 to completion are estimated to be approximately $20,000,000.

Mariner

	1964	1965	1966
Spacecraft	$28,360,000	$14,055,000	$1,250,000
Experiments	8,920,000	2,466,000	1,800,000
Ground operations	11,872,000	4,479,000	750,000
Total Spacecraft and Support	$49,152,000	$21,000,000	$3,800,000
Atlas-Agena (Launch Vehicle Procurement Program)	(10,550,000)	(2,377,000)	(200,000)
Total (including launch vehicles)	($59,702,000)	($23,377,000)	($4,000,000)

Mariner is the United States program for early flyby missions to Venus and Mars. In 1962, Mariner II made history as the first successful planetary mission to Venus. Mariner IV, which was launched in late November 1964 on a flyby mission to Mars, is similar in design concept to Mariner II, although its technology is considerably advanced. Mariner IV is a 575-pound spacecraft carrying instruments to measure micrometeoroid impacts, magnetic fields, and atomic particles in space. During its close pass by Mars on July 14, 1965, it will take a series of TV pictures of the planet's surface. Also, passage of the spacecraft's signal through the Martian atmosphere will provide a measurement of the height and density of the atmosphere.

The Jet Propulsion Laboratory manages the Mariner Program and built the spacecraft in-house. Lewis Research Center was responsible for procurement of the Atlas-Agena launch vehicle.

The FY 1965 funds covered the extensive testing and prelaunch activities required for Mariner IV and the identical but unsuccessful Mariner III which was launched in early November 1964. The funds also will cover support of the major part of the in-flight phase of the program. This includes around the clock monitoring of the spacecraft condition, diagnosis of problems and exercise of the command function when required, and continuing analysis and reporting on the wealth of telemetry data being received.

The FY 1966 funds will continue the above support through the Mars encounter and postencounter phase and, in addition, will cover the major part of extensive post-flight data analysis and the preparation of final reports.

FY 1963 and prior years funding for this program, including launch vehicles, amounted to $115,569,000. Funding requirements for FY 1967 to completion are estimated to be $500,000.

Voyager

	1964	1965	1966
Spacecraft	---	$7,150,000	$40,000,000
Experiments	---	200,000	2,000,000
Ground operations	---	400,00	1,000,000
Total	---	$7,750,000	$43,000,000

The definition of the next series of Mars flight missions is being initiated to meet the 1971 and subsequent opportunities. The spacecraft for these missions are named Voyager and will have the primary objective of obtaining detailed information on the nature of the planet Mars, which includes the characteristics of its atmosphere, meteorology, its surface and subsurface conditions, trapped radiation belts and most importantly, information on the nature of any extraterrestrial life on the planet. The secondary objective will be to obtain scientific information on the interplanetary medium existing between Earth and Mars.

Such a mission requires a spacecraft capable of carrying large scientific payloads to the planet, telemetering considerable amounts of data back to earth and having long life in orbit about the planet, and on the planetary surface. Conceptual studies completed in FY 1964 indicated the spacecraft weight to meet these requirements would be in the 7,000 to 10,000 pound class. Such a spacecraft could be launched by a Saturn IB-Centaur launch vehicle. The spacecraft system concept indicated by the studies, which would meet the requirements of gathering data both in orbit and on the planetary surface would include three basic modules: the bus-orbiter module, the retro-propulsion module, and the capsule module. The Voyager system will be designed for use during several Mars opportunities, thus providing a base for a long range scientific exploration program. By completing the definition phase by FY 1966, the operational Voyager system could be launched during the 1971 Mars opportunity.

Overall management of this program is the responsibility of the Office of Space Science and Applications, NASA Headquarters. The Jet Propulsion Laboratory is responsible for management of the Voyager project including overall spacecraft system integration.

A project definition phase (Phase I) is being initiated in FY 1965 and is to be completed by the end of FY 1966. A separate industrial contract effort is planned for the spacecraft system (the bus, retro-propulsion module and overall integration) and another for the capsule system. System design, functional specifications for all subsystems, and selected subsystem development and breadboard testing will be accomplished under Phase I. Fabrication and testing plans, schedules, and detailed estimates of resource requirements will be generated by this effort. Based on the results of Phase I, a decision can be made regarding the initiation in FY 1967 of flight hardware development (Phase II).

FY 1965 funds are being used to initiate the spacecraft system design definition. This will cover preliminary design of the bus-orbiter module and the retro-propulsion module, preliminary definition of the capsule module interface, and preliminary investigation of the capsule and science integration with the spacecraft. The FY 1966 funds will be used to complete the Spacecraft System Phase I effort.

After evaluation of Phase I results, the total scope of the program will be established so that Phase II could be initiated in FY 1967.

Pioneer

	1964	1965	1966
Spacecraft	$10,805,000	$12,311,000	$5,500,000
Experiments	2,744,000	1,424,000	2,100,000
Ground operations	51,000	1,265,000	400,000
Total Spacecraft and Support	$13,600,000	$15,000,000	$8,000,000
Delta (Launch Vehicle Procurement Program)	(4,100,000)	(2,900,000)	(5,900,000)
Total (including launch vehicles)	($17,700,000)	($17,900,000)	($13,900,000)

Pioneer missions will measure interplanetary phenomena in deep space to provide simultaneous data with Earth satellites and to fill time gaps in monitoring in deep space between the widely separated flights of planetary spacecraft.

The Pioneer spacecraft will weigh about 140 pounds and will be launched by the Thrust Augmented Improved Delta launch vehicle. It will be spin stabilized for simplicity and reliability. The goal for the lifetime of the mission is six months or more. The first four spacecraft will alternate between missions toward, and missions away from, the Sun, approaching as close as 75,000,000 miles and going as far away as 110,000,000 miles.

A critical experiment on the spacecraft measures the extremely low level interplanetary magnetic field. For this reason, considerable effort is being expended to assure that the spacecraft will be as magnetically clean as the state-of-the-art will permit. Other experiments on the first two flights will measure the flux of atomic particles coming from the Sun, cosmic rays, and the electron density in space. Measurements of micrometeoroid impacts will be added on the third and fourth flights.

The Office of Space Science and Applications is responsible for overall management of this program. Responsibility for project management rests with the Ames Research Center, and the Space Technology Laboratory is building the four spacecraft under a fixed price incentive fee contract.

The FY 1965 funds will cover assembly and testing of the prototype spacecraft, and the fabrication, assembly, and initial tests for the first two flight spacecraft. The FY 1966 funds will cover the final testing, launch, and post launch operations for the first two flight spacecraft as well as the assembly and start of testing for the third and fourth spacecraft.

FY 1963 and prior years funding for this four flight program, including launch vehicles, amounted to $2,614,000. Funding requirements for FY 1967 to completion are estimated to be $4,000,000.

OFFICE OF SPACE SCIENCE AND APPLICATIONS — SUSTAINING UNIVERSITY PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Sustaining University Program was planned and initiated to strengthen university participation in aeronautical and space science and engineering endeavors and to broaden NASA's sponsored research activities. The program's objectives are to: (1) increase the future supply of scientists and engineers required in space related science and technology; (2) build laboratories urgently needed for space research in selected universities; and, (3) improve the universities' role in support of NASA by encouragement of creative multi-disciplinary investigations, development of new capabilities, and consolidation of space oriented activities. These three aspects of the Sustaining University Program are complementary to project sponsored research and to each other.

Universities are the traditional source of both new knowledge and highly trained manpower. Only through a carefully designed program can the supply of scientific talent and the development of significant and relevant research capabilities keep pace with the demands of the national space effort. The training aspect produces skilled manpower, research scientists, technicians and instructors. Adequate facilities are essential, if scientific undertakings are not to be hampered further by an unsuitable environment. Additionally, by supporting research at selected institutions not currently participating in the space program, the number of universities and scientists involved in attacking some of the fundamental problems facing NASA has grown significantly.

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Training	$19,811,700	$25,000,000	$25,000,000
Research facilities	12,000,000	10,000,000	8,000,000
Research	8,188,300	11,000,000	13,000,000
Total	$40,000,000	$46,000,000	$46,000,000

Distribution of Program Amount by Installation:

Jet Propulsion Laboratory	$60,000	$35,000	$35,000
NASA Headquarters	39,940,000	45,965,000	45,965,000

BASIS OF FUND REQUIREMENTS:

Training

	1964	1965	1966
Training.....	$19,811,700	$25,000,000	$25,000,000

The space program continues to place increasingly severe demands on the supply of highly trained scientists and engineers. The demand is in two general directions: those technical personnel required to participate directly in the solution of immediate problems confronting current space activities and those required to conduct future research, teach new students in order to replenish the manpower pool, and evaluate and organize the vast amounts of scientific data acquired through increasing space experimentation.

The predoctoral research training program is designed to provide 1,000 persons receiving Ph.D.'s annually. This type of program has been strongly recommended by the President's Science Advisory Committee as necessary and reasonable. The Committee stated that a special effort must be made if the supply of highly trained scientists and engineers is to keep pace with the demand. It was further determined that there are adequate numbers of qualified students available who would not enter graduate research training unless new opportunities were made available. The Committee recommended that the national output of persons receiving Ph.D.'s should reach at least 7,500 annually by the year 1970. In 1963 the number of persons receiving the Ph.D. degree in the engineering, mathematical and physical sciences totalled 4,250.

1,071 new students began their three years of training under the NASA predoctoral program in September 1964. About 1,275 new students will begin their three years of training in September 1965. Under the proposed budget for FY 1966, about 1,300 new students would enter the program. Since this program funded smaller numbers of students in previous years, the NASA goal of an output of 1,000 Ph.D.'s per year will not be reached before FY 1968 or FY 1969. In order to ease a sudden manpower shortage, it should be noted that funds injected at a later date will not rapidly accelerate the availability of scientists and engineers.

Although a limited amount of time has elapsed since the first graduate students commenced their space related training under the Sustaining University Program, 38 students have now received their Ph.D. degrees. The fields in which their degrees were earned are: (a) the physical sciences - 17; (b) engineering disciplines - 9; (c) mathematics - 8; (d) life sciences - 3; and (e) other areas - 1. Since receiving their degrees the students have commenced the following activities: (a) university research and/or teaching - 24; (b) post-doctoral scholarships or Fulbright fellowships - 5; (c) employed in Government laboratories - 3; (d) employed in industrial laboratories - 6. Those graduates whose post-Ph.D. employment involves university research or teaching have remained within the university in order to continue work of a space related nature, and to participate in the production of highly trained new talent.

Specialized training for selected students offers the students identification with NASA's goals and problems and involves them directly in the new programs of the space age. In many cases the students' professors are also engaged in space research activities. The students thus have a unique relationship with NASA through contact with scientists and experiments generated by experienced senior investigators. Such close ties will provide the trainee with additional motivation for the continuation of studies and participation in the national space effort. A by-product of these traineeships is the incentive they provide to undergraduates who look forward to similar participation.

The predoctoral training grants are aimed directly at alleviation of a most critical manpower deficiency. The training program also includes related activities such as post-doctoral conversion of scientists desiring to enter space related fields, enhancement of the utility of people possessing unique capabilities, and summer seminars for carefully selected students with outstanding potential.

Research Facilities

	1964	1965	1966
Research facilities.....	$12,000,000	$10,000,000	$8,000,000

During the last year, NASA continued to move forward in its effort to help universities acquire the research laboratories necessary for space oriented work. Twelve more facilities grants were awarded to as many institutions which are already heavily committed to research and training in support of the national space program. Significant progress was made on the design and construction work of the fifteen prior year awards and, as a result, five buildings, representing over 150,000 square feet of additional laboratory type space, were completed and occupied by university scientists. When all of these structures have been erected, over a million square feet of critically needed laboratory space will have been added to the country's universities where the investment in research and training is substantial. Without a program of this type, an increasing number of universities will be constrained from accommodating any expanded amount of space oriented work. This expansion of high quality graduate research, and the construction of laboratories to make it effective for use in many disciplines, is essential to the successful accomplishment of NASA's mission in space. Although space oriented research extends through many fields of scientific investigation, it has one general requirement. This is a common need for more sophisticated and specialized facilities. Except for the relatively few theorists in their quiet offices, most of the scientists doing research with a space orientation must have laboratories adequate to house and service their equipment. The pattern followed by universities in the past, of building for the individual departments, has resulted today in the situation where it is frequently quite difficult or impossible to locate suitable laboratory space which will permit an efficient and broad attack on space research problems.

Examples of the significant achievements which are resulting from this program are the facilities completed to date. The first completed was the bio-medical annex to the Harvard Cyclotron. These modest sized facilities of 4,500 gross square feet are enabling eminent researchers from Harvard and the Massachusetts General Hospital to use the cyclotron for clinical and biological applications. Initially, twelve investigators together with their supporting staff are scheduled to use the facilities on research programs involving the irradiation of human and animal tissue and organs as a means of determining some of the shielding requirements for the Apollo mission. These facilities represent a relatively small investment which greatly enhances university scientists' capabilities to do important space related research.

The second completed project involved the addition of two floors to the University of Minnesota's Physics Building. The space is designed for research in the fields of atmospheric, solar, and cosmic ray physics, all subjects of particular importance to NASA. The 17,400 gross square feet of area will house and serve approximately 50 faculty members, research associates, and graduate students for their analytical and experimental research involving balloon and rocket flight experiments and mass spectroscopic examinations of planetary and upper atmosphere compositions.

The Laboratory for Space Sciences at the University of Chicago was also completed and occupied in 1964. These facilities are quite typical of one of the principal objectives of the program in which NASA encourages the establishment of interdisciplinary groups to do space research. The building contains 45,000 square feet of various types of research facilities for investigators who were formerly spread over the campus. The University researchers will have the required specialized facilities in which they may prepare flight experiments and analyze data obtained from nearly every unmanned scientific space flight to date. NASA supported pre-doctoral trainees are likewise profiting from this space oriented environment.

Other facilities completed to date comprise the following: a 108,000 square foot Materials Research Center at Rensselaer Polytechnic Institute funded by NASA, the National Science Foundation, and private donations, and facilities for propulsion sciences research at Princeton University. Princeton faculty members and graduate students are working on chemical, nuclear, and ion propulsion and have helped resolve some of the major combustion instability problems formerly inherent in large liquid rocket motors.

As can be ascertained from reviewing the facilities programs in process in other agencies, none has a program designed to serve the unique needs of NASA, nor is NASA's program fulfilling the missions of other agencies. However, the programs in toto are complementary. They are striking evidence of a continuing national commitment to graduate research and education as the key to our nation's social, technological, and economic progress. These programs are helping to meet the demands of our economy for more skilled personnel and knowledge. The laboratories will enable many more promising young scientists to cope with the explosion of new knowledge and to contribute effectively in a world of intellectual, political, economic, and technological complexity. Continuation of this effort will require $8 million in FY 1966 to acquire approximately 250 thousand square feet of laboratory space.

Research

	1964	1965	1966
Research.....	$8,188,300	$11,000,000	$13,000,000

The support of broad programs of space and aeronautical research, specifically tailored to the individual characteristics of each university, affords the maximum opportunity for balancing and strengthening existing work, and for stimulating the development and growth of new ideas and talent. In this manner, the space program obtains the most vigorous, productive, and creative contributions a university can provide.

Many of the scientific and technological problems facing NASA require an understanding of the behavior of large and complex systems that resist piecemeal attack, and their solution demands the concerted and cooperative effort that universities can provide by bringing together their many specialists from the varied technical and scientific disciplines. Additionally, by supporting research at selected institutions not currently participating in the space program, the number of universities attacking some of the fundamental problems of the space program is permitted to grow and thus broaden the base of the Nation's research capability. By providing new opportunities to these institutions to participate, many excellent research programs have already emerged and new talents and skills have been developed. Through this portion of the program, some $28 million at 56 institutions will have been invested through FY 1965 to obtain results which will help to determine the long-range course of space technology.

At universities where prior involvement in space research has been minimal, several projects have developed to a point where they have succeeded in obtaining support on their individual merits, either from other NASA program offices or other agencies. Thus, these grants have served to provide a basis for new researchers and have provided them with an opportunity to develop their work to a point where it can attract sufficient attention to be recognized and independently supported. In addition, by virtue of the stabilized, long-range funding provided under the grant, these schools have been able to hold and attract staff members who might have moved to other institutions more capable of providing research opportunities.

Reviews of the publications and progress reports by interested NASA program offices and the scientific community indicate that the smaller schools can be counted upon to make outstanding contributions to the space program if given the opportunity to participate. Examples of such work are materials research at the University of Denver, astrophysics at Montana State College, and studies of the planet Jupiter at the University of Florida. Engineering research in structures at Texas A&M has attracted considerable attention, and at William and Mary significant progress has been made toward the eventual utilization of the 600 megavolt synchrocyclotron under construction at the Langley Research Center for fundamental research in high energy physics.

At the larger institutions, grants under this program have provided a broad base of support to NASA sponsored research projects, lending additional strength and breadth to these project efforts and permitting better long-range planning on the part of the institution. At UCLA, this program provided support for the development of a project for the collection of meteoroids in space, and has supported the design and fabrication of a unique testing chamber for spacecraft magnetometers. At the California Institute of Technology, the Graduate Research Center of the Southwest, and the University of California at Berkeley, grants have supported fundamental research which has resulted in the development of new flight experiment designs and new opportunities for the interpretation of data acquired from flight experiments. The University of Maryland Computer Center has developed new techniques in programming space science information. The University of Pennsylvania, through support provided by the Sustaining University Program, has created a unique capability in the development of unconventional power sources; this multidisciplinary effort draws upon the talents and skills of the many disciplines within the university. At the University of Washington (Seattle), a broad multidisciplinary program of ceramics research has been initiated.

In several instances the impact of these grants upon the university has been extensive. At William and Mary the grant was instrumental in supporting a new Ph.D. program in physics, while at several other institutions participation has resulted in large matching contributions from the university and private donors. These are examples of how this broad, flexible, and long-range form of support can stimulate the strengthening and development of selected institutions.

For the continuation and orderly growth of this special purpose research in FY 1966, approximately sixty-six projects will be supported at a cost of $13 million. Fifty-six of these grants will be for the continuation of projects supported in FY 1965, and the remainder will be to universities participating in this research program for the first time.

OFFICE OF SPACE SCIENCE AND APPLICATIONS — LAUNCH VEHICLE DEVELOPMENT PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The purpose of the launch vehicle development program is to ensure the timely availability of launch vehicle capability to meet mission requirements. Continuing surveillance of mission requirements establishes the needs for launch vehicle configuration, operating techniques, and systems technology. As mission requirements exceed existing launch vehicle capabilities, means to improve system performance are studied and defined. If major system development is required to meet new mission needs, implementation of the development would be within the launch vehicle development program. Scout and Delta development programs, generated and implemented in this fashion, were completed in FY 1963. The Centaur vehicle development is continuing in FY 1966 with the first operational flight scheduled for calendar year 1965.

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Supporting research and technology..	$3,800,000	$7,100,000	$4,000,000
Centaur development.....	108,100,000	89,400,000	59,600,000
Total.....	$111,900,000	$96,500,000	$63,600,000

Distribution of Program Amount by Installation:

John F. Kennedy Space Center,NASA.	$983,000	$1,783,000	$1,050,000
Marshall Space Flight Center.....	---	---	13,000,000
Goddard Space Flight Center.....	250,000	925,000	550,000
Langley Research Center.....	115,000	650,000	300,000
Lewis Research Center.....	109,497,000	91,317,000	47,600,000
NASA Headquarters.....	1,055,000	1,825,000	1,100,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

	1964	1965	1966
Advanced studies.....	$180,000	$925,000	$1,500,000
Fluid behavior studies.....	480,000	---	---
Vehicle subsystem studies.....	316,000	1,475,000	750,000
Propulsion technology.....	491,000	2,000,000	1,000,000
Applied mathematics.....	433,000	100,000	250,000

	1964	1965	1966
Guidance technology	---	---	500,000
FLOX	1,900,000	2,600,000	---
Total	$3,800,000	$7,100,000	$4,000,000

The supporting research and technology program provides for advanced studies to identify new launch vehicle requirements and to determine alternative approaches to satisfy these requirements. In addition, efforts are continuing to provide an available source of data on new technology (vehicle subsystems, propulsion, guidance) and operational techniques which may be applied to vehicle improvements or new vehicle development, as required, to meet new mission requirements.

Funds provided in FY 1964 were utilized for studies including zero gravity fluid behavior phenomena and cryogenic propellant systems to increase the amount of thrust per pound of propellant.

FY 1965 funds are supporting studies of a kick stage for high velocity missions, spin motor technology and a continuation of the FLOX technology effort. A vehicle planning study effort has been initiated to assist in identifying and defining the data requirements of the program. Other study areas include solid propulsion accuracy prediction, atmospheric dispersion of toxic fumes, and fluorine technology.

The FY 1966 program will include increased effort on the kick-stage study and complementing technology efforts. Tasks will include guidance and propulsion technology and investigation of other vehicle subsystems. Also, applied mathematics efforts will concentrate on definition and utilization of computer program work in launch vehicle planning and technology.

Centaur Development

	1964	1965	1966
Vehicle development	$93,729,000	$77,320,000	$39,500,000
Supporting services	5,133,000	3,834,000	1,500,000
Tracking instrumentation	86,000	300,000	100,000
Atlas boosters	4,558,000	4,250,000	---
RL-10-A3 engine development	1,095,000	---	---
Propellants	3,499,000	3,696,000	5,500,000
RL-10-A3 engine improvements	---	---	13,000,000
Total	$108,100,000	$89,400,000	$59,600,000

The purpose of the Centaur Development Project is to develop a high performance liquid hydrogen fueled launch vehicle for NASA unmanned lunar and planetary missions. Centaur meets the requirement for a vehicle capable of carrying payloads too heavy for Atlas-Agena class vehicles and too light to

warrant use of the Saturn vehicles. The first operational use of Centaur will be for the Surveyor missions to the lunar surface. The Centaur vehicle consists of a modified Atlas booster and a high-energy upper stage (Centaur) employing liquid hydrogen and liquid oxygen propellants. The Centaur stage contains a light weight inertial guidance subsystem and other compact, lightweight subsystems to permit maximum payload capacity.

This development project includes design, development, fabrication and eight flight tests of the Centaur vehicle supported by an extensive ground test program. Four of these flight tests have been completed; the remaining four flight tests are planned to demonstrate proper guidance operation, direct ascent to lunar impact, the operational (production) configuration, and a two-burn capability. The development program will extend through calendar year 1966.

The ground test program includes such major tests as a full scale dynamic separation test of the Atlas from Centaur, static loading tests of the full scale Atlas vehicle, dynamic tests of the Atlas/Centaur/Surveyor combination, structural and fatigue testing of the Centaur tanks, and static firing tests of the test vehicles in flight configuration.

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

The NASA Office of Space Science and Applications has assigned management of the Centaur project to the Lewis Research Center. The RL-10-A3 engine development program is under the direction of the Marshall Space Flight Center since these engines are also used with the Saturn vehicle, but integration of these engines with the Centaur vehicle is under the management of the Lewis Research Center.

The Centaur project, initiated in 1958 by the Advanced Research Projects Agency of the Department of Defense and transferred to NASA in 1959, underwent a reorientation program after the failure of the first flight test on May 8, 1962. This reorientation included greater emphasis on ground testing prior to flight and a number of design and procedure changes to improve reliability and performance.

The second flight test of the Atlas-Centaur vehicle on November 27, 1963, was a complete success. The third flight was also successful, although one test objective was not fully achieved because of failure of one of the hydraulic systems in the Centaur stage. The fourth vehicle was launched in December 1964 and was successful, although a secondary test objective, an attempt to restart the engines after the Centaur was in orbit, did not succeed.

Funding for FY 1966 is for continuation of developmental effort on the Centaur vehicle such as engineering and design effort, ground test programs and flight tests. In addition, improvement effort on the RL-10-A3 engines,

formerly funded by the Office of Manned Space Flight, has now been included in the Centaur development project. RL-10 project history may be found in the Office of Manned Space Flight justification. This improvement effort along with the development of light weight subsystems, and an extensive program to reduce the overall weight of the vehicle is underway to increase the Centaur payload capacity.

Completion of the development project is expected in Fiscal Year 1967. Total project costs are estimated at $575 million including the RL-10-A3 engine improvement program. The cost of the Project through FY 1964 was $391.7 million.

OFFICE OF SPACE SCIENCE AND APPLICATIONS

LAUNCH VEHICLE PROCUREMENT PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

It is the objective of the Launch Vehicle Procurement program to provide launch vehicles for unmanned space missions. This program includes the purchase and adaptation of vehicle hardware for specific missions, the procurement of the necessary support, engineering and maintenance, and the procurement of services associated with the launching of the vehicle. The launch vehicles currently procured through this program are: Scout, Delta, Thor-Agena, Atlas-Agena, and Atlas-Centaur.

In previous budget submissions funding for procurement of these vehicles was shown as part of the cost of the various flight projects. In this submission vehicle costs are shown as a non-add notation with the specific missions supported only to permit an assessment of total project costs. Sustaining Engineering and Maintenance, previously Operational Vehicle Support presented under Vehicle Development, is not charged to the projects. For the first time, however, total vehicle procurement funding requirements are presented as a separate program. This has been done to provide a presentation that is more consistent with actual procurement practices.

The fabrication and adaptation of vehicles is initiated on the basis of projected launch requirements to insure that a vehicle will be available when each spacecraft is ready for launch. Various factors are evaluated in establishing the quantity of vehicles to be procured. These are: current and projected inventories, vehicles under contract but not delivered, current projected launch schedules, and future mission adaptation requirements. Procurement of vehicles is adjusted to maintain minimum inventories; however, maintenance of some inventory is necessary to provide the flexibility to meet changing requirements.

In addition to operational hardware procurement, a continuing engineering and maintenance effort is necessary to keep the current inventory of launch vehicles up-to-date and ready to meet changing spacecraft and mission requirements. The objective of this effort is to provide continuing support to launch vehicles that are operational, but can benefit from modification to improve performance and reliability. This effort is accomplished through product improvement programs, maintenance of ground support equipment, vehicle system engineering, and other supporting services.

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Scout	$11,500,000	$13,196,000	$11,700,000
Delta	30,101,000	32,650,000	30,700,000
Agena	54,599,000	60,040,000	82,300,000
Centaur	32,000,000	47,814,000	69,800,000
Atlas	1,786,000	972,000	---
Total	$129,986,000	$154,672,000	$194,500,000

Distribution of Program Amount by Installation:

John F. Kennedy Space Center, NASA	$836,000	$3,025,000	$3,175,000
Goddard Space Flight Center	23,326,000	19,960,000	23,025,000
Pacific Launch Operations Office	---	90,000	---
Langley Research Center	11,930,000	13,106,000	11,700,000
Lewis Research Center	87,875,000	106,006,000	149,130,000
NASA Headquarters	6,019,000	12,485,000	7,470,000

The over all mission plan for launches during this period is:

Vehicle	Calendar Year 1964	Calendar Year 1965	Calendar Year 1966
Scout	8	6	9
Delta	5	7	9
Thor-Agena	2	2	4
Atlas-Agena	6	4	5
Centaur	0	1	3

BASIS OF FUND REQUIREMENTS:

Scout Procurement

	1964	1965	1966
Vehicles	$4,900,000	$4,096,000	$5,750,000
Motors	2,000,000	1,300,000	1,650,000
Logistics and other	1,200,000	300,000	300,000
Sustaining engineering and maintenance	3,400,000	7,500,000	4,000,000
Total	$11,500,000	$13,196,000	$11,700,000

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

There are two launch sites capable of launching the Scout vehicle: The Air Force Western Test Range in California, and Wallops Island, Virginia. Logistic support of these launch sites has been integrated into a single effort within this program.

The first operational Scout vehicle was launched April 26, 1962. There have been 24 launches through the end of calendar year 1964 for a wide variety of NASA, Department of Defense, and Atomic Energy Commission missions.

The FY 1966 funds for Scout Procurement will be applied to existing procurement actions and to the initiation of new procurements of first, second, third, and fourth stage motors to meet FY 1966 launch requirements. Funding is also provided for adaptation of the Scout vehicle to satisfy spacecraft and mission peculiar requirements.

To adequately provide Sustaining Engineering and Maintenance support for Scout missions, funds are required for improving vehicle system and subsystems deficiencies as they are discovered through operational use. In past years, funds have been utilized for nozzle redesign of the first stage motor, velocity control improvement, launch complex standardization, and other minor improvements.

In FY 1966, funds are requested for upkeep and replacement of ground support equipment to provide necessary capability for adequate ground test and launch of the Scout vehicle system. Funds requested in FY 1966 will also provide for the maintenance of the two launch complexes at the Wallops Island launch site, and the launch complex at the Western Test Range. In addition, funds are requested for adequate spares and vehicle instrumentation support.

Delta Procurement

	1964	1965	1966
Delta stages	$20,930,000	$14,996,000	$2[illegible],530,000
Thor boosters	4,815,000	10,200,000	[illegible],700,000
Propellants	326,000	250,000	250,000
Third stages	430,000	265,000	420,000
Sustaining engineering and maintenance	3,600,000	6,939,000	4,800,000
Total	$30,101,000	$32,650,000	$30,700,000

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

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

Effort is underway using FY 1965 funding for improvement of the Delta vehicle to provide increased payload volume and weight. The improved performance will be obtained through improvements in the Delta second stage and use of thrust augmentation with the Thor booster.

Funds requested for FY 1966 will provide for launch services requirements for the Delta vehicle at the Eastern Test Range and to provide a new launch capability at the Western Test Range. Launch services associated with the Delta launch vehicle are procured on an annual basis. Included in the FY 1966 request are funds to continue procurement of Thor boosters, Delta second stages, and X-258 third stages to meet the launch schedule requirements for the Delta vehicle.

FY 1966 funds for Sustaining Engineering and Maintenance will provide for launch site and range safety improvements, new spin rockets, support of a Western Test Range launch capability, modification of miscellaneous test equipment, investigation of separation techniques, performance studies, and telemetry measurements.

Agena Procurement

	1964	1965	1966
Agena production	$14,087,000	$14,708,000	$17,261,000
Agena mission modifications	11,271,000	15,597,000	28,798,000
Thor procurement	894,000	4,827,000	3,985,000
Atlas procurement	22,057,000	10,211,000	26,091,000
Propellants	90,000	645,000	465,000
Sustaining engineering and maintenance	6,200,000	14,052,000	5,700,000
Total	$54,599,000	$60,040,000	$82,300,000

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

The Agena was developed by the Air Force as a second stage for use in its programs. Early in 1960, it was decided to use the Agena in combination with the Thor and Atlas rather than develop a similar stage. Each Agena must be modified, however, to meet mission requirements. NASA space missions utilizing the Thor-Agena include the Polar Orbiting Geophysical Observatory, the meteorological satellite Nimbus, the communications satellite Echo II, and the Canadian Topside Sounder, Alouette. All Thor-Agena vehicles are presently planned to be launched from the Western Test Range into polar or near-polar orbits.

NASA uses the Atlas-Agena for its unmanned lunar and planetary exploration missions, such as the Ranger and the Lunar Orbiter projects. The Atlas-Agena has placed Mariner spacecraft on trajectories to fly-by Venus and Mars. It has been used on the Ranger project, and will be employed to launch heavier scientific and applications satellites such as the Geophysical Observatories, the Astronomical Observatories, and the Applications Technology Satellite. The Atlas-Agena is predominantly launched from the Eastern Test Range to support NASA missions.

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

Funds requested for FY 1966 will provide for continued procurement of the basic Agena stage, Atlas and Thor boosters, and the modifications necessary to adapt the Agena stages for mission peculiarities. Funding is also provided for contractor launch services which include receipt, assembly, check-out, and launch of the vehicles.

FY 1966 Sustaining Engineering and Maintenance funds will provide for the continuation of the Atlas Improvement project jointly supported by NASA and the DOD, the development of a standard universal shroud, miscellaneous engineering support services and ground support equipment modifications at the Western Test Range for the Thor-Agena and at the Eastern Test Range for the Atlas-Agena vehicle system.

Centaur Procurement

	1964	1965	1966
Vehicle production	$19,151,000	$24,050,000	$28,920,000
System integration	2,443,000	2,038,000	3,990,000
Atlas procurement	7,156,000	12,598,000	12,740,000
RL-10 engine procurement	3,100,000	5,800,000	3,250,000
Propellants	150,000	3,328,000	1,500,000
Sustaining engineering and maintenance	---	---	19,400,000
Total	$32,000,000	$47,814,000	$69,800,000

The Centaur vehicle is a high performance, general-purpose launch vehicle for use on unmanned lunar and planetary missions which are beyond the capability of the Atlas-Agena vehicle. The present procurement of Operational Centaur vehicles is programmed to meet the launch vehicle requirements of the Surveyor unmanned lunar surface exploration project. The first Operational Centaur is scheduled for launch in calendar year 1965.

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

Funds requested for FY 1966 to continue Centaur Procurement in support of the Surveyor program, provide final increment of funding for Atlas boosters for the first seven Surveyor vehicles and an increment on the procurement of the next five vehicles. Funding is also included for the necessary systems integration of these vehicles with the Surveyor spacecraft.

Since the operational vehicle will be launched for Surveyor lunar missions, scheduled to begin in calendar year 1965, Sustaining Engineering and Maintenance is included for the first time in this request. Estimates are based on experience gained with other launch vehicles in early operational use. Services included are minor changes or improvements as discovered to be necessary through operational use, maintenance of ground support equipment and pre-flight and post-flight engineering analyses of performance and reliability aspects of the Operational Centaur.

Atlas Procurement

	1964	1965	1966
Atlas Vehicles.....	$1,786,000	$972,000	---

This project consists of procurement of Atlas launch vehicles for unmanned missions. At the present time, two vehicles are procured for the Office of Advanced Research and Technology, Space Vehicle Systems, project Fire. Project management for this project has been assiged to the Lewis Research Center.

FY 1963 and prior funding for this project amounted to $6.4 million. FY 1965 funding will complete the procurement of the vehicles for the Fire project.

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SUMMARY OF LAUNCH VEHICLE PROCUREMENT FOR UNMANNED PROGRAMS

Program/Project	Vehicle	Fiscal Year 1964	Fiscal Year 1965	Fiscal Year 1966
Geophysics and Astronomy				
Orbiting Solar Observatory	Delta	$3,650,000	$361,000	$1,400,000
Orbiting Astronomical Observatory	Atlas-Agena	5,626,000	9,039,000	15,100,000
Orbiting Geophysical Observatory	Atlas-Agena	6,959,000	3,672,000	13,598,000
Orbiting Geophysical Observatory	Thor-Agena	3,213,000	4,454,000	802,000
Explorers	Scout	6,600,000	4,296,000	7,700,000
Explorers	Delta	11,750,000	12,350,000	9,500,000
Explorers	Thor-Agena	2,697,000	11,560,000	4,100,000
Lunar and Planetary Exploration				
Ranger	Atlas-Agena	14,863,000	3,136,000	200,000
Surveyor Lander	Atlas-Centaur	32,000,000	47,814,000	50,400,000
Lunar Orbiter	Atlas-Agena	170,000	2,335,000	22,200,000
Mariner	Atlas-Agena	10,550,000	2,377,000	200,000
Pioneer	Delta	4,100,000	2,900,000	5,900,000
Bioscience				
Biosatellite	Delta	---	9,000,000	9,100,000
Meteorological Satellites				
TIROS	Delta	3,800,000	1,100,000	-0-
Nimbus	Thor-Agena	3,516,000	6,358,000	6,200,000
Communications Satellites				
Echo II	Thor-Agena	805,000	---	---
Syncom	Delta	3,201,000	---	---
Applications Technology Satellites				
Applications Technology Satellites	Atlas-Agena	---	3,057,000	14,200,000

Program/Project	Vehicle	Fiscal Year 1964	Fiscal Year 1965	Fiscal Year 1966
Space Vehicle Systems				
Reentry	Scout	$1,000,000	$1,000,000	---
FIRE	Atlas	1,786,000	972,000	---
Nuclear Electric Systems				
SERT	Scout	500,000	400,000	---
Sub-total		$116,786,000	$126,181,000	$160,600,000
Sustaining engineering and maintenance		13,200,000	28,491,000	33,900,000
TOTAL		$129,986,000	$154,672,000	$194,500,000

OFFICE OF SPACE SCIENCE AND APPLICATIONS — BIOSCIENCE PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objectives of the Bioscience program are to: (1) determine the location, origin, nature, and level of development of extraterrestrial life; (2) evaluate from a biological standpoint the origin and evolution of the solar system to acquire an understanding of the origin of terrestrial life; (3) determine the effects of the space environment on earth organisms with particular emphasis on factors which can assist in predicting their effects on man. This program will provide a better understanding of life and life processes, assist in the discovery of unique aspects of the space environment which are pertinent to life in space, and develop information which is essential to long duration manned space flight. A program of basic and applied research is being conducted to support the accomplishment of these program objectives.

In relation to these objectives it is noteworthy that the National Academy of Sciences - (National Research Council) Summer Study Group report of 1962 placed substantial emphasis on the exobiological goal of finding and exploring extraterrestrial life. More recently, the Space Science Board of the National Research Council recommended that unmanned exploration of the planet Mars, involving both physical and biological investigations, and expressly the search for extraterrestrial life, be made the primary objective of the Nation's space effort in the ten to fifteen years following the Project Apollo manned lunar landing.

In order to expedite the search for life on Mars and other planets, two actions were taken. The first was the establishment of a study effort which had as its objective the preliminary design of an automated biological experiment system which will provide a capability for detecting and describing planetary life and related environmental factors. This system is intended as a payload for Voyager missions to Mars. The second management action was the establishment of a program to integrate and expedite planetary quarantine efforts.

The Biosatellite program is directed toward the study of the biclogical effects of (a) weightlessness, (b) weightlessness combined with a known source of radiation, and (c) removal of living organisms from the 24-hour cycle of the Earth's rotation. The basic research with this Earth orbiting satellite is expected to provide quantitative data which will assist man in adapting to the space environment. From over 185 experiments submitted by the scientific community, 20 have been selected for flight. These have been packaged into 3 integrated experiment payloads. Three spacecraft have been assigned to these three principal payloads, plus three for backup, for a total of six planned flights.

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Supporting research and technology	$12,979,000	$12,700,000	$15,500,000
Biosatellite	8,500,000	16,000,000	16,000,000
Total	$21,479,000	$28,700,000	$31,500,000

Distribution of Program Amount by Installation:

Manned Spacecraft Center	$234,000	$475,000	$1,000,000
Goddard Space Flight Center	250,000	250,000	250,000
Jet Propulsion Laboratory	1,243,000	1,499,000	1,250,000
Ames Research Center	9,856,000	17,267,000	17,450,000
NASA Headquarters	9,896,000	9,209,000	11,550,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

	1964	1965	1966
Exobiology	$5,200,000	$4,900,000	$5,000,000
Environmental biology	2,900,000	2,800,000	2,800,000
Behavioral biology	2,100,000	2,100,000	2,100,000
Physical biology	1,991,000	1,900,000	1,900,000
Planetary quarantine	---	---	1,000,000
Automated biological experiment system	---	---	1,000,000
Bioscience investigations for manned missions	788,000	1,000,000	1,700,000
Total	$12,979,000	$12,700,000	$15,500,000

Exobiology

The search for extraterrestrial life will be one of the prime objectives in the post-Apollo period. In managing this part of the program, NASA Centers, universities, and industrial research organizations, are using three approaches:

1. An attempt is being made to synthesize substances which will have characteristics similar to primitive single celled organisms.

2. The physical environments of the planets are being studied by instruments from the Earth, from high-altitude balloons, and from planetary fly-bys. Such measurements will assist in defining the planetary environments and in determining whether life as we know it could exist on the planets, or whether the conditions are so severe that living processes are probably excluded. This data will also assist in the design of experiments appropriate to such diverse environmental conditions.

3. Life detection experiments are being designed for both unmanned and manned exploration. At present, several different automated life detector instruments are being constructed for the remote detection of extra-terrestrial planetary life using unmanned landing spacecraft.

The development of life detection techniques and instruments is primarily centered around the development of specialized instruments which will evaluate a specific facet of chemical composition, morphology, or physiological processes. About a dozen life detector instruments are being developed for remote sample collection and detection of life on Mars. Field tests have shown the Mark III Gulliver detector to be effective in environments hostile to life, such as the desert, highly saline areas, and a mountain top. Ball Brothers Research Corporation, in collaboration with Dr. Wolf Vishniac of the University of Rochester, has recently advanced the Wolf Trap to an engineering breadboard device.

An automated biological experiment system concept is being studied as a payload for the Mars-Voyager mission. This concept visualizes an integrated set of experiments designed for a lifetime of two Earth years (approximately one Martian year) on the surface of Mars to collect, detect, and describe biological and chemical evidence of life.

The Planetary Quarantine program, an outgrowth of the sterilization effort, requires increased emphasis commencing in FY 1966. Sterilization is essential to exobiological investigations of the planets because earth organisms might be landed on Mars and have an explosive growth which would interfere with subsequent scientific investigations. Another hazard is that of possible back contamination of the Earth at a later date. The sterilization program includes research to improve present methods and to develop new methods of sterilization compatible with reliability. At the present time, capsules of basic, simple design can be sterilized but further effort is required for complex capsules to define the effect of sterilization on reliability. Accomplishment of sterilization requires detailed standards, plans, and procedures for contamination control throughout manufacture, assembly, testing, launch and landing on the planet.

Environmental Biology

Research is being conducted on the biological effects of the space environment on living earth organisms. All known space factors are being studied in laboratories on Earth except such unique factors as weightlessness, removal from the effects of the Earth's rotation, and primary cosmic radiation. The Biosatellite program will study these unique factors in flight, and compare the results with Earth based studies.

In relation to the exobiology mission, the parameters of extraterrestrial environment within which given organisms can exist, is being defined. In support of this goal, various animals and plants are being subjected to simulated planetary conditions.

Research with biological organisms is underway to develop their application in space (1) in bioregenerative algal or bacterial life-support systems, (2) as test organisms to determine the biological safety of other planets, (3) for studying the potential of inducing hibernation or decreased metabolic activity in astronauts, and (4) for studying the biomedical effects of the space environment.

Bed rest studies for simulating weightlessness of 2-week and 1-month periods have been completed using human volunteers. Calcium loss of up to 10 percent from the skeleton (heel bone) was determined by X-ray techniques. Research by various NASA grantees has shown that numerous species of organisms can survive simulated Martian environmental conditions.

Behavioral Biology

Research is being conducted to determine the effect of the unique space environment on the orientation, behavior, and biological rhythms of various organisms. Neurophysiological, biochemical, and behavioral analyses are being accomplished to define brain behavioral relationships of importance to the organism in dealing with stress producing environmental factors. Living systems are being studied, using psychological, physiological, biochemical, and biophysical techniques, to determine the molecular basis of acquisition, processing, storage, and retrieval of information. The effects of prolonged confinement in small spaces and other types of environments which produce complex behavioral problems are being studied.

Examples of the work underway in Behavioral Biology are: (1) investigators at Princeton have designed equipment for detecting changes in temperature and activity in small organisms during orbital flight; and (2) at the University of Kentucky Medical School, primates are being used to study the effects of geophysical factors such as gravity and magnetic forces on biological rhythms.

Physical Biology

Research is being conducted into nutrition and metabolism as they affect energy exchange within living organisms exposed to various stresses which may be encountered in space flight. Studies are also being conducted on living organisms which are uniquely suitable for experimental biological investigation in orbiting vehicles and planetary probes.

Research is underway on an automatic electronic scanning device, utilizing computer analysis for recording, counting, and assorting chromosomes in order to show anatomical changes in blood cells and chromosomes. Such changes may be indicators of various environmental stress conditions being experienced in space flight.

In the area of biophysics, studies are being conducted on the dynamics of various physiological systems, directed toward explaining the adverse effects encountered by the astronauts during their orbital missions.

Bioscience Investigations for Manned Missions

This effort includes the research and development necessary to provide scientific experiments and associated equipment for flight on manned spacecraft. Four experiments for the Gemini missions are being prepared for flight during calendar year 1965. The development of an equal number of experiments will be initiated during FY 1965 for the Apollo Earth orbital missions. Effort will be continued to define those areas in which Bioscience investigations must be carried out to support manned space missions and in which an astronaut is necessary as a technician or scientist during the flight of the experiment.

Summary

The FY 1965 SR&T Advanced Studies effort includes increased emphasis on Exobiology with continuing research in Environmental, Behavioral, and Physical Biology. In FY 1966 the emphasis on Exobiology will be continued with a follow-on study effort on the automated biological experiment system and the fabrication and testing of hardware. Funding will continue in an effort to develop methods and procedures for effectively sterilizing spacecraft. The FY 1966 funds requested for Bioscience Investigations for Manned Space Missions are needed to continue preparation of the Apollo experiments for flight, and to determine future experiment requirements consistent with extended Apollo or Manned Orbiting Laboratory missions. Support of Gemini experiments will continue at approximately the same level as in FY 1965.

Flight Program (Biosatellite)

	1964	1965	1966
Spacecraft	$5,567,000	$11,190,000	$10,200,000
Experiments	2,921,000	4,560,000	4,200,000
Ground operations	12,000	250,000	1,600,000
Total Spacecraft and Operations	$8,500,000	$16,000,000	$16,000,000
Delta (Launch Vehicle Procurement Program)	(---)	(9,000,000	(9,100,000)
Total (including launch vehicles)	($8,500,000)	($25,000,000)	($25,100,000)

The Biosatellite will consist of a spacecraft with a recoverable experiment capsule designed to orbit the Earth for periods ranging from 3 to 30 days, depending on the experiments aboard. It will investigate the effects of the unique environments of space upon lower forms of life, plants, small animals, and primates in order to obtain basic biological data, to determine and delineate those hazards which may exist for astronauts, and to define the degree of degradation in human performance during long term space flights.

The study of the effects of weightlessness will be given the highest priority. Also of importance will be the assessment of the effects of a known source of gamma radiation when combined with weightlessness. The

specimens will be shielded from most of the cosmic radiation, thereby removing the cosmic effect as an independent variable in these experiments. Ground based radiation experiments will be performed employing the same types of specimens as those within the Biosatellite in order to obtain data which excludes weightlessness as a variable.

The experiments used to explore the combined effects of radiation and weightlessness were selected because ground based laboratory experiments have shown that resulting genetic changes or damage can be consistently interpreted as resulting from a specific dose of radiation. Examples of the experiments selected are: the Tribolium or flour beetle which in its larval state is very sensitive to radiation so that embryonic development is affected and wing defects later occur; the genetic effect (lethal mutations) on Habrobracon (wasps); and the effects of zero gravity on radiation induced damage (mutation and chromosome breaking) in Drosophila (fruit flies). Identical experiments which are not irradiated will be flown aboard the Biosatellite as "controls" to separate the effect of weightlessness from the combined effects.

The circadian (about a day) rhythms that occur in all living cells form the basis for other experiments. Normally these rhythms follow the local light-dark or tidal cycle, and if the organism is removed from its normal 24-hour cycle it rephases itself with the new environment very slowly. The rhythmic changes in body temperature of a strain of rats will be examined in the Biosatellite while it is removed from the immediate effects of the Earth's periodic rotation for an orbital period of 21 days.

The most complex system studied will be that of the primate. The effects of weightlessness on its cardiovascular, skeletal, and central nervous sytems will be studied during orbits of 30 day's duration. With the aid of deeply implanted brain electrodes, the animals' sleep-wakefulness cycle, response to stimuli, and performance of simple tasks will be studied through the examination of electroencephalogram (brain wave) patterns. Venous and arterial pressures, cardiac output, electrocardiograms and urinary constituents will be studied to determine the effect of weightlessness on the circulatory system and metabolism in general. X-ray examination of the animals will be made pre-flight and post-flight to determine if there is a loss of calcium from the bones due to relative immobility in the weightless state.

The recoverable spacecraft is being designed by the prime contractor, the General Electric Company, Reentry Systems Division. Overall management and direction of the Biosatellite project is the responsibility of NASA Headquarters. Project responsibility has been assigned to the Ames Research Center. Most of the initial design has been completed. Fabrication of the experimental models of the heat shield and reentry capsule have been completed. Proof tests of the recovery parachute, and capsule and environmental tests of the experiments have commenced. An agreement has been negotiated with the Air Force to recover the Biosatellites (including prior testing of the recovery system) by the aerial recovery method, with provisions for a back-up recovery from the water in the event aerial retrieval is not successful.

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The FY 1963 and prior years funding for this six flight program, including launch vehicles, amounted to $1,959,000. Funding for FY 1964 provided for the initiation of design, fabrication, and testing of the spacecraft. Funding for FY 1965 provides for the continuation of the fabrication and testing of the spacecraft and incremental funding for experiment development. Funding for FY 1966 will provide continued funding of the spacecraft contract, continued experiment development, and fabrication of flight ready hardware, and funding of recovery development and operations. Funding requirements for FY 1967 to completion including launch vehicles are estimated to be $20,000,000.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS METEOROLOGICAL SATELLITES PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objectives of the Meteorological Satellites Program are: (1) the development of advanced meteorological observation techniques, sensors, subsystems, and integrated systems for scientific study of the atmosphere and for obtaining operational weather surveillance and forecasting data; (2) to flight test and assess promising new techniques and hardware developments prior to commitment to operational systems; (3) to provide maximum interim operational weather observation data prior to the availability of the operational satellite system; (4) to assist the Department of Commerce, Weather Bureau with the development of Tiros Operational Satellite (TOS) system; and (5) to obtain meteorological soundings for scientific and forecasting purposes.

The development of advanced hardware and techniques (1 above) are accomplished, for general application, in the Supporting Research and Technology project. Specific experiments, subsystems, and techniques are also developed in the flight projects (Meteorological Flight Experiments, Tiros and Nimbus) to be tested along with the general developments produced under SR&T (2 above): Tiros VII and VIII and Tiros I (Eye) will provide interim weather surveillance (3 above). The direct implementation costs of the TOS program are funded by the Department of Commerce, Weather Bureau which reimburses NASA for TOS spacecraft procurement and launch operations. Prior year Tiros and Nimbus programs have provided for the development of the spacecraft and sensors utilized for the present TOS program and the Tiros project will provide for a continuing systems and technology improvement effort directly applicable to TOS (4 above). Meteorological Soundings is a continuing effort within the Meteorological Satellite Program (5 above).

Eight Tiros spacecraft have been launched since 1960 and the launch and operation in orbit of Nimbus I in the summer of 1964 have contributed to fulfilling these objectives. The TOS system, which is to become operational during 1966, is being developed from technology gained from the Tiros and Nimbus projects. Meteorological Sounding Rockets have provided data in the region from 20 to 60 miles indicating important temperature and wind velocity changes not previously known to exist.

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Supporting research and technology	$7,754,000	$7,500,000	$8,200,000
Meteorological flight experiments.	---	1,200,000	4,000,000
Tiros.....	11,506,000	4,100,000	4,800,000

	1964	1965	1966
Nimbus	$41,673,000	$16,000,000	$22,700,000
Meteorological soundings	2,244,000	2,400,000	3,000,000
Total	$63,177,000	$31,200,000	$42,700,000

Distribution of Program Amount by Installation:

Manned Spacecraft Center	$135,000	$50,000	$200,000
Marshall Space Flight Center	80,000	120,000	120,000
Goddard Space Flight Center	62,346,000	29,575,000	39,720,000
Langley Research Center	444,000	420,000	530,000
NASA Headquarters	172,000	1,035,000	2,130,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

	1964	1965	1966
Synchronous meteorological satellites	$210,000	$100,000	$100,000
Meteorological component development	2,790,000	2,214,000	2,000,000
Meteorological sensor development	1,342,000	1,546,000	1,100,000
Meteorological atmospheric research	2,155,000	2,420,000	2,300,000
Advanced systems and components	1,010,000	720,000	1,500,000
Applications for manned space missions	247,000	500,000	1,200,000
Total	$7,754,000	$7,500,000	$8,200,000

The objectives of the Supporting Research and Technology effort are: (1) to develop sensors, control and power components, and data conversion systems to facilitate the basic acquisition of meteorological data; (2) to investigate new techniques and data processing systems for obtaining improvements in data accuracy and coverage; (3) to evaluate data from satellites and sounding rockets for utilization in design improvement studies; (4) to investigate new applications of meteorological systems using current components; (5) to increase the reliability and life time of spacecraft instrumentation; and (6) to develop equipment for the observation of earth atmospheric phenomena from manned orbital spacecraft.

Project direction is by the Office of Space Science and Applications at NASA Headquarters, with implementation both by Headquarters and Goddard Space Flight Center.

Funds were expended in FY 1963 and prior years to support efforts in such areas as conducting a feasibility study of a synchronous meteorological satellite, camera resolution studies for the eccentric and synchronous orbit missions, for design and development work on telemetry systems and amplifiers for meteorological satellites, for a preprototype model of a dielectric tape camera system, sensor calibration, meteorological data analyses, and studies of methods of data handling. Funds for FY 1964 were utilized to continue developments previously initiated and for new studies and developments in components and systems for the synchronous meteorological satellite experiments, rocket wind measurements, sferics studies and for studies leading to an interrogation, recording and locating subsystem (IRLS) for collecting meteorological and oceanographic data from remote instrumented platforms.

FY 1965 funds provide for developments and studies initiated in prior years to be continued and initiation of effort in measurement of stratospheric temperatures and the thermal structure of the atmosphere, and microwave sensing techniques. Also, hardware developments are being initiated for preprototype cryogenic cooling systems for meteorological sensors, stabilization and control systems components with improved reliability and longer life, and improved solar paddles. Funding has also been utilized in FY 1965 to initiate advanced research and development on gyro-magnetic stabilization systems, long-life electronic instrumentation, and feasibility studies for an advanced meteorological satellite system.

Applications for manned space missions include the study and development of scientific investigations and advanced remote sensing equipment for the observation of atmospheric phenomena from manned orbital spacecraft. Several investigations of this type are to be undertaken on manned Gemini flights. Studies of experiments for later manned orbital spacecraft are programmed for FY 1965 and FY 1966 to be prepared to take full advantage of manned space flight missions and capabilities.

In FY 1966, in addition to continuing most of the areas identified above, efforts will be initiated in an improved automatic picture taking camera storage system, a preprototype bi-fold solar paddle array, a compatible ground station for an on-board digital TV system providing improved accuracy and longevity, a long-life control system, and on a preprototype interrogation, recording, and location subsystem to investigate satellite measurement of the atmospheric structure. Studies are also planned on automatic pattern recognition for interpretation and analysis of TV cloud pictures and on program definition of advanced meteorological satellite systems.

Meteorological Flight Experiments

	1964	1965	1966
Meteorological flight experiments.	---	$1,200,000	$4,000,000

The title of this project was changed since the FY 1965 budget submission from Synchronous Meteorological Satellite Experiments to Meteorological Flight Experiments because some experiments will be flown in other than

synchronous orbits. Meteorological experiments will be undertaken on the five Applications Technology Satellites (ATS) to explore the techniques of obtaining continuous cloud cover data, over both full and selected earth areas, from the vantage point offered at high altitude and synchronous orbits. The objective of this effort is to provide a capability for monitoring short-lived severe storms. The observations will also provide data on phenomena associated directly with energy transfer processes affecting the weather, including day-night transition effects. Prior to the flight experiments, studies will be conducted concerning the use of a line scan camera or a camera with image motion compensation for use on the spin-stabilized ATS flights.

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

FY 1965 funds are being used to procure and modify high and low resolution camera systems, to procure zoom lenses for the high resolution camera, to provide for ground equipment and integration support for the 6,500 mile orbit missions (ATS-A).

In FY 1966, funds are required to procure high and low resolution cameras, including image dissectors (line scan) or image motion compensation devices, and additional zoom lenses for the high resolution camera for the ATS spin-stabilized, synchronous flights (ATS B and C).

Tiros

	1964	1965	1966
Spacecraft	$6,724,000	$1,400,000	$600,000
Ground support	4,782,000	1,250,000	1,800,000
TOS improvements	---	1,450,000	2,400,000
Total Spacecraft and Support	$11,506,000	$4,100,000	$4,800,000
Delta (Launch Vehicle Procurement Program)	(3,800,000)	(1,100,000)	(---)
Total (including launch vehicles)	($15,306,000)	($5,200,000)	($4,800,000)

The Tiros project has demonstrated the engineering and scientific feasibility of the accumulation and dissemination of meteorological information from earth orbiting satellites. The objectives of the continuing Tiros research and development project are: (1) to provide maximum interim operational data for use in weather analysis and forecasting prior to availability of data from operational systems; (2) to provide developmental support for the TOS system; and (3) to provide research and development toward advanced meteorological satellite systems.

Eight Tiros spacecraft have been successfully launched since April 1960. The Tiros series satellites provided an average of 190 useable cloud cover pictures per day resulting in the preparation of approximately 40 special storm advisories per month and 15 improvements to weather analyses per month. The ninth spacecraft, Tiros I (Eye), the spin-stabilized "wheel" configuration, will be launched in 1965 to obtain earth oriented pictures and provide a capability of interim operational use by obtaining daily global cloud cover data. This configuration will be utilized for the Weather Bureau funded operational satellite system, called Tiros Operational Satellite (TOS) System.

Efforts are underway to develop flight hardware for improvements to the TOS system, to improve reliability and extend subsystems and component life and to meet operational data requirements.

The tenth and eleventh Tiros spacecraft will be utilized to provide research and development data for advanced meteorological satellite systems development.

The tenth and eleventh spacecraft are scheduled to be launched during 1966 into a highly eccentric orbit with apogee at approximately synchronous altitude. The spacecraft will be able to view the full disc of the Earth and selected geographical areas for periods of approximately three hours.

The Office of Space Science and Applications, NASA Headquarters, is responsible for the overall management of the Tiros project. Responsibility for project management is assigned to Goddard Space Flight Center. The major contractor is the Astro-Electronics Division of RCA.

The FY 1963 and prior years funding for the currently approved 11-flight program including launch vehicles amounted to $35.1 million. The FY 1964 funds were used to complete funding of the eighth spacecraft and for partial funding of three additional spacecraft (I, K, and L) and related ground equipment, and operations. The FY 1965 funds are to be utilized for the incremental funding for: (1) the Tiros I, K, and L spacecraft and related ground equipment; (2) ground operation to support Tiros VII and VIII in orbit and Tiros I; and (3) improvements to the TOS system.

FY 1966 funds will be used to complete funding for the K and L spacecraft and related ground equipment, for ground support for Tiros I and K, and for continued effort in the TOS improvement program. Funding requirements for FY 1967 and to completion are estimated to be $10.2 million.

Nimbus

	1964	1965	1966
Spacecraft	$34,173,000	$8,700,000	$10,800,000
Experiments	---	4,100,000	6,700,000
Ground operations and support	7,500,000	3,200,000	5,200,000
Total Spacecraft and Support	$41,673,000	$16,000,000	$22,700,000

	1964	1965	1966
Thor-Agena (Launch Vehicle Procurement Program).....	(3,516,000)	(6,358,000)	(6,200,000)
Total (including launch vehicles).....	($45,189,000)	($22,358,000)	($28,900,000)

The overall project objectives of Nimbus are to provide sensor and subsystem testing of equipment prior to inclusion in prototype operational systems and to provide data for atmospheric research. Data obtained are made available for meteorological research and operational use to the Weather Bureau and other domestic and foreign weather services. Specific objectives of Nimbus are to conduct experimentation leading to obtaining: (1) full global daytime cloud cover data; (2) daytime cloud cover data for local users; (3) infrared measurements of the night time cloud cover; and (4) observation of pressure, temperature, wind and water vapor at several altitudes over the entire globe. The Nimbus spacecraft is larger than Tiros or TOS and is oriented to view the earth at all times. Nimbus provides a basic satellite system for testing a variety of subsystems, sensors and meteorological experiments. The Nimbus I spacecraft was successfully launched August 28, 1964. Due to a short second burn of the Agena B vehicle, the orbit achieved was much more elliptical than desired. All systems operated and the sensors provided excellent data throughout the one month active life of the spacecraft. A failure in the solar array drive mechanism terminated useful operation. Three cloud picture-taking experiments were flown. These included three vidicon cameras for global daytime cloud cover data, a high resolution infrared radiometer (HRIR) for global night time cloud cover data, and the automatic picture transmission (APT) system for direct transmission of real-time daylight cloud cover pictures to small local weather stations. The cameras tested have been selected for operational system use, and methods of adapting the HRIR to operational spacecraft are being investigated.

Nimbus C, scheduled for launch in 1966, will weigh about 900 pounds and will be an improved version of the Nimbus I spacecraft. Modifications will be made to solar array drive mechanisms and a Thrust-Augmented Thor-Agena B vehicle will be used to provide the additional thrust to lift the spacecraft into the planned circular polar orbit. This spacecraft will: (1) provide additional global research data from the HRIR and vidicon camera; (2) acquire additional lifetime data on sensors in orbit; (3) provide direct transmission of real-time daylight cloud cover pictures to local weather stations; (4) initiate experimentation with night time direct local readout of HRIR data through APT ground stations; and (5) provide unique data from the digital medium resolution infrared radiometer (MRIR). The MRIR experiment will permit a full global study of the earth's heat balance, and represents one of the most significant meteorological experiments so far undertaken.

The current Nimbus program includes the development of two additional spacecraft (Nimbus Band D) which are scheduled for launch in 1967 and 1968,

respectively. This represents a continuing effort to develop and test space meteorological observatories having adequate power, stabilization accuracy, and flexibility to accommodate a variety of experiments, many of which will be eventually applicable to the operational programs. The developmental hardware and techniques include: (1) experiments for atmospheric research such as an interferometer and the Weather Bureau spectrometer; (2) provision for the on-board recording of operational APT cloud cover data; (3) the initial experimentation of a satellite interrogation, recording and locating subsystem (IRLS); and (4) a 50-watt radioisotope thermoelectric generator (RTG) which will demonstrate the feasibility of long life power supplies for meteorological satellites.

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

FY 1963 and prior years funding including launch vehicles amounted to $60.7 million. The FY 1964 funds were utilized to complete the Nimbus I spacecraft, provide for related ground operations and support, and to initiate modifications of the controls for the Nimbus B spacecraft. FY 1965 funds are being utilized to complete the Nimbus C spacecraft, incremental funding of the Nimbus B spacecraft, and experiments and related ground operations and support. FY 1966 funds are required for final preparation, launch, and ground operations for Nimbus C, incremental funding to continue the Nimbus B spacecraft, experiments, ground operations, and support efforts, and initiate development of the Nimbus D spacecraft and experiments.

Funding requirements for FY 1967 to completion, through the "D" spacecraft and including launch vehicle costs are estimated to be $22.2 million.

Meteorological Sounding Rockets

	1964	1965	1966
Large meteorological sounding rocket project	$1,800,000	$1,920,000	$1,900,000
Development of small meteorological sounding rocket system	444,000	420,000	500,000
Field experiment support	---	60,000	600,000
Total	$2,244,000	$2,400,000	$3,000,000

The objectives of the Large Meteorological Sounding Rocket project are to develop and improve sensors and techniques for measuring the basic meteorological parameters in the region 40 to 60 miles above the earth and the exploration of the structure and behavior of the atmosphere in this region. Launchings from sites at several different latitudes provide data

concerning the magnitude and extent of the dynamic and thermodynamic variations of the atmospheric properties in the upper stratosphere and mesosphere.

The objective of the Small Meteorological Sounding Rocket project is to develop a reliable, simplified, self-sufficient sounding rocket system (rocket vehicle, sensors, and data acquisition) which will provide a capability for routine measurements of the basic meteorological parameters in the 20 to 40 mile region of the atmosphere.

Field experiment support provides for conducting sounding rocket experiments in cooperation with other countries. Through this support, data useful to NASA are obtained over the territories of cooperating foreign countries on a cost-sharing basis, involving no exchange of funds. Thus, NASA may supply rockets and training while the foreign agency furnishes the payloads and launching facilities.

The Office of Space Science and Applications, NASA Headquarters, is responsible for the overall management of the Meteorological Sounding Rockets project. Responsibility for management of large sounding rockets is assigned to Goddard Space Flight Center and responsibility for small sounding rockets is assigned to Langley Research Center. Implementation of field experiment support is assigned to Goddard Space Flight Center and Wallops Station.

In FY 1963 and prior years, a total of $1.7 million was utilized in large sounding rockets and $0.2 million in small sounding rockets. In FY 1964, twenty-six large sounding rockets were launched using three experiments: acoustic grenade, pitot-static tube, and sodium vapor. These launches provided measurements of the atmosphere and its variation from the tropical to subarctic regions and from season to season using launch sites at Wallops Station; Ft. Churchill, Canada; Ascension Island; and Kronogaard, Sweden. Also, about 100 small meteorological sounding rockets were launched with various types of sensor payloads including new separation and parachute recovery devices. During FY 1965, approximately fifty large sounding rocket launches are planned. The results are expected to lead to the refinement of measurement techniques and provide more extensive scientific data. Also, funds are being utilized for the purchase and flight test of about 100 small sounding rockets, post flight analyses and launch area safety studies. In FY 1966, funds are required to provide for launch of 45 to 50 large sounding rockets, launch of approximately 100 small sounding rockets and payloads, improvement of rocket systems, procurement of additional ground equipment, and initiation of design and development effort on an advanced system. Also, funds are required for the development of field experiment projects jointly with countries in South America, Europe, and Asia to study and observe the upper atmosphere through the use of small meteorological sounding rockets.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

OFFICE OF SPACE SCIENCE AND APPLICATIONS — COMMUNICATION SATELLITES PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objectives of the Communication Satellites Program are to assure that technology required for establishment of future communications satellite systems is developed; to study requirements for, and technically assess, the applicability of satellites to the future needs of communications systems; and to fulfill NASA's responsibility under the Communications Satellite Act of 1962. High frequency radio, used for much of the present world-wide communications system, is not a reliable means of communication. In addition, neither high frequency radio nor the current submarine cables can provide for television and high speed data transmission. Communications satellites offer the possibility of microwave communication over long distances by providing relay stations at altitudes where they can be viewed from widely distant points on the Earth's surface. Thus, they offer the potential for providing all types of telecommunication services on a world-wide basis.

There are growing demands for an improved world-wide navigation system, and for traffic control, search and rescue, and communication systems for aircraft and ships. Satellites offer great potential in this area. NASA, working jointly with five other Government Agencies, will determine the existing and estimated requirements, the cost effectiveness, and the potential capability of a satellite system to meet these future needs.

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Supporting research and technology.	$1,637,000	$2,100,000	$2,500,000
Echo II.....	1,675,000	220,000	---
Relay.....	2,590,000	525,000	200,000
Syncom.....	2,511,000	210,000	100,000
Early gravity gradient experiment..	---	5,000,000	---
Total.....	$8,413,000	$8,055,000	$2,800,000

Distribution of Program Amount by Installation:

Goddard Space Flight Center.....	$7,661,000	$1,415,000	$1,500,000
Langley Research Center.....	200,000	300,000	300,000
NASA Headquarters.....	552,000	6,340,000	1,000,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

	1964	1965	1966
Communications	$1,587,000	$1,725,000	$2,100,000
Navigation	50,000	375,000	400,000
Total	$1,637,000	$2,100,000	$2,500,000

The supporting research and technology efforts have been concentrated in three areas: advanced passive and active communications satellite concepts; navigation-traffic coordination system feasibility; and experimentation on fundamental problems of electromagnetic propagation.

Although no additional passive communication satellite launches are planned, a modest effort on materials, structures, and erection system development for advanced passive satellites is underway and will continue during FY 1966. Exploration of passive satellite technology is being continued because such satellites have unlimited multiple access and frequency response capabilities, inherent long life and high reliability. Material and structure development efforts are directed toward providing greatly reduced weight and more efficient large reflecting areas. Studies are underway on gravity gradient stabilized lenticular structures and on the possible utilization of solar pressure for satellite period control. Erection systems are being studied which utilize the memory characteristics of certain materials as a means of reliably deploying and erecting lightweight structures in the space environment.

Investigation effort will continue in FY 1966 on active satellite systems capable of linking terminals of greatly reduced size and cost, making possible communications with over-ocean aircraft, ships at sea, and small emergency land stations. Beginning in FY 1965 and continuing in FY 1966, investigations and experimental design efforts will be pursued on Time-Division Multiplex (TDM) systems. Recent studies indicate that TDM offers the greatest potential in multiple access communications with mixed and small size mobile terminals.

Navigation traffic coordination satellite system feasibility studies funded in prior years clearly indicated that satellites could assist over-ocean aircraft and ships at sea to obtain more precise position information under all weather conditions, and could aid air-sea traffic control, and coordination of emergency rescue operations. As a result, a formal agreement was made involving the Departments of Commerce, Defense, Interior, and Treasury, the FAA and NASA, whereby an ad hoc Joint Navigation Satellite Committee (JNSC) was established to determine and evaluate existing and future agency requirements, analyze and compare various navigation-traffic coordination systems (including satellites), and recommend a national program plan which will set forth the required future effort. In FY 1966, studies will be

conducted in the navigation-traffic control area to determine the technology needed to meet national program objectives, and investigations will be continued on promising position-fixing techniques utilizing existing NASA satellites and ground facilities.

Further advances in higher power communications satellites are foreseen. These satellites would be capable of broadcasting either voice or television directly to conventional home FM radio or television receivers of entire populations. In FY 1965, mission feasibility studies will be initiated on direct broadcast satellites capable of broadcasting voice to FM home radios, and advanced mission studies on TV broadcast satellites will follow in FY 1966.

In the measurements area, investigations initiated on the effect of scattering of electromagnetic waves by localized weather conditions are nearing completion. The results have made important contributions to the International Telecommunications Union Conference on Space Communications. Techniques have been developed for measuring radio reflectivity characteristics of large inflatable structures on the ground so that their potential usefulness in space can be predicted. In FY 1966, these techniques will be used to make measurements on small segments of new and improved passive satellite materials and structures and on advanced antenna designs to determine their characteristics.

Echo II

	1964	1965	1966
Spacecraft	$660,000	---	---
Ground operations and support	1,015,000	$220,000	---
Total Spacecraft and Support	$1,675,000	$220,000	---
Thor-Agena (Launch Vehicle Procurement Program)	(805,000)	(---)	(---)
Total (including launch vehicles)	($2,480,000)	($220,000)	(---)

The Echo II project consisted of design, development, launch and evaluation of a 135 foot large inflatable passive communication satellite. Other than a low level effort in experiments on Echo II, the project was completed in FY 1964. FY 1963 and prior year funding, including launch vehicles, amounted to $15.1 million. FY 1965 funds are being utilized to support post launch communications experiments and data analysis. No funds for FY 1966 are required.

Relay

	1964	1965	1966
Spacecraft	$130,000	---	---
Ground operations and support	2,460,000	$525,000	$200,000
Total	$2,590,000	$525,000	$200,000

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

Relay I was successfully launched in December 1962, and Relay II in January 1964. Ground stations participating in Relay experiments were located in the U. S., Europe, Japan, and Brazil.

The Office of Space Science and Applications is responsible for overall management. Responsibility for project management is assigned to Goddard Space Flight Center. The major contractors were Radio Corporation of America for spacecraft development; Space Technology Laboratories for satellite preliminary design, systems coordination and planning, test station operation, and experimental review and analysis; Philco Corporation for West Coast ground station; American Telephone and Telegraph, and International Telephone and Telegraph for ground station operation.

The FY 1963 and prior years funding for the two launches including launch vehicles amounted to $37.4 million. FY 1965 funds are being used for ground station operational support, spare parts, and data reduction and analysis. FY 1966 funds are required for continued data reduction and analysis. Subsequent fiscal year funding requirements will be minimal and determined by the utility and lifetime of the two satellites in orbit.

Syncom

	1964	1965	1966
Spacecraft	$725,000	$50,000	---
Ground operation and support	1,786,000	160,000	$100,000
Total Spacecraft and Support	$2,511,000	$210,000	$100,000
Delta (Launch Vehicle Procurement Program)	(3,201,000)	(---)	(---)
Total (including launch vehicles)	($5,712,000)	($210,000)	($100,000)

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

Three Syncom spacecraft have been launched: Syncom I in February 1963 was unsuccessful; Syncom II in July 1963 was successful in achieving the desired inclined synchronous orbit; and Syncom III was successfully launched into an equatorial synchronous (stationary) orbit. Syncoms II and III continue to function satisfactorily.

The Office of Space Science and Applications, NASA Headquarters, is responsible for overall management. Responsibility for project management is assigned to Goddard Space Flight Center. The major contractors for the Syncom project are Hughes Aircraft Company for spacecraft development and telemetry and command equipment, and Space Technology Laboratories for range and range-rate equipment.

The FY 1963 and prior years fundings for this 3 flight program including launch vehicles amounted to $25.4 million. FY 1965 funds are being used for ground station logistics support and maintenance; operational support; and data reduction and analysis. A reduction in the FY 1965 funding was made due to the elimination of a fourth Syncom flight and due to transfer of operational support of Syncom II and Syncom III to the Department of Defense (DOD) in 1965. FY 1966 funds are required for continued data reduction and analysis. Subsequent fiscal year funding requirements will be minimal and determined by the utility and lifetime of the two satellites in orbit.

Early Gravity Gradient Experiment

	1964	1965	1966
Spacecraft.....	---	$5,000,000	---

The Early Gravity Gradient project consists of the design, development, and flight testing of a gravity gradient stabilization system. The primary objective of this effort is to demonstrate a gravity gradient stabilization subsystem in support of the advanced Defense Communication Satellite Program in the near synchronous altitude region, provide data to support the selection of design parameters, and assess the feasibility of gravity gradient stabilization for advanced space systems.

NASA and DOD entered into an agreement whereby the Air Force Space Systems Command will be responsible for the procurement of flight hardware, and will flight test the gravity gradient system as an integral part of the initial Defense Communications Satellite flights. NASA will continue to monitor this effort and provide technical assistance to the Air Force. FY 1965 funds of $5,000,000 will be made available to the Air Force to cover the costs of the spacecraft. No FY 1966 funds are required for this project.

A flight test is scheduled for the second quarter of 1966.

OFFICE OF SPACE SCIENCE AND APPLICATIONS — APPLICATIONS TECHNOLOGY SATELLITES PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The title of this program has been changed since the FY 1965 budget from Advanced Technological Satellites to Applications Technology Satellites. The objectives however remain the same. These objectives are: (1) to develop spacecraft technology particularly suited for space applications, (2) to provide capability for experimental testing of techniques and devices from various engineering and technological disciplines in the space environment, particularly in the higher altitude orbits, and (3) to provide basic technological and scientific data on gravity gradient stabilization in a 6,500 mile orbit which may be extrapolated to the more difficult synchronous orbits. There is a need in the Department of Defense and in the National Aeronautics and Space Administration for improved spacecraft technology in the areas of stabilization, orientation, and station keeping in the synchronous orbit. There is a requirement for obtaining engineering data on the stationary orbit (equatorial synchronous orbit) for use in designing systems for that discrete orbit with its unique features and also a requirement in both the Department of Defense and the National Aeronautics and Space Administration for basic information to validate theoretical concepts of the physical parameters effecting gravity gradient stabilization. This information is required in such detail as to be amenable to extrapolation to other altitudes and be convertible to engineering handbook type data for use in systems design. It is the purpose of the Applications Technology Satellites program to meet these requirements.

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Supporting research and technology.....	$2,162,000	$1,700,000	$2,000,000
Applications technology satellites.....	15,377,000	21,695,000	26,700,000
Total.....	$17,539,000	$23,395,000	$28,700,000

Distribution of Program Amount by Installation:

Goddard Space Flight Center.....	$16,478,000	$22,699,000	$28,182,000
Jet Propulsion Laboratory.....	1,061,000	396,000	518,000
NASA Headquarters.....	---	300,000	---

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

	1964	1965	1966
Spacecraft parts and subsystem elements	$976,000	$750,000	$1,000,000
Control	1,011,000	650,000	400,000
Wave propagation	175,000	300,000	600,000
Total	$2,162,000	$1,700,000	$2,000,000

The objective of the Applications Technology Satellites Supporting research and technology is to sponsor a continuing effort of spacecraft component and materials investigations and development; advanced instrumentation, stabilization and control systems development; technology experiment feasibility and design; and advanced system studies. The work is being performed by various industrial companies, universities and NASA Installations.

Spacecraft Parts and Subsystem Elements

In FY 1966 development efforts currently underway on advanced spacecraft components and materials will be continued. The effort to investigate multiple beam forming, electronically steerable, spacecraft antenna array techniques previously initiated has begun to yield very promising results. In FY 1966, laboratory models of the most promising arrays will be developed for experimental purposes to determine their potential for space applications such as: multiple access communications with small mobile terminals, and direct broadcast satellites. Efforts will also be continued on millimeter-wave component investigation and development for higher frequency communications systems.

Control

In the spacecraft controls area, passively damped gravity-gradient stabilization attitude control system parametric studies have been rigorously pursued in prior fiscal years. These efforts have provided the basis for conceptual designs of satellites in intermediate altitude and synchronous orbits. In fiscal years 1964-1965, development efforts were initiated on stabilization components, such as passive dampers, extendable booms and boom deployment mechanisms, and on associated instrumentation required to determine the attitude of a gravity gradient stabilized spacecraft. Efforts will be continued in FY 1966 to optimize designs and assess the performance of improved stabilization components. These efforts directly support the flight project.

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In FY 1965, mission feasibility studies were initiated in-house on advanced applications technology satellite concepts. This effort will be augmented with contractual support. The study efforts are directed toward a long-lived, fully stabilized spacecraft having a large space erectible antenna which can be pointed precisely to selected geographic areas on earth. Active stabilization control systems, as well as hybrid gravity gradient systems will be considered. Technology requirements and optimum approaches will be determined in these studies.

Wave Propagation

In the millimeter wave propagation and technology experiment areas, feasibility design studies are being pursued. In FY 1966, effort will be continued on the design and preliminary development of a spaceborne millimeter propagation experiment for ATS. The frequency range, 10 to 100 Gigacycles per second (Gc/s, equal to a billion cycles per second), is of great interest because the lower frequency bands are very crowded as compared with frequency bands of 10 to 100 Gc/s. However, little is known the propagation anomalies in this frequency range.

Applications Technology Satellites

	1964	1965	1966
Spacecraft	$9,832,000	$18,831,000	$24,100,000
Operational support	5,545,000	2,864,000	2,600,000
Total Spacecraft and Support	$15,377,000	$21,695,000	$26,700,000
Atlas Agena (Launch Vehicle Procurement Program)	(---)	(3,057,000)	(14,200,000)
Total (including launch vehicle)	($15,377,000)	($24,752,000)	($40,900,000)

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

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

Funding for this project commenced in FY 1964. FY 1965 funds are being utilized for partial funding for spacecraft and the gravity gradient system development, communication transmitters and receivers and for scientific and technological experiments. FY 1966 funds will be utilized to continue funding for spacecraft and the gravity gradient system, communication test equipment and for scientific and technological experiments hardware. The major portion of the ground station system development and modifications costs are included in the Office of Tracking and Data Acquisition fund requirements. Funding requirements including launch vehicle procurement for FY 1967 and to completion of this 5-flight program are estimated to be $69 million.

OFFICE OF ASSISTANT ADMINISTRATOR FOR TECHNOLOGY UTILIZATION

TECHNOLOGY UTILIZATION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

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

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Identification: Technology searches and surveys.....	$1,090,000	$1,300,000	$1,400,000
Evaluation of innovations.....	580,000	700,000	700,000
Regional information dissemination projects.....	950,000	1,850,000	1,900,000
Analysis of technology transfer; research and development management; the long range implications of the space program.....	880,000	900,000	1,000,000
Total.....	$3,500,000	$4,750,000	$5,000,000
Distribution of Program Amount by Installation:			
NASA Headquarters.....	$3,500,000	$4,750,000	$5,000,000

BASIS OF FUND REQUIREMENTS:

One of the important elements of the technology utilization program is the identification and reporting of new technology resulting from NASA activities. This is accomplished primarily by NASA personnel but in certain circumstances by specialists from research institutes, universities and industry. The identification and reporting of new technology also includes a state-of-the-art survey effort. This effort is organized around broad scientific

areas and disciplines. Surveys are now underway in a number of fields including inorganic coatings, tape recording and data processing, microelectronics, antennas, and membrane phenomena. To evaluate reported innovations for originality and potential value to industrial users, the technology utilization program utilizes the services of a number of industrial research institutions. Commercially oriented reports of these developments are then prepared and published in a number of formats. In FY 1966 the identification and evaluation efforts will be pursued at about the same levels as FY 1965.

In addition to the normal method of dissemination via libraries and mailing lists, seven pilot projects in regional information dissemination are being supported. These dissemination centers, in most instances, are operated by universities. Center personnel review, interpret and convert new technology to the industrial needs of participating organizations. Using the latest NASA capabilities (printed index journals, microfiche, computer tapes and programs, etc.) these centers provide pertinent technological information on a selective basis to industrial users. The Midwest Research Institute (MRI) pilot project was initiated in early FY 1962. MRI has employed a broad approach to dissemination serving more than 1000 firms. From this experience, MRI is now developing more intensive working relationships with selected firms using back-up computer support from the Aerospace Research Applications Center (ARAC) at Indiana University. The Aerospace Research Applications Center is now nearing the end of its second year of operation. This center charges companies a membership fee for the services the center offers. The three primary services are the Retrospective Search Service, the Selective Dissemination Service, and the Industrial Applications Service. All but two of the original 29 member companies have renewed their memberships and the center has considerably expanded its enrollment in the second year. During FY 1964, five centers in addition to MRI and ARAC were established. These are at Wayne State University (Detroit), the University of Pittsburgh, University of Maryland, the North Carolina Science and Technology Research Center and Southeastern State College (Durant, Oklahoma). All seven centers are pilot programs designed to implement those elements appropriate to the industrial needs of their respective areas. In addition to these seven centers, it is planned that several new pilot programs will be started with FY 1966 funds.

Beginning in fiscal years 1962 and 1963, a number of universities received grants for research in the management of research and development. At the University of California (Berkeley) an attempt is underway to establish a computer simulation of the process of scientific inquiry including literature search, information retrieval and analogous reasoning. At the Massachusetts Institute of Technology studies on complex problem solving, interpersonal conflict, multiple task assignments and decision making have been initiated. Other studies underway include research in contracting systems and procedures, project management, cost estimation and budgeting.

The impact of the space program upon the national economy particularly with respect to its effect upon the different geographic, industrial, and civilian sectors of the economy; upon national economic growth; and upon the alloca-

tion of scientific and engineering manpower has been studied within the Technology Utilization Program. A study recently started at the University of California (Los Angeles) is attempting to analyze the shifting geographic patterns of primary first-tier and second-tier contracting. Another study funded at Washington University (St. Louis) attempts to analyze the national impact of alternative assumptions concerning the level and composition of governmental spending streams with particular emphasis being laid upon the nature of the expenditures.

NASA expenditures have had a major impact on the economy of the Cape Kennedy area, especially on the functioning and development of local governmental units, school boards, planning boards, and utility services. This impact is being studied in both an empirical and a qualitative sense to learn the types and magnitude of the problems created by the space center build-up. In another case, NASA expenditures have stimulated rapid growth of a major scientific laboratory in Boulder, Colorado. Many changes in the economic base of the community, population, and local attitudes have resulted. A study now underway at the University of Colorado will analyze these changes in considerable depth throughout the community.

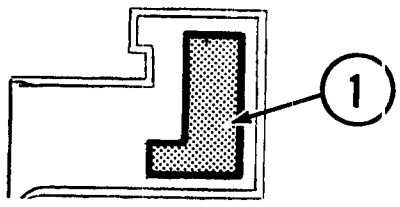
It is to be emphasized that the Technology Utilization Program at its present stage is still very much an experimental program. Future plans, therefore, call for careful review of every phase of the present Technology Utilization Program in order to determine the effectiveness of the current approaches which are being pursued. Future plans also call for feasibility studies of the numerous additional ideas generated by the Program, ideas which offer promising new avenues whereby new science and technology emanating from the space program can be more readily transferred to the non-space community.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1966 ESTIMATES

AMES RESEARCH CENTER



AMES RESEARCH CENTER
FISCAL YEAR 1966 ESTIMATES
LOCATION PLAN

LEGEND	
N-200	ADMINISTRATION BUILDING
N-201	AUDITORIUM
N-202	ADMINISTRATION BUILDING ANNEX
N-203	ENGINEERING SERVICES BUILDING
N-204	SPACE TECHNOLOGY BUILDING
N-205	10- BY 14-INCH SUPERSONIC WIND TUNNEL
N-206	12-FOOT PRESSURE WIND TUNNEL
N-206A	12-FOOT PRESSURE WIND TUNNEL, AUXILIARIES BUILDING
N-207	FLUID MECHANICS LABORATORY
N-208	SUPERSONIC FREE-FLIGHT WIND TUNNEL
N-209	PRESSURIZED BALLISTIC RANGE
N-210	SPACE FLIGHT SIMULATION LABORATORY
N-211	AIRPLANE HANGAR AND SHOP
N-212	STRUCTURAL FABRICATION SHOP
N-213	INSTRUMENT RESEARCH LABORATORY
N-214	MODEL FINISHING SHOP
N-215	7- BY 10-FOOT WIND TUNNEL NO. 1
N-216	7- BY 10-FOOT WIND TUNNEL NO. 2
N-217	1- BY 3.5-FOOT HIGH SPEED WIND TUNNEL
N-218	14-FOOT TRANSONIC WIND TUNNEL
N-219	ELECTRICAL SERVICES BUILDING
N-220	TECHNICAL SERVICES BUILDING
N-221	40- BY 80-FOOT WIND TUNNEL
N-222	2- BY 2-FOOT TRANSONIC WIND TUNNEL
N-223	HYPERVELOCITY BALLISTIC RANGE
N-224	ATMOSPHERE ENTRY SIMULATOR
N-225	SUBSTATION
N-226	6- BY 6-FOOT SUPERSONIC WIND TUNNEL
N-227	UNITARY PLAN WIND TUNNELS BUILDING
N-227A	11-FOOT TRANSONIC WIND TUNNEL
N-227B	9- BY 7-FOOT SUPERSONIC WIND TUNNEL
N-227C	8- BY 7-FOOT SUPERSONIC WIND TUNNEL
N-227D	UNITARY PLAN WIND TUNNELS, AUXILIARIES BUILDING
N-228	HYPERVELOCITY AIR FLOW LABORATORY
N-229	3.5-FOOT HYPERSONIC WIND TUNNEL
N-229A	3.5-FOOT HYPERSONIC WIND TUNNEL, AUXILIARIES BUILDING
N-230	HYPERVELOCITY RESEARCH LABORATORY
N-231	HYPERSONIC HELIUM TUNNEL
N-232	PILOT MODEL OF HYPERVELOCITY FREE FLIGHT FACILITY
N-233	DATA REDUCTION BUILDING
N-234	GASDYNAMICS LABORATORY
N-235	CAFETERIA BUILDING
N-236	BIOSCIENCE LABORATORY
N-237	HYPERVELOCITY FREE FLIGHT FACILITY
N-238	MACH 50 HELIUM TUNNEL
N-239	LIFE SCIENCES RESEARCH LABORATORY
N-240	SPACE ENVIRONMENT RESEARCH FACILITY

FACILITIES AUTHORIZED OR UNDER CONSTRUCTION

A. LIFE SCIENCES RESEARCH LABORATORY
B. SPACE ENVIRONMENT RESEARCH FACILITY
C. SPACE FLIGHT GUIDANCE RESEARCH FACILITY
D. STRUCTURAL DYNAMICS LABORATORY
E. SATELLITE ATTITUDE CONTROL SYSTEMS TEST FACILITY
F. FLIGHT SIMULATOR FOR ADVANCED AIRCRAFT (1965)
G. INSTRUMENT BUILDING EXTENSION (1965)
H. ADMINISTRATIVE MANAGEMENT BUILDING (1965)

PROPOSED PROJECTS

1. SPECTROSCOPIC-MEASUREMENTS LABORATORY (1966)
2. SYSTEMS ENGINEERING FACILITY (1966)
3. SPACE SCIENCES RESEARCH LABORATORY (1966)

· NORTH ·

U.S. NAVY WAREHOUSE AND STORAGE AREA

AMES RESEARCH CENTER

NAVAL AIR STATION

WALCOTT ROAD
WARNER ROAD
DURAND ROAD
KING ROAD
ARNOLD AVENUE
ARNOLD CIRCLE
ARNOLD AVENUE

SCALE: 1 INCH = 300 FEET

CF 1-1

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 66 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION	COGNIZANT PROGRAM OFFICE FOR INSTALLATION	LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Ames Research Center	Advanced Res. & Tech.	Moffett Field, California	Santa Clara	Mountain View

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.

PERSONNEL STRENGTH	FY 1964	FY 1965	FY 1966
NASA PERSONNEL *(End of Year)*	2204	2205	2205
CONTRACTOR AND OTHER PERSONNEL	292	350	378
TOTAL ALL PERSONNEL	2496	2555	2583

LAND	NO. ACRES
NASA-OWNED	115
OTHER GOVERNMENT AGENCY-OWNED	120
NON-FEDERAL *(Leases, easements)*	-0-
TOTAL LAND	235
TOTAL CAPITAL INVESTMENT *(Including NASA-Owned Land) (as of June 30, 19 64)*	$ 155,427.0

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YEAR	FY 1966 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Systems Engineering Facility	OSSA	96.0	2,749.0	---	2,845.0
ALL OTHER PROJECTS		48,835.0			
TOTALS		48,931.0	2,749.0		

CF 1-2

NASA FORM 1029 (REV. NOV 64) PREVIOUS EDITIONS ARE OBSOLETE.

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1966 ESTIMATES

SYSTEMS ENGINEERING FACILITY

AUTHORIZATION LINE ITEM: Ames Research Center

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

LOCATION OF PROJECT: Moffett Field, Santa Clara County, California

COGNIZANT NASA INSTALLATION: Ames Research Center

TYPE OF CONSTRUCTION PROJECT: New

FUNDING:

FY 1965 and Prior Years	$96,000
FY 1966 Estimate	2,749,000
Total Funding Through FY 1966	$2,845,000

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$1,798,200
Site improvement	LS	---	$38,000	38,000
Roads, parking, walks	LS	---	72,100	72,100
Utilities	LS	---	91,400	91,400
Electrical distribution	LS	---	101,900	101,900
Building	Sq. Ft.	57,925	21.61	1,252,000
Special building construction features	LS	---	242,800	242,800
Equipment				$940,800
Packaged clean room	LS	---	25,900	25,900
Vibration, acceleration and shock equipment	LS	---	105,700	105,700
Solar concentrator	LS	---	51,700	51,700
Temperature, humidity and altitude chamber	LS	---	41,300	41,300

	Unit of Measure	Quantity	Unit Cost	Total Cost
Spin table	LS	---	$77,100	$77,100
Optics equipment	LS	---	61,600	61,600
Reaction-control tester	LS	---	50,600	50,600
Analog computer	LS	---	103,000	103,000
Digital components	LS	---	258,800	258,800
Pulse-code-modulation telemetry equipment	LS	---	113,400	113,400
Magnetic and RF screen room	LS	---	51,700	51,700
Design	---	---	---	---
		Subtotal		$2,739,000
Fallout Shelter	---	---	---	$10,000
		TOTAL		$2,749,000

PROJECT PURPOSE:

The proposed facility will provide laboratory space and equipment for development, test, evaluation and checkout of flight hardware and of advanced systems under development for future spacecraft.

PROJECT DESCRIPTION:

The facility will be located on real property available through a use permit from the U. S. Navy. The new concrete structure includes a two-story test area of 9,100 square feet and a laboratory wing with two stories and a basement. The total floor area will be approximately 58,000 square feet. No major simulators or test chambers are included, but equipment adequate for components or small-systems test, research, and development will be provided. A clean room will be provided for the preparation of spacecraft hardware and precision equipment. The vibration system, small centrifuge, and shock tester will simulate transportation, launch, and flight loads on the flight equipment and development models. Heat fluxes corresponding to solar constants from 10 to 100 times that on earth will be obtained through use of a solar collector. Temperature, humidity and altitude chambers will simulate spacecraft environments for flight articles. Optical equipment will be used for developmental work on guidance and attitude control systems and components. Telemetry test equipment, command and ranging simulation equipment, as well as computer equipment, will be used for the testing and evaluation of spacecraft data systems and for development of data coding methods, on-board data processors, encoders and decoders, and data storage systems.

PROJECT JUSTIFICATION:

Early in 1963 the Ames Research Center was assigned project management responsibility for two important flight programs, the Pioneer and Biosatellite. In our efforts to broaden the base of unmanned scientific space investigations tailored to support manned space flight, the Ames Research Center made temporary housing arrangements for the 105 engineers and technicians of the Systems Engineering Division and the Pioneer and Biosatellite project management teams in hastily constructed office space inside the large airplane hangars and squeezed-in temporary quarters at several other scattered locations around Ames.

The proposed Systems Engineering Facility is designed to house these technical groups in a contiguous area and provide laboratory and test bay space for Systems Engineering Division support for bench testing and flight certification of spacecraft components, subsystems, and experiments developed both in-house at the Ames Research Center and by contractors. It is planned that complete flight ready spacecraft will be environmentally tested at larger facilities of the contractor or at other NASA Centers possessing the total systems testing capability. However, it is essential that a limited capability for the small scale environmental testing be developed to permit Ames to do an effective project management job by providing the tools required to assure that the quality and reliability of components selected for flight will meet the rigorous space flight requirements.

ESTIMATED FUTURE YEAR FUNDING FOR THIS PROJECT: None

AMES RESEARCH CENTER
FISCAL YEAR 1966 ESTIMATES

SYSTEMS ENGINEERING FACILITY

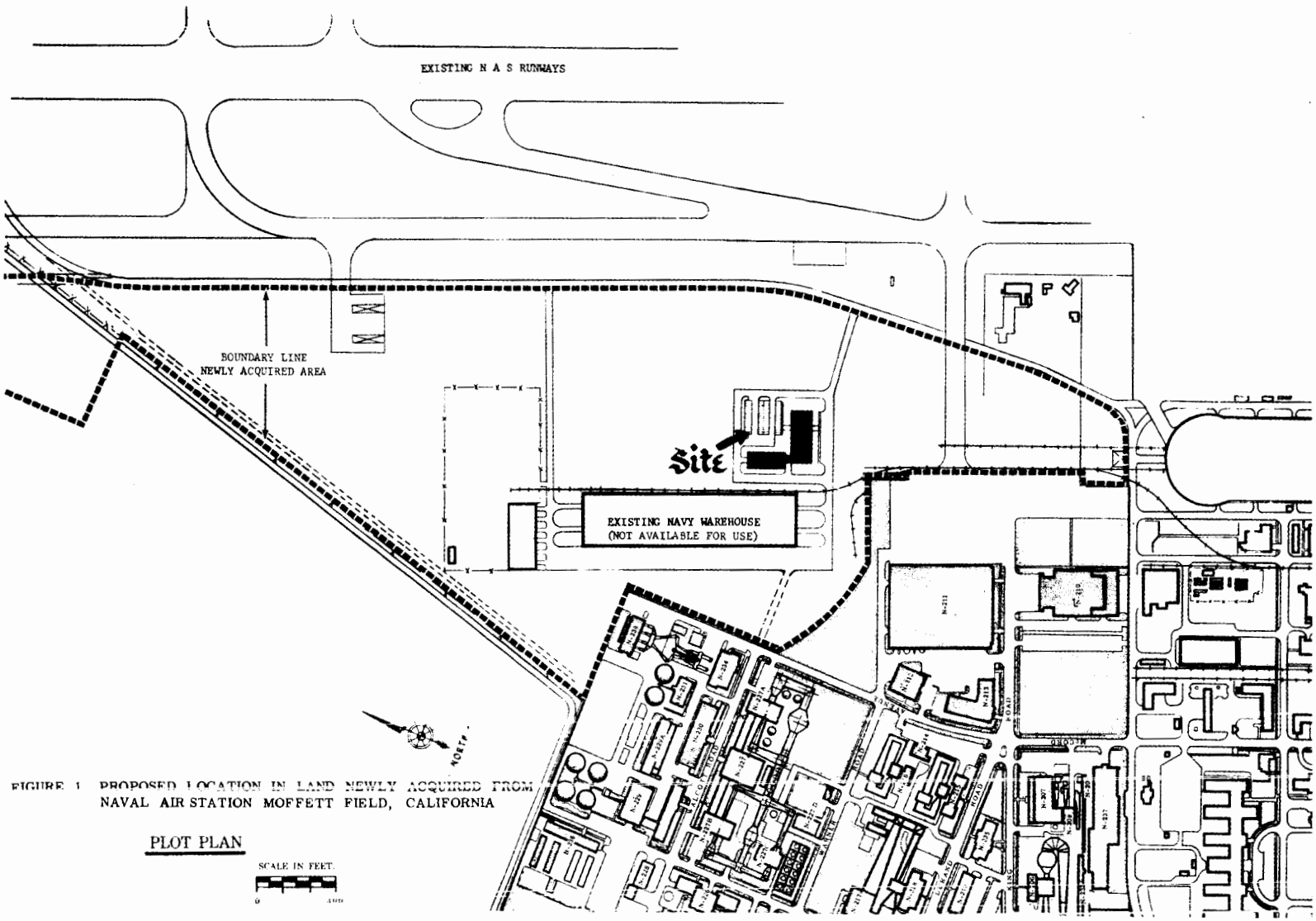
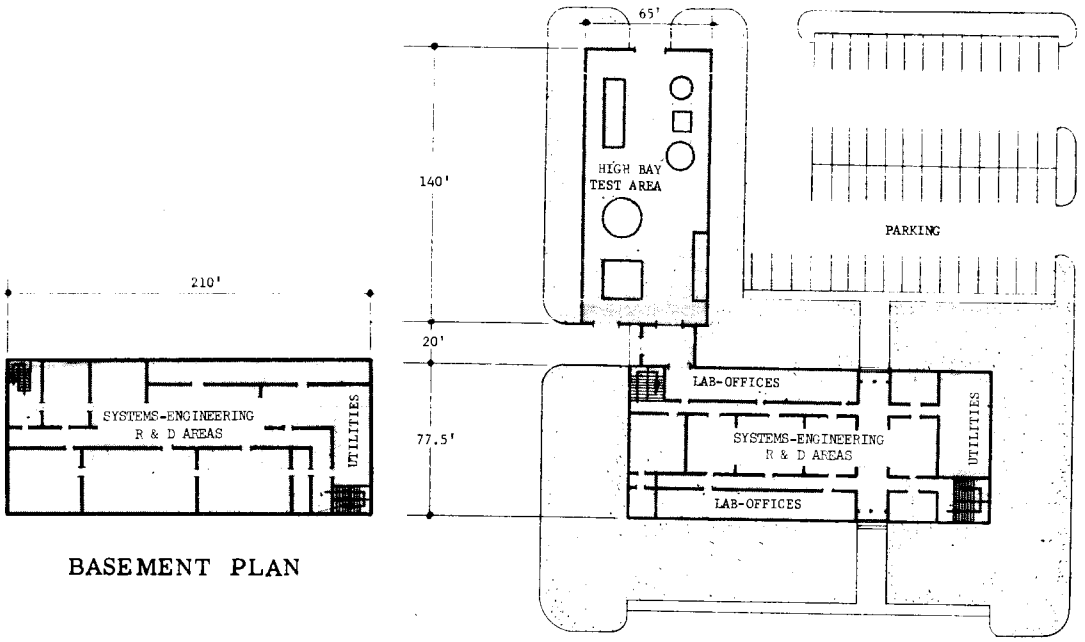


FIGURE 1 PROPOSED LOCATION IN LAND NEWLY ACQUIRED FROM NAVAL AIR STATION MOFFETT FIELD, CALIFORNIA

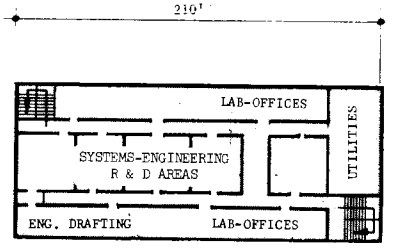
AMES RESEARCH CENTER
FISCAL YEAR 1966 ESTIMATES

SYSTEMS ENGINEERING FACILITY



FIRST FLOOR PLAN

BASEMENT PLAN



SECOND FLOOR PLAN

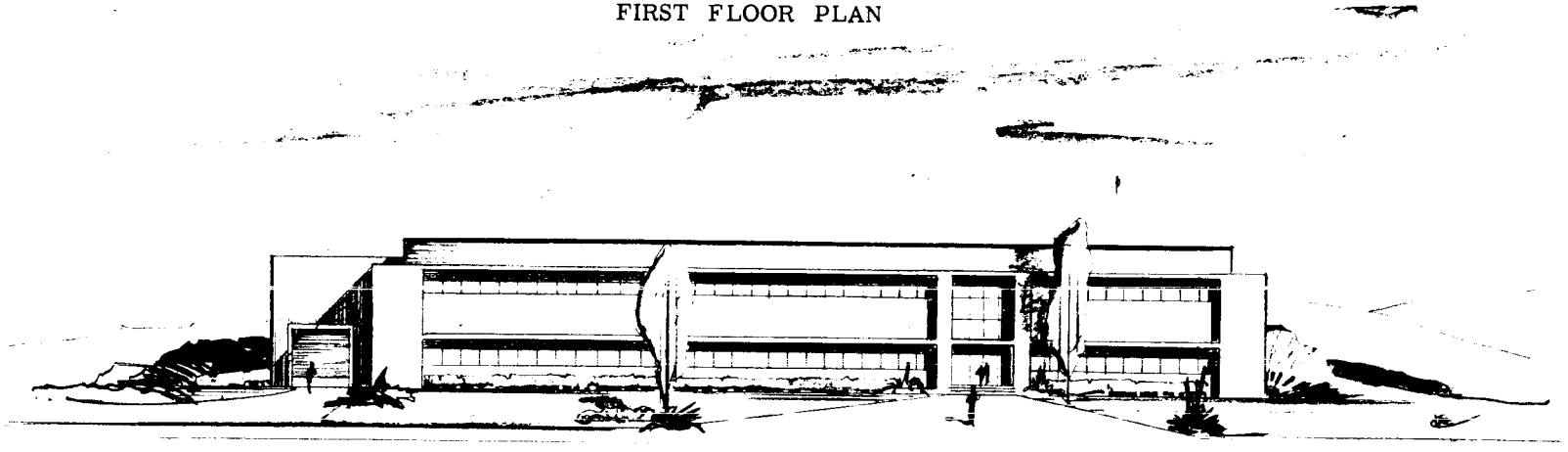


FIGURE 2

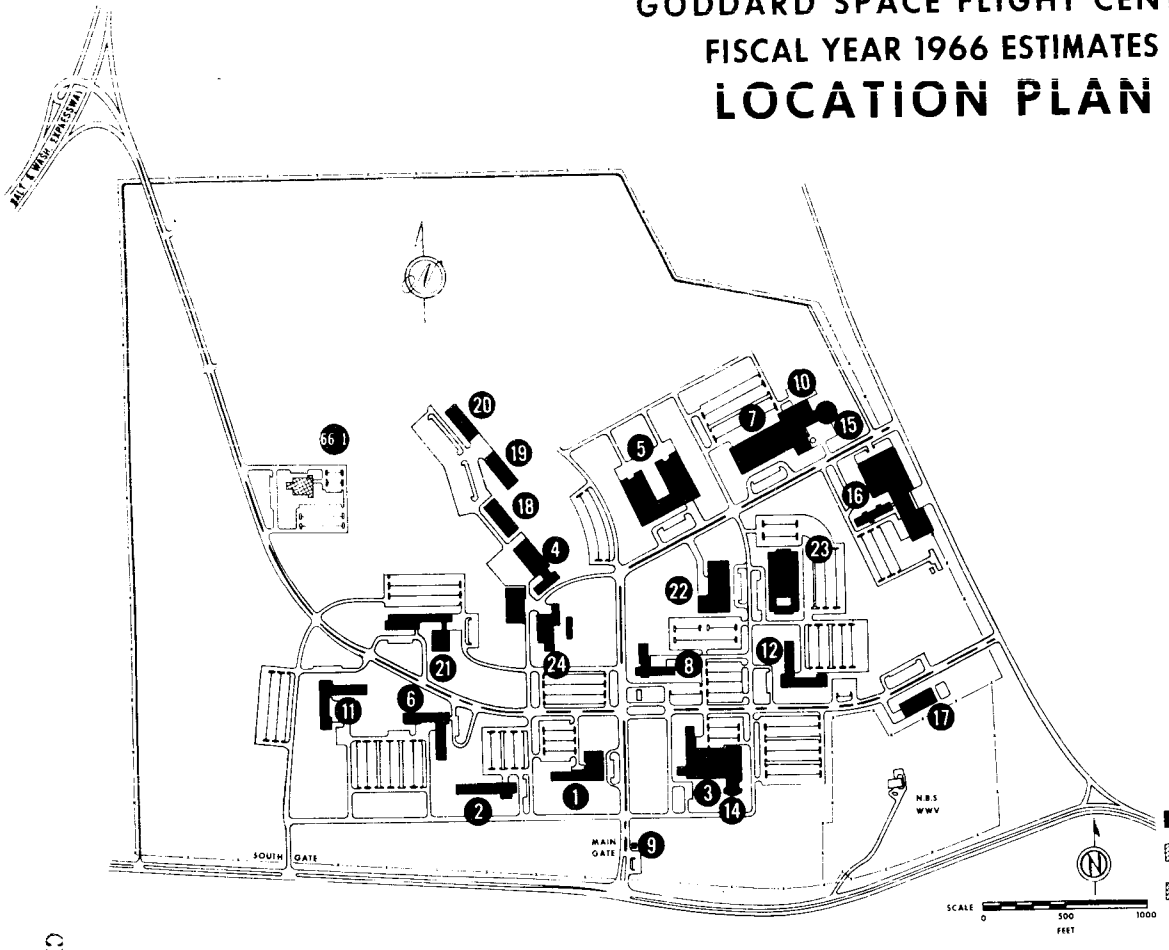
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1966 ESTIMATES

GODDARD SPACE FLIGHT CENTER

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1966 ESTIMATES
LOCATION PLAN



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

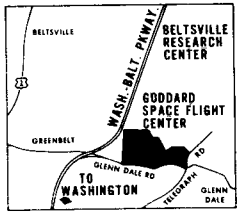
EXISTING FACILITIES

FACILITIES UNDER CONSTRUCTION

FACILITIES PROPOSED IN 1966 ESTIMATES

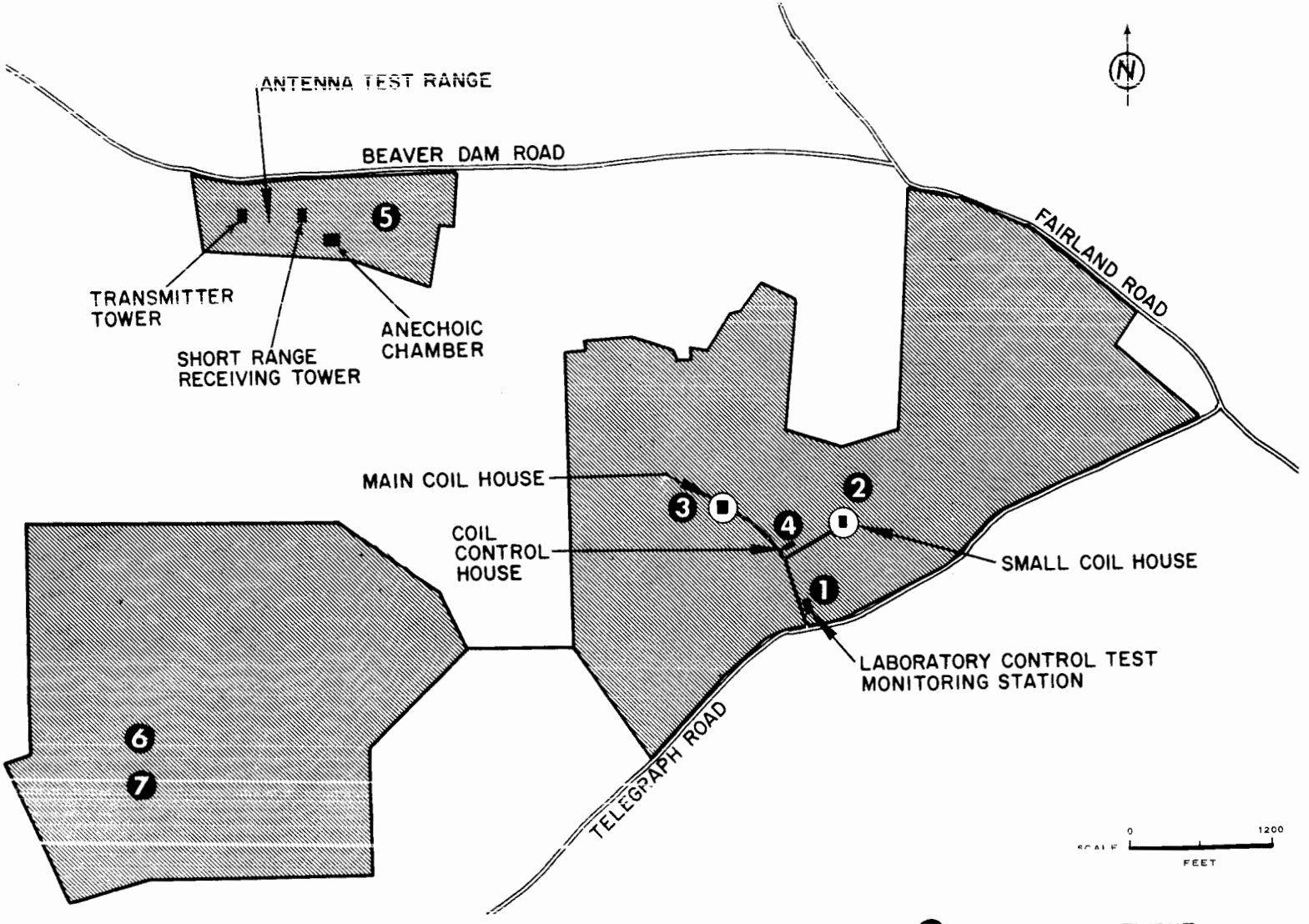
FACILITIES PROPOSED IN 1966 ESTIMATES

66-1 NASA SPACE SCIENCE DATA CENTER



GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1966 ESTIMATES

REMOTE SITE AREAS



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1966 BUDGET ESTIMATES

(Dollars in thousands)

762-046 C - 63 - 15

NASA INSTALLATION	COGNIZANT PROGRAM OFFICE FOR INSTALLATION	LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Goddard Space Flight Center	Space Sci. & Appli.	Greenbelt, Maryland	Prince Georges	Greenbelt, Maryland

INSTALLATION MISSION

This Center is responsible for complete development of unmanned sounding rockets and orbiting spacecraft experiments in basic and applied science. The work covers scientific satellites, and communications and weather satellites which orbit in cislunar space (region between the earth and the moon). In addition, the Center manages NASA's Delta rocket and two world-wide tracking, data acquisition and data reduction networks.

PERSONNEL STRENGTH	FY 1964	FY 1965	FY 1966
NASA PERSONNEL *(End of Year)*	3,675	3,725	3,725
CONTRACTOR AND OTHER PERSONNEL	1,892	2,310	2,320
TOTAL ALL PERSONNEL	5,567	6,035	6,045

LAND	NO. ACRES
NASA-OWNED	530
OTHER GOVERNMENT AGENCY-OWNED	652
NON-FEDERAL *(Leases, easements)*	-0-
TOTAL LAND	1,182

TOTAL CAPITAL INVESTMENT *(Including NASA-Owned Land) (as of June 30, 1964)*	$ 118,739.0

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YEAR	FY 1966 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
NASA Space Science Data Center	OSSA	120.0	2,000.0	-0-	2,120.0
Utility Installations	OSSA	45.0	400.0	-0-	445.0
ALL OTHER PROJECTS		80,157.9			
TOTALS		80,322.9	2,400.0		

CF 3-3

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CONSTRUCTION OF FACILITIES

FISCAL YEAR 1966 ESTIMATES

NASA SPACE SCIENCE DATA CENTER

AUTHORIZATION LINE ITEM: Goddard Space Flight Center

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

LOCATION OF PROJECT: Greenbelt, Prince Georges County, Maryland

COGNIZANT NASA INSTALLATION: Goddard Space Flight Center

TYPE OF CONSTRUCTION PROJECT: New

FUNDING:

FY 1965 and Prior Years	$120,000
FY 1966 Estimate	2,000,000
Total Funding Through FY 1966	$2,120,000

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$1,590,000
Building	Sq. Ft.	50,000	$25.00	1,250,000
Raised floor system	Sq. Ft.	3,000	5.00	15,000
City water lines	LS	---	19,500	19,500
Chilled water lines	LS	---	78,000	78,000
Steam lines	LS	---	48,000	48,000
Sanitary and storm lines	LS	---	47,500	47,500
Electrical power and communications	LS	---	53,000	53,000
Roads, walks, parking	LS	---	79,000	79,000
Equipment				$410,000
Data retrieval	LS	---	325,000	325,000
Microfilm and reproduction	LS	---	85,000	85,000
Design	---	---	---	---

	Unit of Measure	Quantity	Unit Cost	Total Cost
Fallout Shelter*	---	---	---	-0-
		TOTAL		$2,000,000

*Based on a recent GSFC fallout shelter survey, adequate shelter areas in buildings existing or under construction are available to house the projected population of the Center, however some shelter is inherent to the structure and will be provided without additional cost.

PROJECT PURPOSE:

The objective of the NASA Data Center is the efficient collection and interchange of scientific data, both internally and with the scientific community. This project will provide the facilities required for the collection, organization, storage, retrieval, and dissemination of all scientific data resulting from NASA sponsored experiments in space and the upper atmosphere.

PROJECT DESCRIPTION:

This project will provide for the construction of a Space Science Data Center to be located north of the Applied Sciences Laboratory, Building No.11 at the Goddard Space Flight Center. The Data Center will be approximately 50,000 square feet of area consisting of a ground floor and two additional floors. The facility will be of concrete and stell construction having masonry and steel partitions and conform to the existing architectural design of the Center. Raised flooring for the installation of cableways for electronic computers, data handling equipment and associated areas is required for efficient operation and low maintenance costs. Air conditioning will be installed to control temperature and humidity in the data handling and storage areas. Data retrieval, microfilm and reproduction equipment is also included in this project. Offices, including those set aside for study and resident research personnel, and parking facilities will be provided for approximately 150 personnel. By extending existing utilities, the necessary electrical, chilled water, steam and drainage systems will adequately support the proposed facility.

PROJECT JUSTIFICATION:

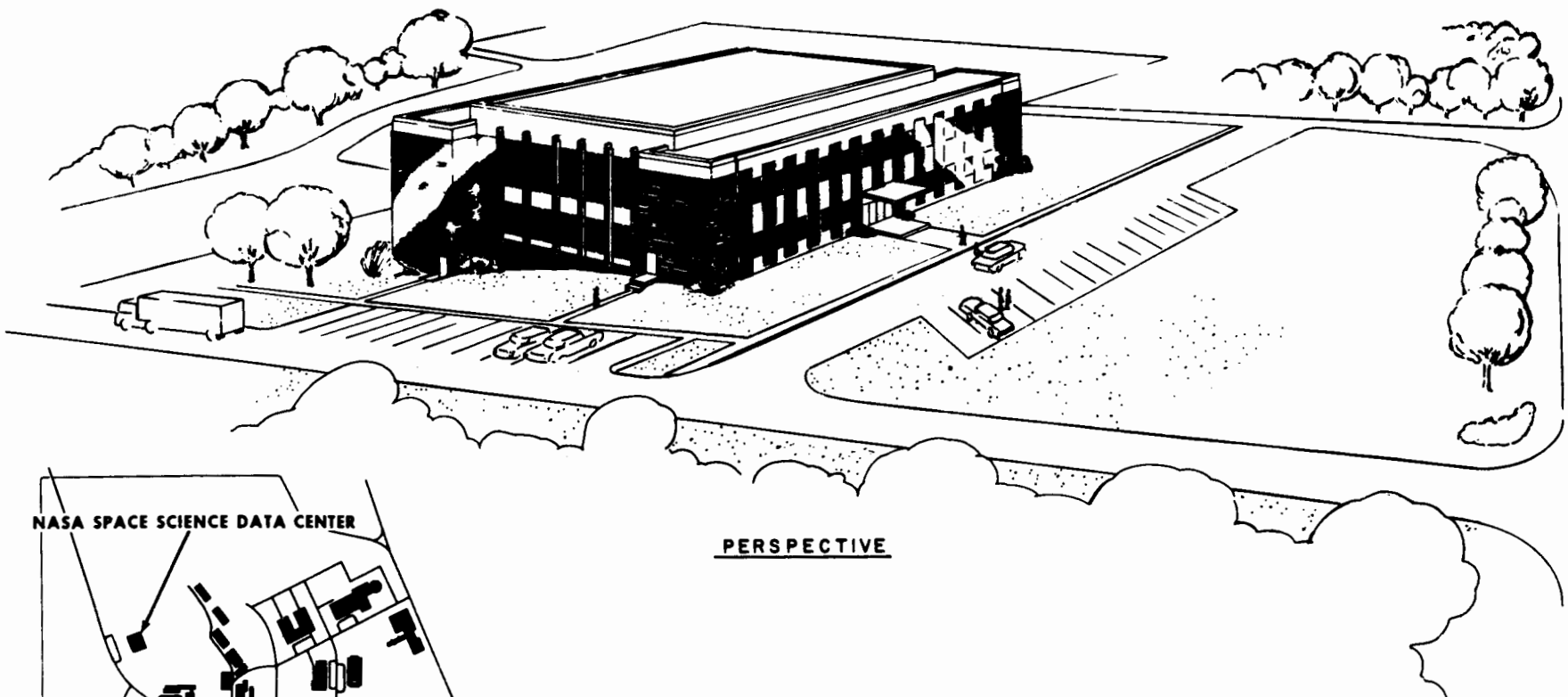
The National Aeronautics and Space Administration under its original implementing act is required to effect the widest possible dissemination of the results of all its research and development projects internally and to the scientific community. Large accumulations of scientific satellite data have been and are presently resulting in significant space science discoveries. However, no facility has been established for the control and utilization of much of this valuable and voluminous data. Although space science experiment information is available from various sources to interested personnel there

is no single source existing where the information accumulated from these experiments can be used in cooperation with information from other data centers, observatories, universities and experimenters thereby effectively communicating to the scientific community and NASA scientists the total spectrum of this scientific data. This data centralization task has been assigned by the NASA to the Goddard Space Flight Center. It is therefore necessary that an appropriate facility be established to provide the capability for present and foreseeable future requirements. The Space Science Data Center proposed herein will serve as a national repository and dissemination point for all NASA sponsored space science research data. This facility will enable the acquisition, organization, storage and retrieval of this data for dissemination internally and to the scientific community.

ESTIMATED FUTURE YEAR FUNDING FOR THIS PROJECT: None

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1966 ESTIMATES

NASA SPACE SCIENCE DATA CENTER



PERSPECTIVE

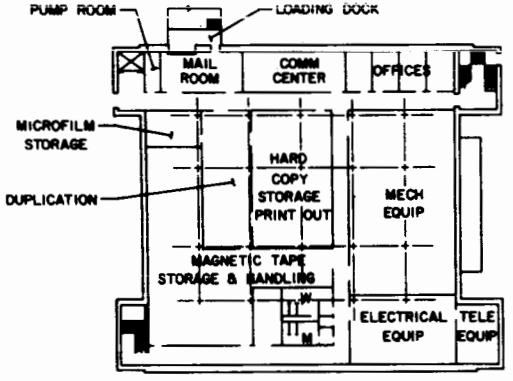
LOCATION PLAN

CF 3-7

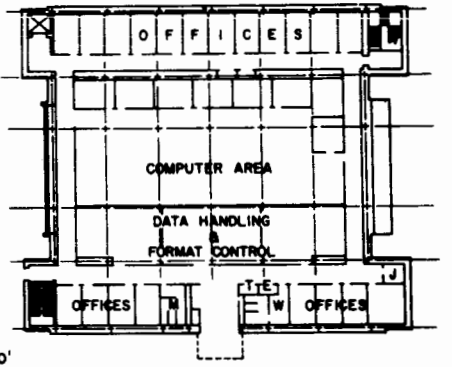
GODDARD SPACE FLIGHT CENTER

FISCAL YEAR 1966 ESTIMATES

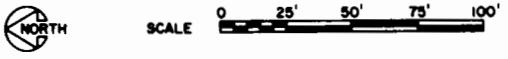
NASA SPACE SCIENCE DATA CENTER

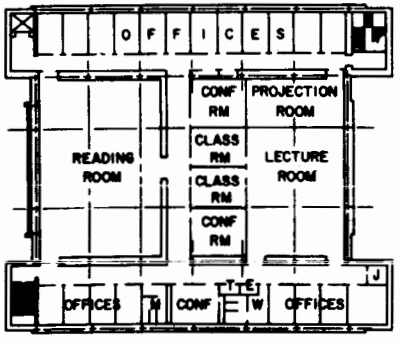


GROUND FLOOR

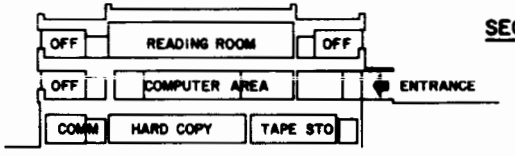


FIRST FLOOR





SECOND FLOOR



SECTION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1966 ESTIMATES

UTILITY INSTALLATION

AUTHORIZATION LINE ITEM: Goddard Space Flight Center

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

LOCATION OF PROJECT: Greenbelt, Prince Georges County, Maryland

COGNIZANT NASA INSTALLATION: Goddard Space Flight Center

TYPE OF CONSTRUCTION PROJECT: New

FUNDING:

FY 1965 and Prior Years	$45,000
FY 1966 Estimate	400,000
Total Funding Through FY 1966	$445,000

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$150,000
Modifications to Buildings #3 and #14 including air-conditioning and electrical systems	LS	---	$150,000	150,000
Equipment				$250,000
Diesel generators	Each	2	75,000	150,000
Electrical switchgear and accessories	LS	---	100,000	100,000
Design	---	---	---	---
Fallout Shelter (Not feasible)	---	---	---	None
		TOTAL		$400,000

PROJECT PURPOSE:

This project will provide an increase in auxiliary power for the centers' increasing Tracking and Data operations. This auxiliary power will serve as back-up during critical mission operations to preclude failure of computer, communications, and air conditioning equipment should the prime commercial power fail.

PROJECT DESCRIPTION:

This project provides for the installation of two (2) diesel generators in the basement of the Central Power Plant to meet increased critical power requirements for Tracking and Data Computer Systems in the Central Flight Control and Range Operations Laboratory (Building #3) and the Spacecraft Operations Facility (Building #14). The generators will compliment two (2) existing 300 KW diesel generators that are presently used for back-up during critical missions. The proposed generators, associated switchgear, and auxiliary equipment will be installed in space reserved for this purpose in the initial design of the power plant. Included in this project are modifications to electrical and air conditioning systems, in Buildings 3 and 14, which are required to extend the back-up system.

PROJECT JUSTIFICATION:

At present the Center uses two (2) 300 KW diesel generators, during critical missions, as back-up power for existing computer, communications, and air conditioning systems being operated in support of the mission. During these tracking operations, diesel and commercial power is used to operate redundant systems. Thus, in the event of commercial power failure, the back-up systems operating under diesel power insure continuous functioning of the vital tracking and communications equipment.

However, the increase in the amount of critical computer and communications equipment being installed in the Buildings 3 and 14 complex requires that additional diesel power and air conditioning back-up be provided. A tabulation of the existing power loads and the requirements for the additional back-up power is as follows:

EXISTING LOADS

Manned Space Flight tracking computers, Building No. 3	150	KW
1 Univac 490 switching system	100	KW
Computer and communications air conditioning systems	300	KW
TOTAL	550	

The Manned Space Flight tracking computers (at 150 KW) and the switching system (at 100 KW) are for electronic equipment power; the air conditioning systems (at 300 KW) are for operation of chilled water and air handling units in the building to provide air conditioning back-up. The two (2) existing 300 KW diesel units accommodate these loads.

The proposed additional diesel units will meet the requirements imposed by the following new loads:

NEW LOADS

Spacecraft control centers; OGO, OAO, OSO, Nimbus/Tiros	230	KW
Data support computers	75	KW
Computer and communication A/C system	300	KW
TOTAL	605	

The spacecraft control center loads represent the requirements of real time control and command operations during operations of the spacecraft noted above. It also includes loads to meet network communication requirements to assure timely issuance of instructions to the various network stations. The Data support computer loads are generated by both manned and unmanned missions. The air conditioning system back-up power is necessary to provide the rigid environmental requirements necessary for the efficient operation of the computers.

ESTIMATED FUTURE YEAR FUNDING FOR THIS PROJECT: None

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

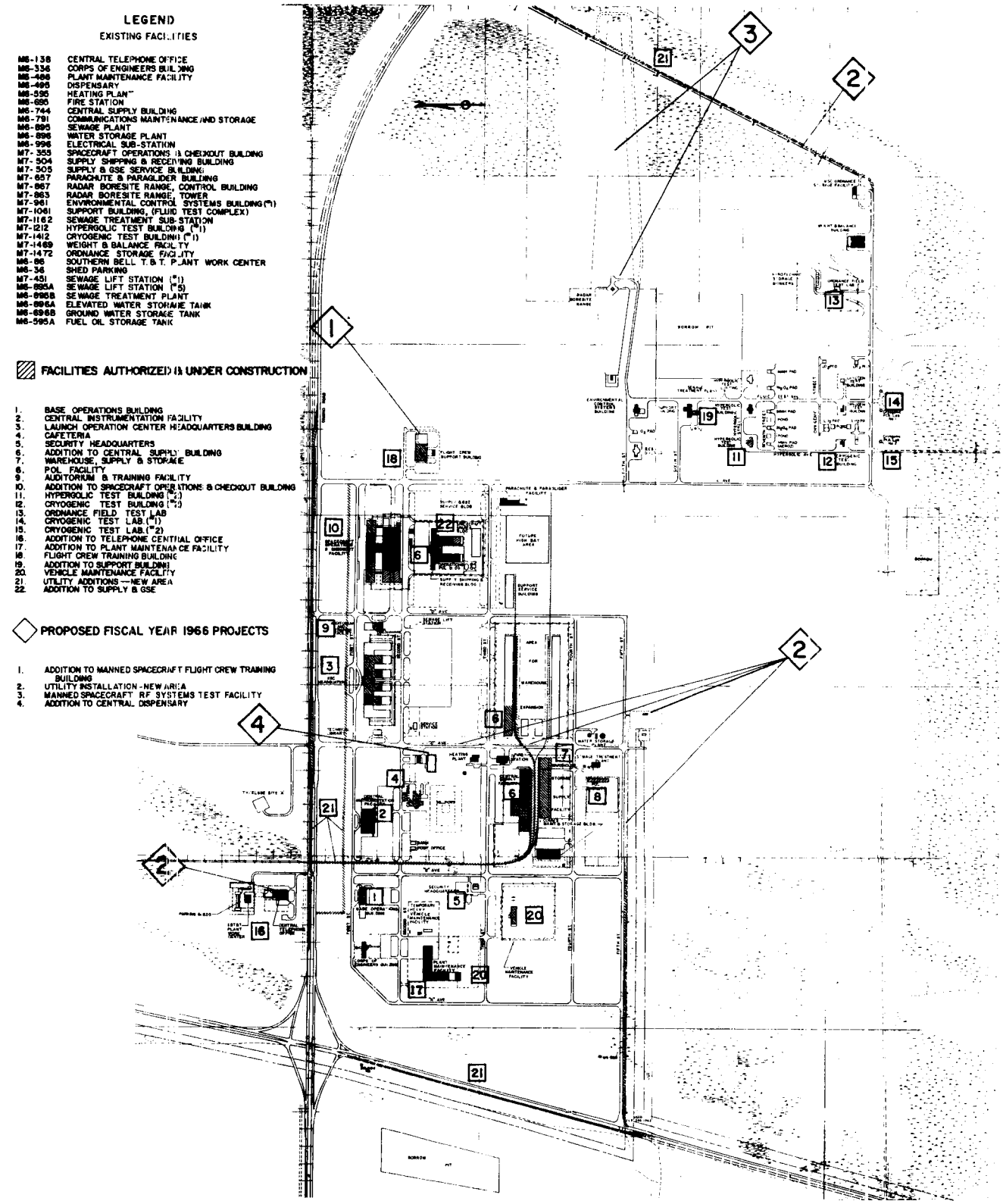
FISCAL YEAR 1966 ESTIMATES

JOHN F. KENNEDY SPACE CENTER, NASA

JOHN F. KENNEDY SPACE CENTER

FISCAL YEAR 1966 ESTIMATES

LOCATION PLAN



CF 4-1

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1966 BUDGET ESTIMATES

(Dollars in thousands)

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

INSTALLATION MISSION

The mission of the John F. Kennedy Space Center, NASA, is to conduct 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 to provide support services for all NASA elements located in the area.

PERSONNEL STRENGTH	FY 1964	FY 1965	FY 1966
NASA PERSONNEL *(End of Year)*	1,625	2,082	2,082
CONTRACTOR AND OTHER PERSONNEL	5,797	8,793	10,602
TOTAL ALL PERSONNEL	7,422	10,875	12,684

LAND	NO. ACRES
NASA-OWNED	88,743
OTHER GOVERNMENT AGENCY-OWNED	-
NON-FEDERAL *(Leases, easements)*	3,340
TOTAL LAND	92,083

TOTAL CAPITAL INVESTMENT *(Including NASA-Owned Land) (as of June 30, 1964)*	$ 298,069.0

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YEAR	FY 1966 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
RF Systems Test Facility	MSF	69.0	1,374.0	-0-	1,443.0
Flight Crew Training Building Extension	MSF	2,453.0	1,425.0	-0-	3,878.0
Extension to the Medical Facility	MSF	390.4	598.0	-0-	988.4
Utility Installations - New Area	MSF	220.5	3,898.0	-0-	4,118.5
Modifications to Launch Complex No. 17	SSA	77.0	1,300.0	-0-	1,377.0
ALL OTHER PROJECTS		820,147.0			
TOTALS		823,356.9	8,595.0		

CF 4-2

NASA FORM 1029 (REV. NOV 64) PREVIOUS EDITIONS ARE OBSOLETE.

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1966 ESTIMATES

MODIFICATIONS TO LAUNCH COMPLEX 17

AUTHORIZATION LINE ITEM: John F. Kennedy Space Center, NASA

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

LOCATION OF PROJECT: Cape Kennedy, Brevard County, Florida

COGNIZANT NASA INSTALLATION: John F. Kennedy Space Center, NASA

TYPE OF CONSTRUCTION PROJECT: Alterations

FUNDING:

FY 1965 and Prior Years	$77,000
FY 1966 Estimate	1,300,000
Total Funding Through FY 1966	$1,377,000

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction	---	---	---	---
Equipment				$1,300,000
Operational television system	LS	---	$233,000	233,000
Second stage propellant loading system	LS	---	1,026,000	1,026,000
Air conditioning for environmental enclosure	LS	---	41,000	41,000
Design	---	---	---	---
Fallout Shelter (Not feasible)	---	---	---	None
		TOTAL		$1,300,000

PROJECT PURPOSE:

This project provides facility alterations to improve the Delta second stage propellant loading system, remote TV monitoring system, and the environmental control of service areas around the vehicle upper stages and the spacecraft.

PROJECT DESCRIPTION:

This project consists of the following additions and modifications:

a. Second-Stage propellant loading system.
b. Operational Television System on pads 17A and 17B
c. Air conditioning unit for environmental enclosures.

The second stage propellant loading system consists of two 1,000 gallon storage tanks, one for the oxidizer (inhibited Red Fuming Nitric Acid) and one for the fuel (Unsymetrical Diemethyl Hydrazine) together with supply lines, valves, a remote console and flow measuring system.

The operational television system consists of:

a. Six 21" TV monitors
b. Two 17" TV monitors
c. Twelve TV cameras with weatherproof enclosures
d. Eight pan tilt systems
e. Eight zoomar systems
f. One central control console
g. Interconnecting cables and fixtures, remote camera selector controls, and video transmission equipment required for a usable system.

The operational TV system will provide remote control from a central console located within the blockhouse with monitors within easy view of the Propulsion Console operator, the Test Conductor, the Launch Director, and Telemetry Tracker. Weatherproof TV cameras located at each launcher will scan propellant servicing system lines and operations, view all vehicle and spacecraft umbilicals, and observe spacecraft third stage and thrust augmented delta solid motor installation and operations. Two TV cameras having wide angle lens and explosion proof enclosures will be mounted on existing mounts on each launch deck. Four TV cameras, having pan, tilt, and zoom lens features will be mounted on ground level near the corners of the apron of each launcher. Pictures from the launch deck and launcher apron cameras will be displayed on six 21" monitors located in the blockhouse. A selector switch will be provided to switch from the six TV cameras of Pad A or Pad B. Also, two stepping switches (remote controlled from Hangar AE) will be provided to step through three TV cameras on each launcher for remote viewing on existing monitors in Hangar AE, Mission Control Center.

The environmental enclosure air conditioning provides a 40 ton air conditioning unit and connections to existing ducts to supply conditioned air to the environmental enclosure surrounding the second stage and spacecraft levels of each gantry. Air-conditioned environmental enclosures provide contamination protection for the Delta space launch vehicle guidance and control area and to the spacecraft area.

PROJECT JUSTIFICATION:

The second stage propellant loading system is required to replace the present system of trailer supply which is manually operated and of insufficient capacity (600 gallons) for the Improved Delta. This system will provide accurate remote controlled propellant transfer in a safe, efficient manner.

The operational television system will supplement the present system installed in 1956 to support the single stage Thor missile tests and is presently inadequate for multistage vehicle and spacecraft operations. The proposed system provides a means of visual monitoring for overall flight readiness and is the only means of viewing strategic areas of the vehicle and launcher during fueling and terminal countdown. This system will permit interested personnel to view the operations from a safe distance, alleviating congestion on the launch pad and decreasing the number of people exposed during hazardous operations.

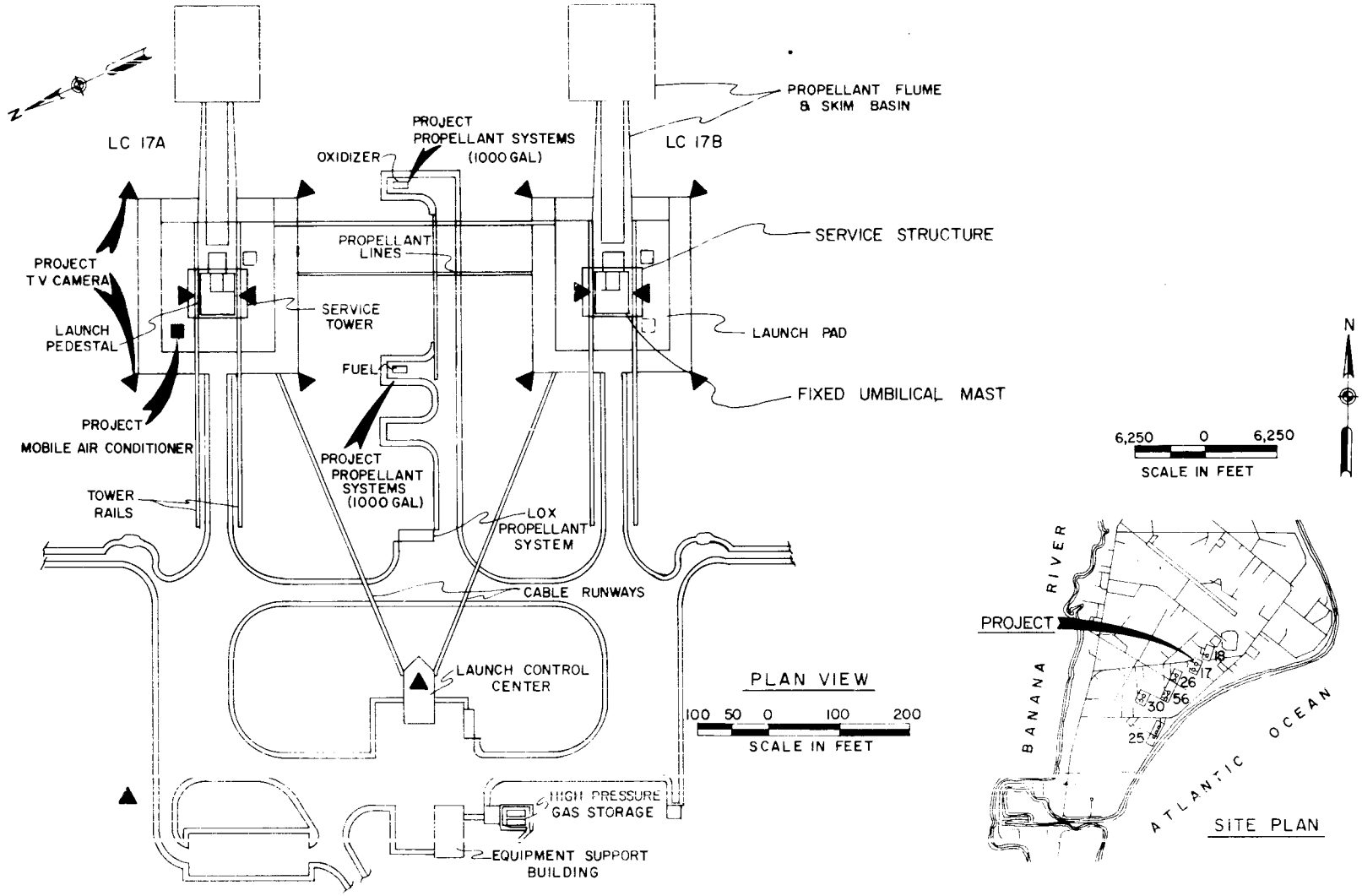
The air conditioning unit for environmental enclosures is required to provide a controlled environment for the upper levels of the gantries where spacecraft and vehicle guidance checkout are performed. Sensitive ground support equipment for spacecraft is located on these levels and needs protection. This equipment must be operational ready by June 1966. The environmental control is now being provided on a limited non-interference basis by borrowed Air Force Eastern Test Range (AFETR) equipment. AFETR will not commit continued support.

ESTIMATED FUTURE YEAR FUNDING FOR THIS PROJECT: None

JOHN F. KENNEDY SPACE CENTER, NASA

FISCAL YEAR 1966 ESTIMATES

MODIFICATIONS TO LAUNCH COMPLEX NO. 17



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1966 ESTIMATES

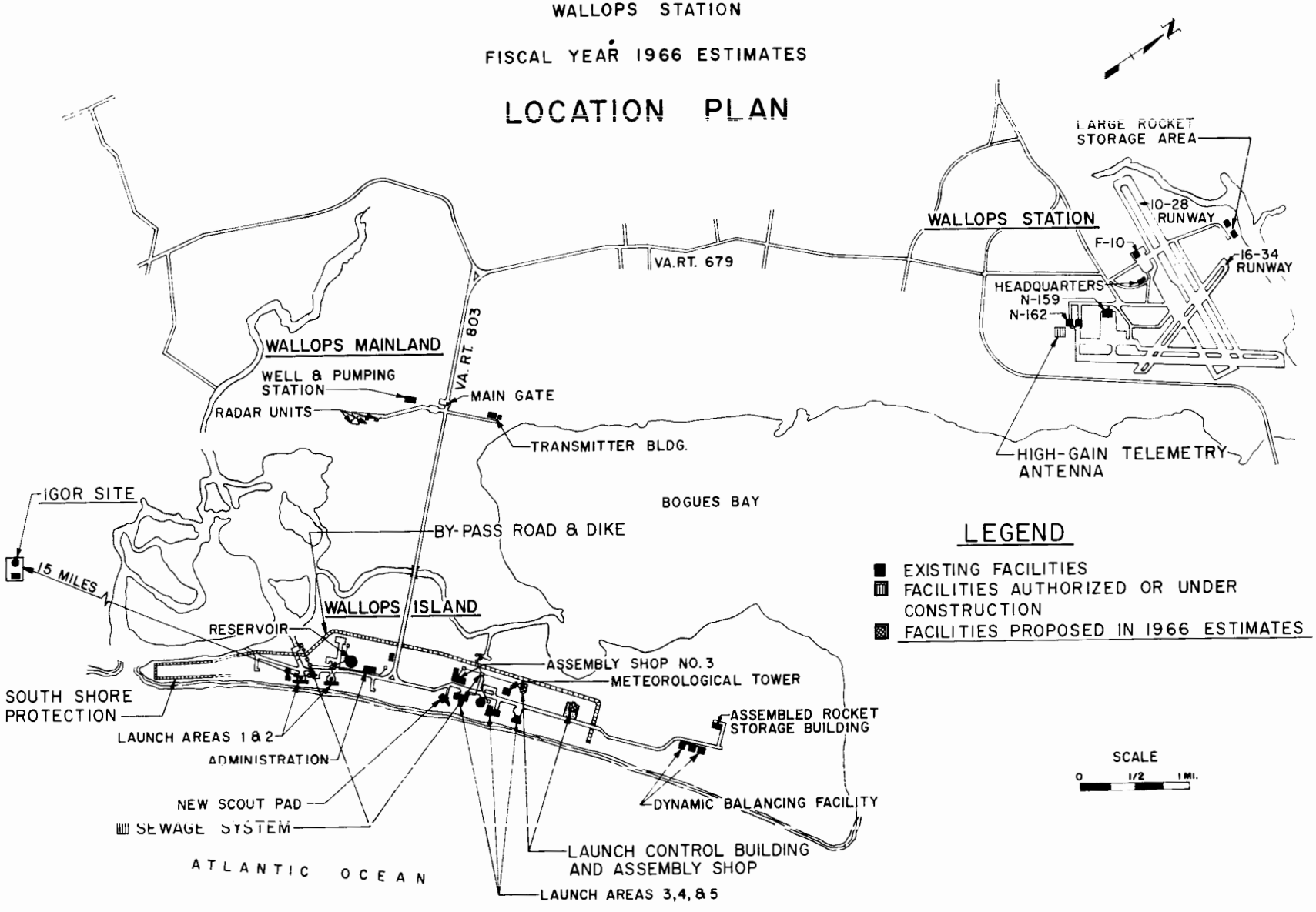
WALLOPS STATION

762-046 O - 65 - 17

WALLOPS STATION

FISCAL YEAR 1966 ESTIMATES

LOCATION PLAN



CF 12-1

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 66 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION	COGNIZANT PROGRAM OFFICE FOR INSTALLATION	LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
WALLOPS STATION	Space Science & Applications	Eastern Shore of Virginia	Accomack, Virginia	40 Miles Northeast Salisbury, Maryland

INSTALLATION MISSION

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

PERSONNEL STRENGTH	FY 19 64	FY 19 65	FY 19 66
NASA PERSONNEL *(End of Year)*	530	530	530
CONTRACTOR AND OTHER PERSONNEL	209	227	223
TOTAL ALL PERSONNEL	739	757	753

LAND	NO. ACRES
NASA-OWNED	6,561.3
OTHER GOVERNMENT AGENCY-OWNED	-0-
NON-FEDERAL *(Leases, easements)*	9.4
TOTAL LAND	6,570.7

TOTAL CAPITAL INVESTMENT *(Including NASA-Owned Land) (as of June 30, 1964)*	$ 42,978.0

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 19 59 THRU CURRENT YEAR	FY 19 66 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Launch Control Building	OSSA	30.0	605.0	-0-	635.0
Assembly Shop	OSSA	30.0	443.0	-0-	473.0
ALL OTHER PROJECTS		$36,525.0			
TOTALS		36,585.0	1,048.0		

CF 12-2

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1966 ESTIMATES

LAUNCH CONTROL BUILDING

AUTHORIZATION LINE ITEM: Wallops Station

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

LOCATION OF PROJECT: Wallops Island, Accomack County, Virginia

COGNIZANT NASA INSTALLATION: Wallops Station

TYPE OF CONSTRUCTION PROJECT: New

FUNDING:

FY 1965 and Prior Years	$30,000
FY 1966 Estimate	605,000
Total Funding Through FY 1966	$635,000

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$267,000
Grading and piling	LS	---	$28,900	28,900
Water and sewerage	LS	---	3,000	3,000
Electrical distribution	LS	---	18,300	18,300
Sub-station	LS	---	12,400	12,400
Roads and parking areas	LS	---	19,700	19,700
Launch control building	Sq. Ft.	3,160	58.45	184,700
Equipment				$338,000
Cabling	LS		120,000	120,000
Trays	LS		55,000	55,000
Firing circuits	LS		48,000	48,000
Checkout consoles	LS		85,000	85,000
Control systems	LS		30,000	30,000

	Unit of Measure	Quantity	Unit Cost	Total Cost
Design	---	---	---	---
Fallout Shelter	---	---	---	-0-
		TOTAL		$605,000

PROJECT PURPOSE:

This project will provide a Launch Control Building (Blockhouse) for launch Pads Nos. 4 and 5 in the North Launch area to house the sounding rocket launch control, experiment monitoring consoles and personnel which are now squeezed into the Scout blockhouse.

PROJECT DESCRIPTION:

The proposed new facility will provide earth covered blast-resistant space for rocket launch control and check-out consoles on the first floor and cable termination racks and console interface equipment in the basement. The first floor will be a removable type floor system to allow complete access to cable trays and equipment in the basement. Space will be provided outside of the blast protected area for an office, toilet, storage, and mechanical and electrical equipment.

The blast protected area will consist of two floor levels approximately 28 feet by 36 feet. A one-story space will be provided for offices, toilet and building equipment approximately 28 feet by 32 feet. The facility electrical substation will be in an enclosure approximately 11 feet by 23 feet. The total area for the Launch Control Building is 3,165 square feet.

All portions of this facility will be of concrete construction with a steel joist framed roof, except the blast protected area which will have a concrete roof system with earth cover. A platform will be provided atop the earth fill for a television camera stand.

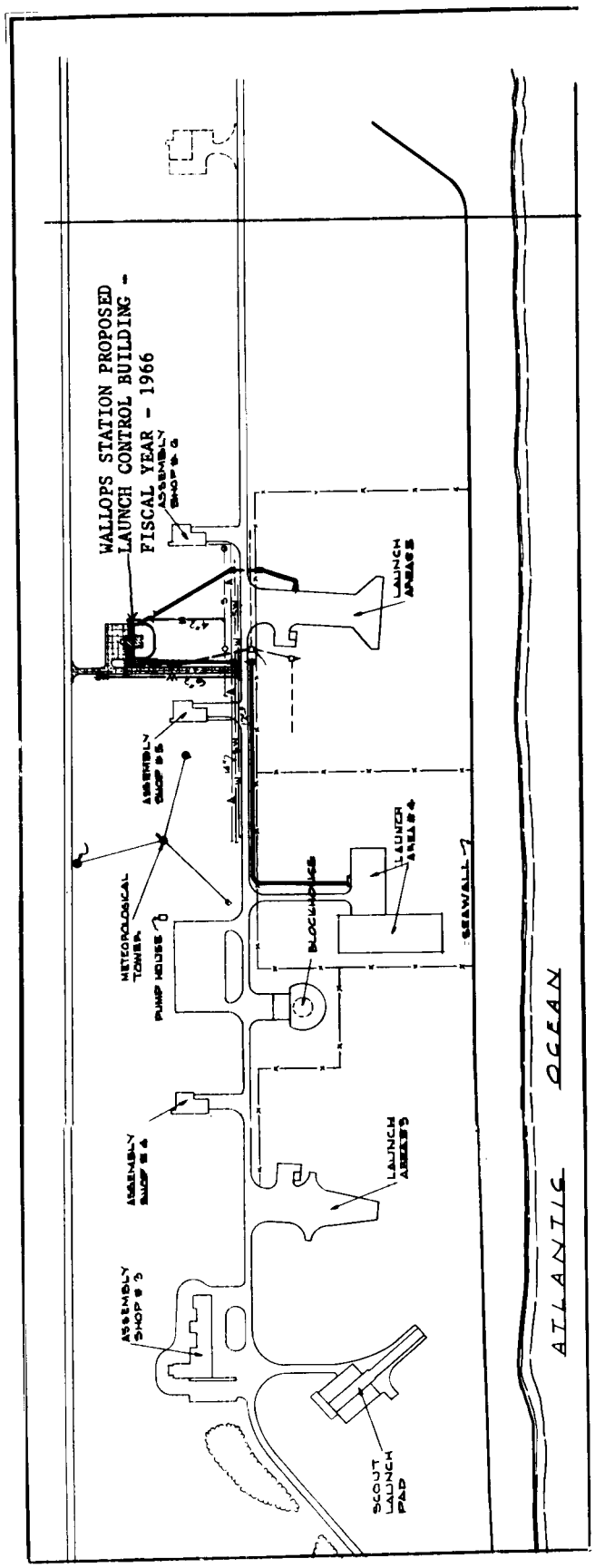
Concrete paving and extensions of existing station utilities systems will support the facility. Control cables in above-ground cable trays will connect the launch consoles with a small cable termination cubicle at Launch Pad No. 5, and with existing termination facilities at Launch Pad No. 4.

PROJECT JUSTIFICATION:

This project is required to relieve an overloaded condition that has existed for three years in this area. The north launch area supports flight programs such as radio-attenuation measurements, Trailblazer reentry heat-transfer experiments, space nuclear auxiliary power systems, solar-oriented control systems, meteor simulation, Vector solid-fuel rocket control systems,

component and system development programs, sounding rockets, and probes. The existing launch control building, which serves four pads and five launchers, is overcrowded on the upper level with two Scout checkout systems, a universal console, radio attenuate measurement console, and associated range interface equipment. The lower level is densely packed with cable entrances, termination racks, trays, and a launch programmer. The composite NASA/Air Force Scout launch schedule will require almost continuous use of the existing blockhouse, precluding the simultaneous use of Pads 4 and 5 for the sounding rocket program because of the severe overcrowding and congestion which now exists.

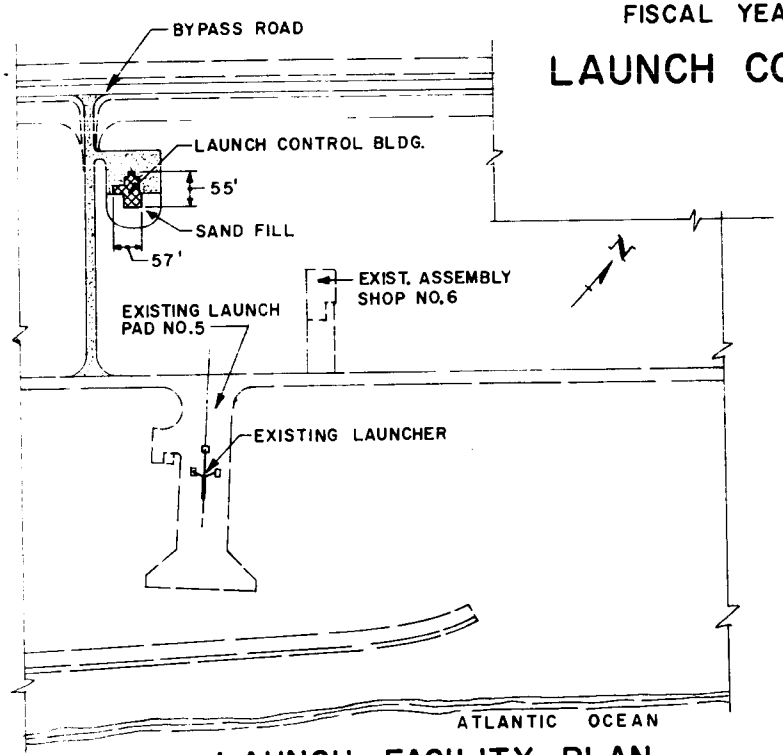
ESTIMATED FUTURE YEAR FUNDING FOR THIS PROJECT: None


WALLOPS STATION PROPOSED
LAUNCH CONTROL BUILDING -
FISCAL YEAR - 1966
ASSEMBLY SHOP # 6
LAUNCH AREA #5
ASSEMBLY SHOP # 5
METEOROLOGICAL TOWER
PUMP HOUSES
BLOCKHOUSES
LAUNCH AREA #4
SEAWALL
ASSEMBLY SHOP # 4
LAUNCH AREA #3
ASSEMBLY SHOP # 3
SCOUT LAUNCH PAD
ATLANTIC OCEAN

WALLOPS STATION

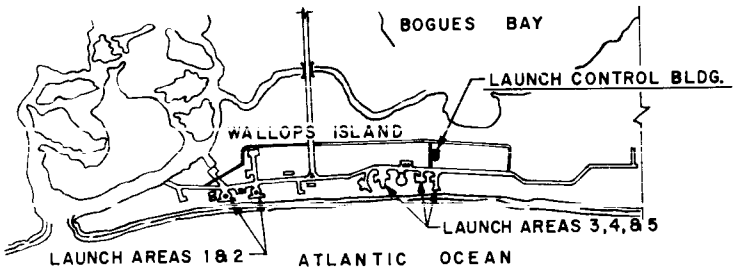
FISCAL YEAR 1966 ESTIMATES

LAUNCH CONTROL BUILDING



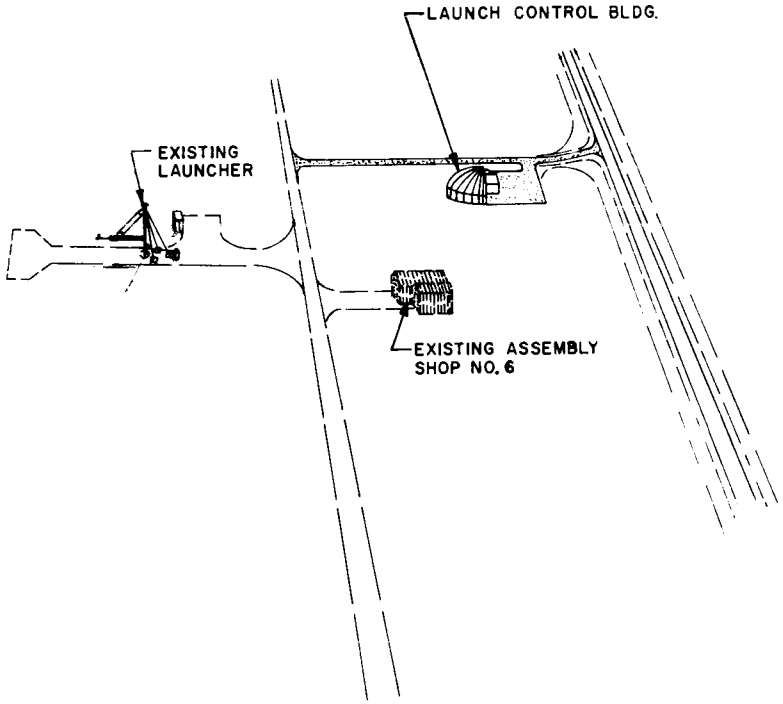
LAUNCH FACILITY PLAN

SCALE 100' 0' 100' 200' 300'

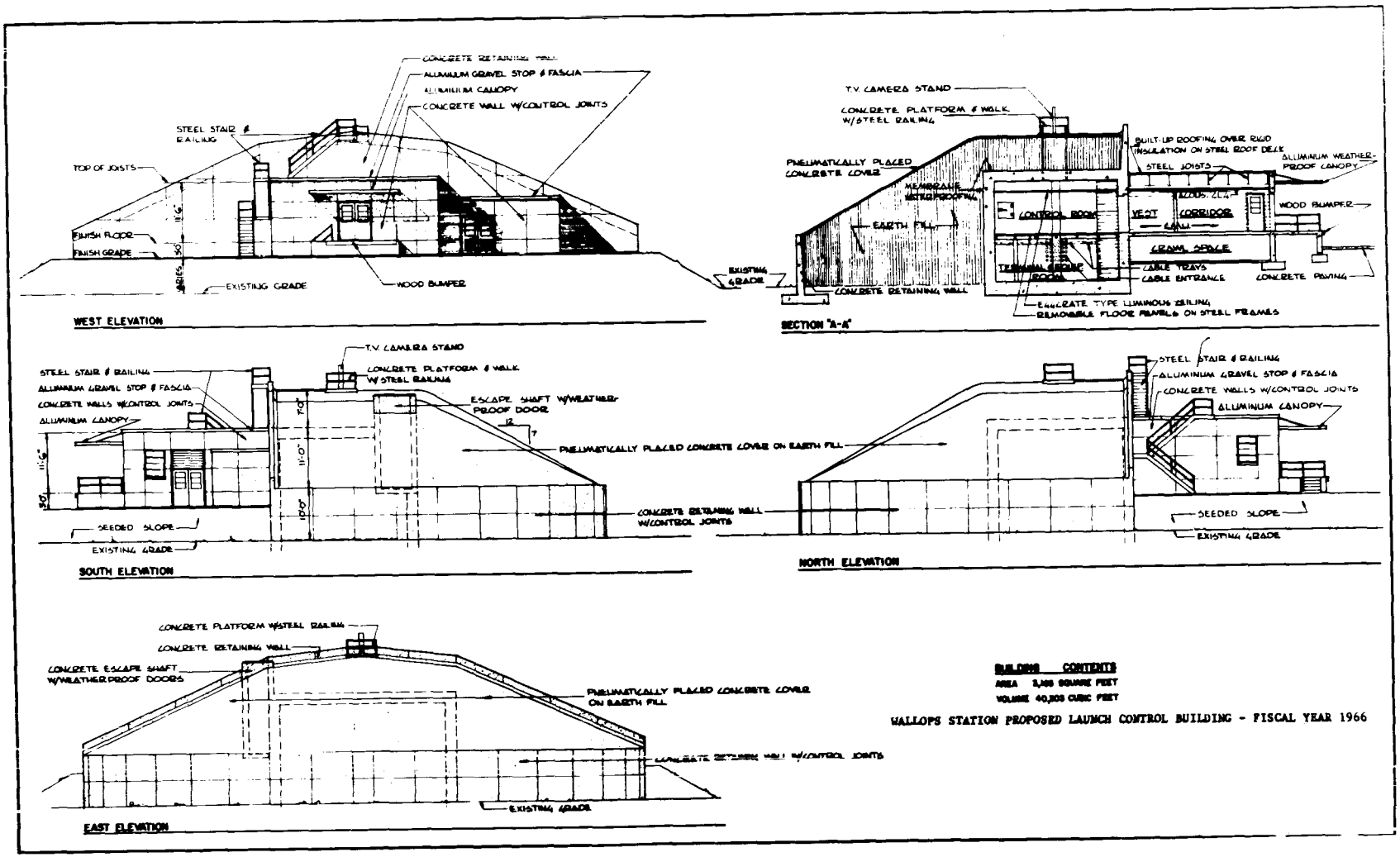


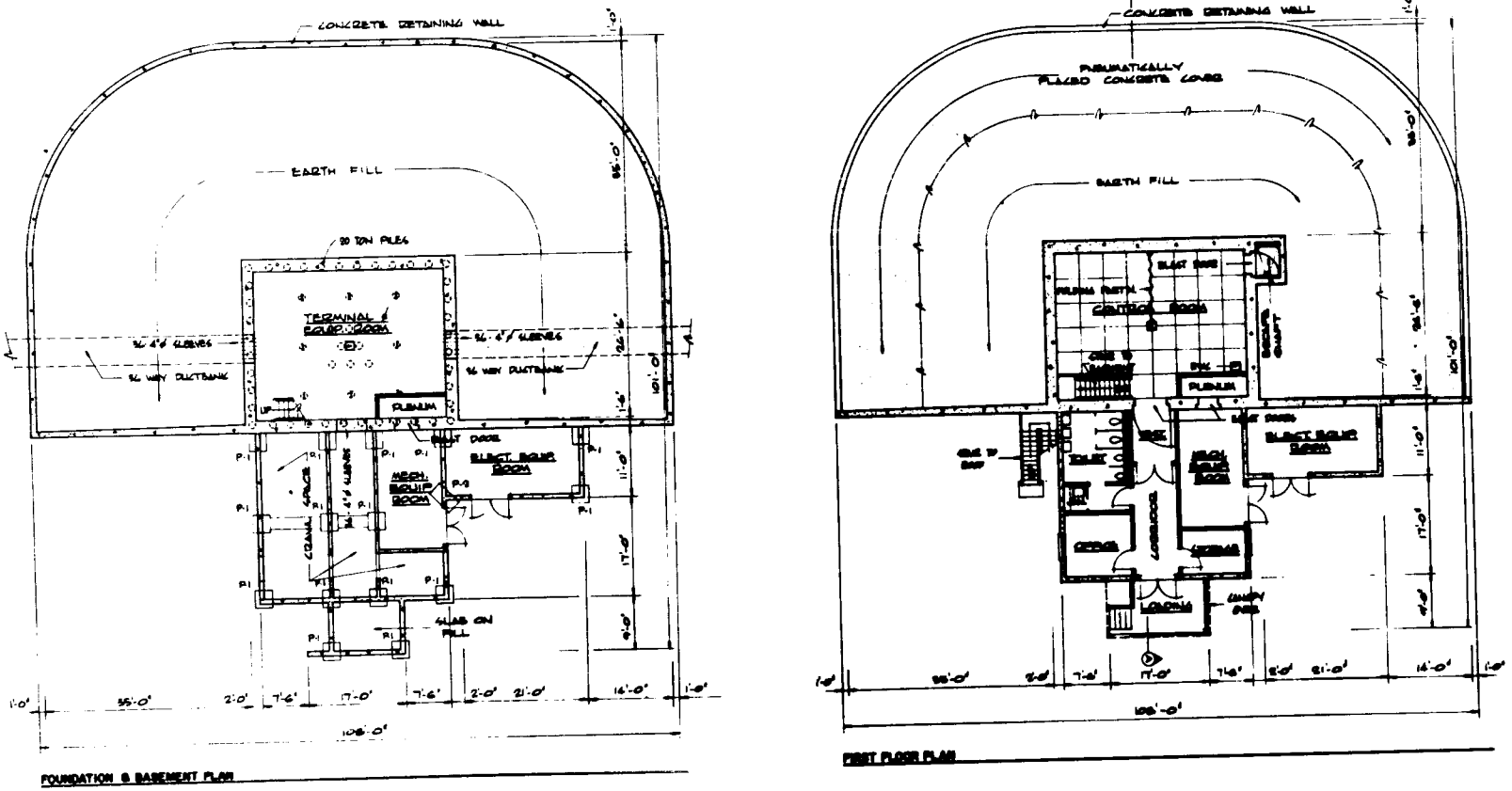
LOCATION PLAN

SCALE 0 1/2 1MI.



PERSPECTIVE





WALLOPS STATION PROPOSED LAUNCH CONTROL BUILDING - FISCAL YEAR 1966

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1966 ESTIMATES

ASSEMBLY SHOP

AUTHORIZATION LINE ITEM: Wallops Station

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

LOCATION OF PROJECT: Wallops Island, Accomack County, Virginia

COGNIZANT NASA INSTALLATION: Wallops Station

TYPE OF CONSTRUCTION PROJECT: New

FUNDING:

FY 1965 and Prior Years	$30,000
FY 1966 Estimate	443,000
Total Funding Through FY 1966	$473,000

PROJECT COST ESTIMATE:

	Unit of Measure	Quantity	Unit Cost	Total Cost
Land Acquisition	---	---	---	---
Construction				$443,000
Grading and piling	LS	---	$29,700	29,700
Water and sewerage	LS	---	18,100	18,100
Electrical distribution	LS	---	15,800	15,800
Sub-station	LS	---	21,200	21,200
Roads and loading areas	LS	---	13,200	13,200
Assembly shop	Sq. Ft.	6,500	53.08	345,000
Equipment	---	---	---	---
Design	---	---	---	---
Fallout Shelter	---	---	---	-0-
		TOTAL		$443,000

PROJECT PURPOSE:

This assembly shop will reduce the congestion and potential safety hazard that now exists in the North Sounding Rocket assembly area by providing three additional air-conditioned explosive safe assembly bays.

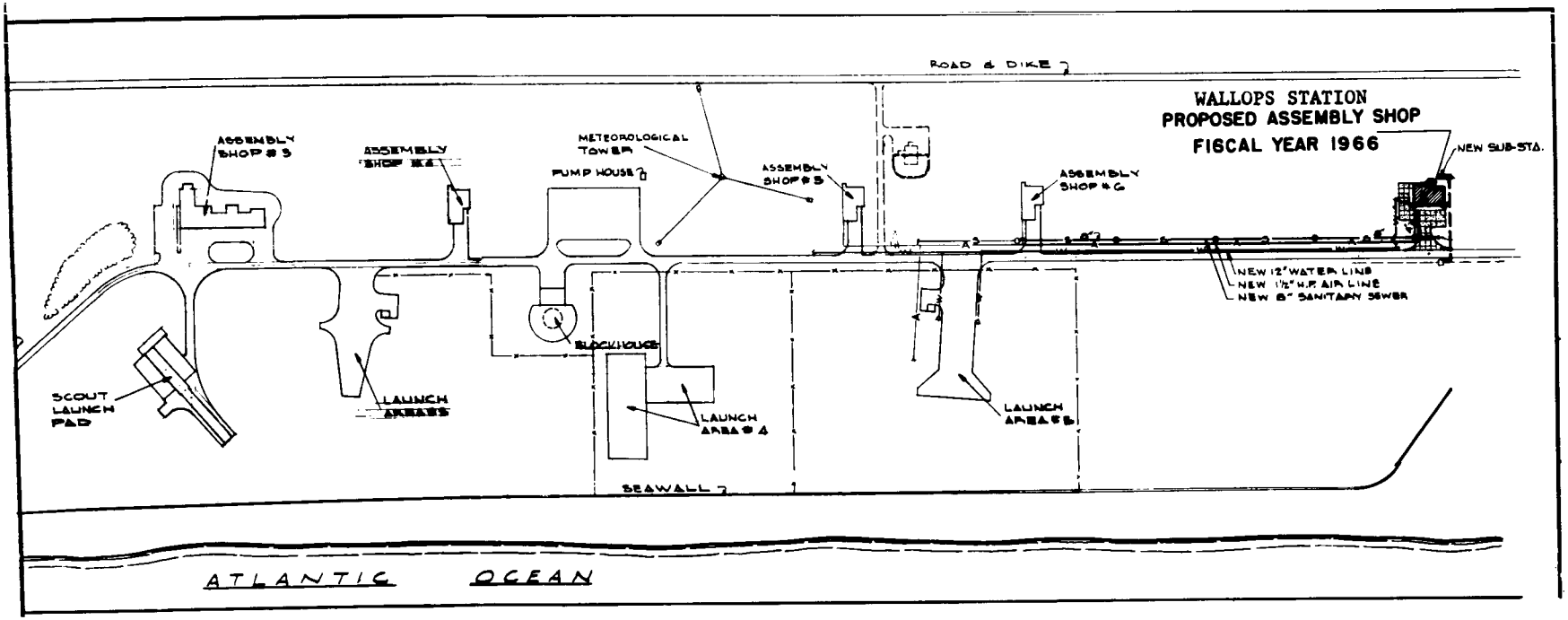
PROJECT DESCRIPTION:

This project will provide a 3 bay assembly building in the north launch area of Wallops Island containing 6,500 square feet of environmentally controlled space for the assembly and checkout of solid fuel, multi-stage rocket systems and payloads. Door and crane clearances will accommodate large payload-stage systems such as Wasp that require vertical assembly. The building will be constructed of structural steel, translucent panels, and 12-inch thick reinforced concrete bay separation walls. Utility requirements will be met by interfacing with existing water, sewerage, and power systems.

PROJECT JUSTIFICATION:

The existing assembly shop in the North Area is not capable of providing the required air-conditioned environment for the current and planned sounding rocket experiments such as ionospheric physics, energetic particles, aeronomy, Trailblazer, Wasp and SERT; nor is it possible to assemble and checkout the sounding rockets in an efficient manner due to the limited space available. It is planned that the sounding rocket stages will flow from the storage magazines to the proposed assembly bays for buildup. The completed stage will then be transferred to the large bay or to the existing shop depending upon the environmental requirements. There, the stages will be assembled into the completed vehicle and integrated with the payload for final combined prelaunch testing. The Assembly Shop is required to alleviate congestion that has been a serious problem for three years in the existing assembly areas, to provide a controlled environment capability for temperature and humidity sensitive fuel grains and payloads, and to avoid exceeding the explosive safety rating of the area. Continued operation with the present facilities alone will have a detrimental effect on vehicles, payloads, personnel and launch schedules.

ESTIMATED FUTURE YEAR FUNDING FOR THIS PROJECT: None

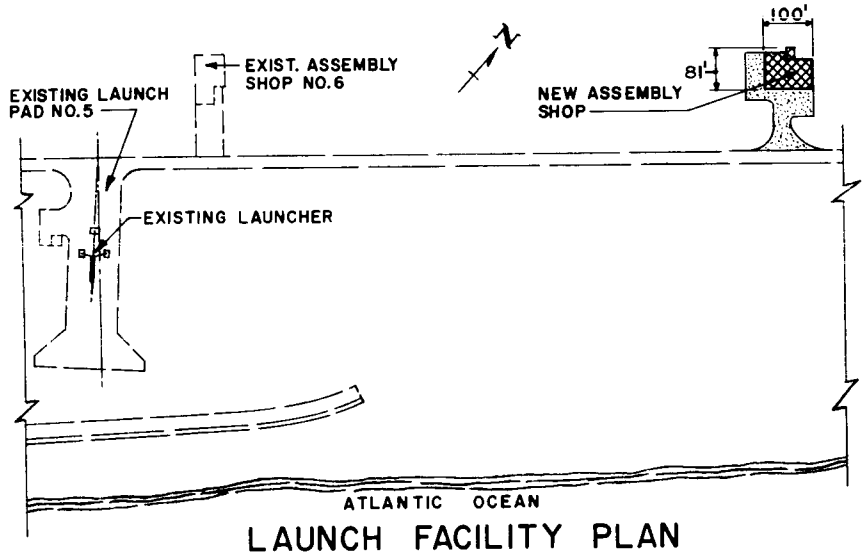

ROAD & DIKE
WALLOPS STATION
PROPOSED ASSEMBLY SHOP
FISCAL YEAR 1966
NEW SUB-STA.
ASSEMBLY SHOP # 3
ASSEMBLY SHOP # 4
METEOROLOGICAL TOWER
PUMP HOUSE
ASSEMBLY SHOP # 5
ASSEMBLY SHOP # 6
NEW 12" WATER LINE
NEW 1½" H.P. AIR LINE
NEW 8" SANITARY SEWER
BLOCKHOUSE
SCOUT LAUNCH PAD
LAUNCH AREAS
LAUNCH AREA # 4
LAUNCH AREA # 5
SEAWALL
ATLANTIC OCEAN

CF 12-12

WALLOPS STATION

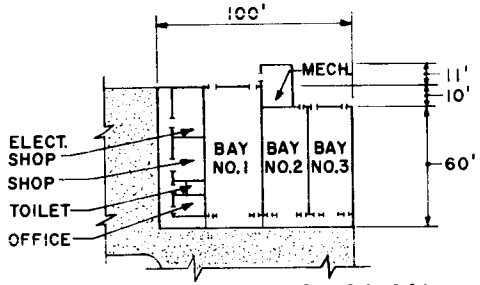
FISCAL YEAR 1966 ESTIMATES

ASSEMBLY SHOP



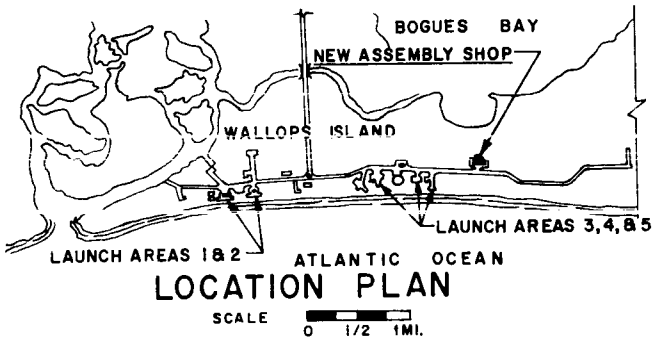
LAUNCH FACILITY PLAN

SCALE 100 0 100 200 300



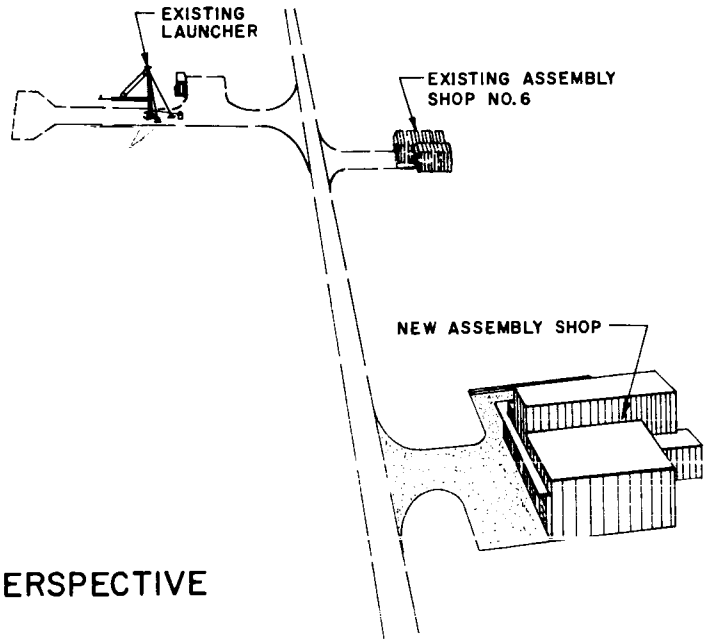
ASSEMBLY SHOP PLAN

SCALE 0' 20' 50' 75' 100'



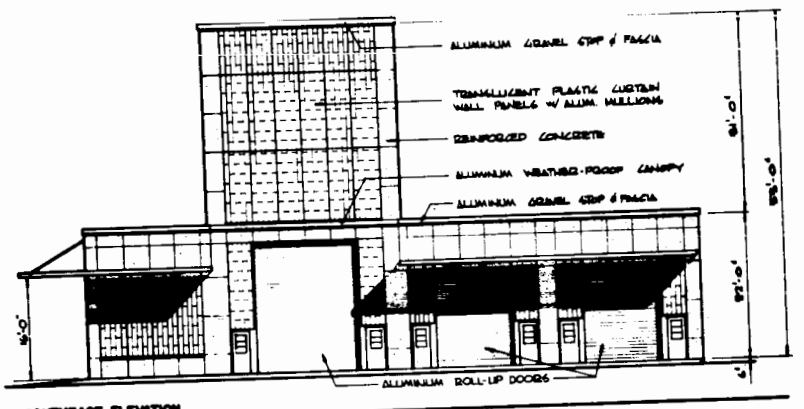
LOCATION PLAN

SCALE 0 1/2 1MI.

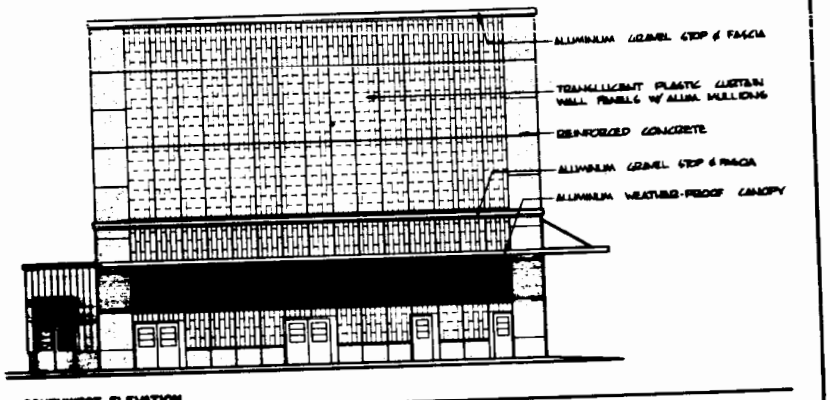


PERSPECTIVE

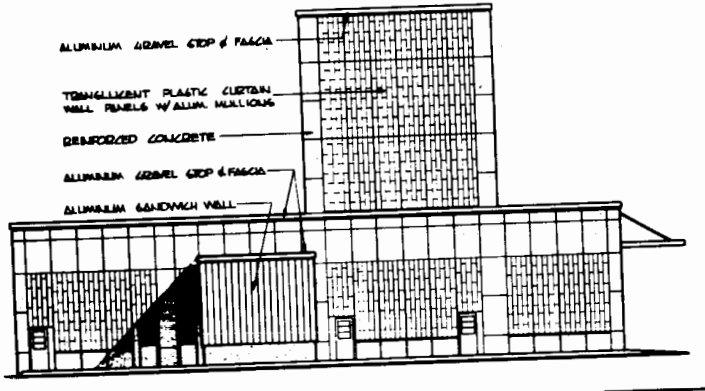
CF 12-13



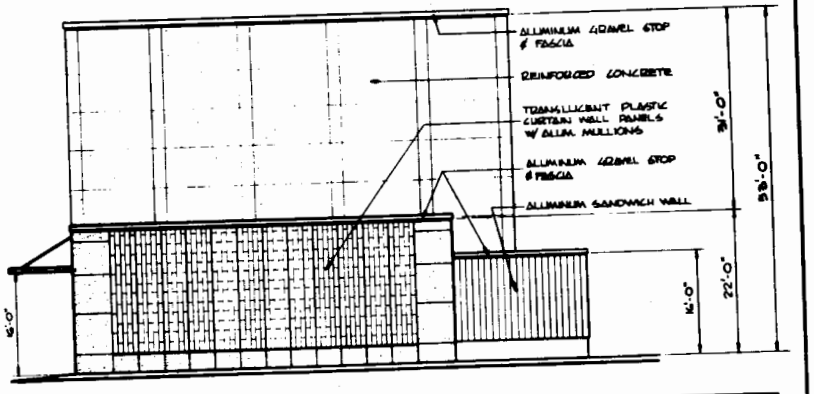
SOUTHEAST ELEVATION



SOUTHWEST ELEVATION

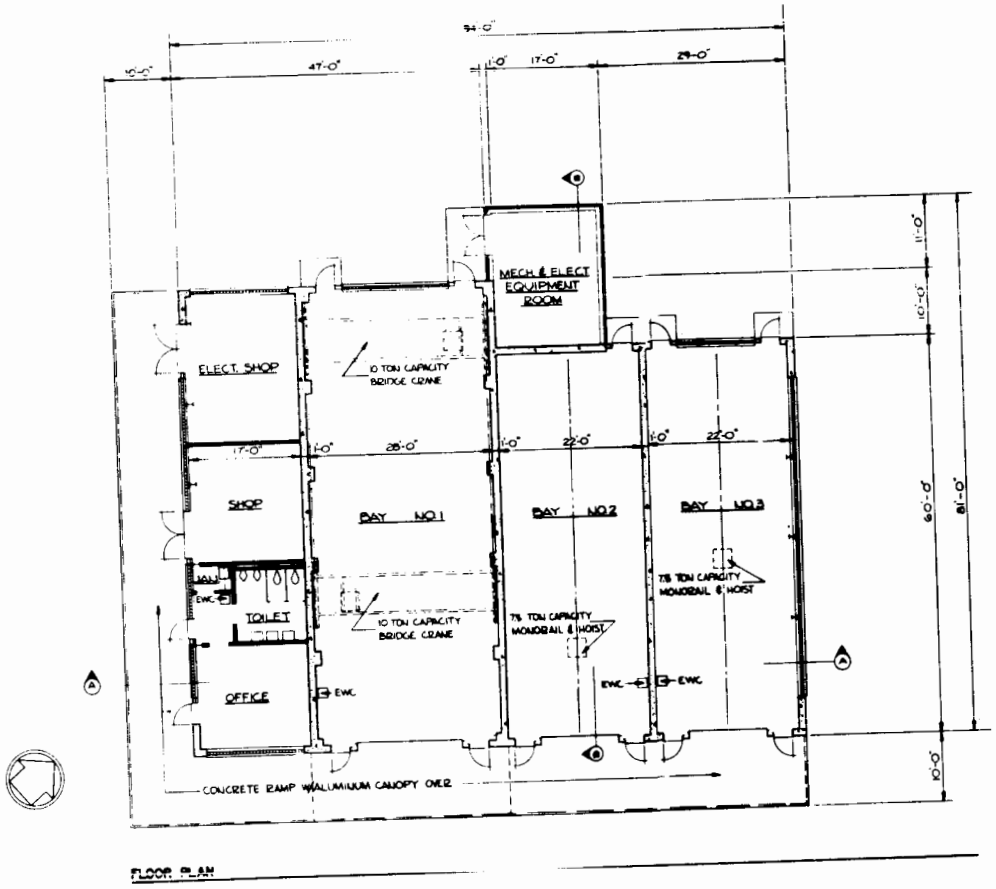


NORTHEAST ELEVATION



NORTHWEST ELEVATION

WALLOPS STATION PROPOSED ASSEMBLY SHOP - FISCAL YEAR 1966



FLOOR PLAN

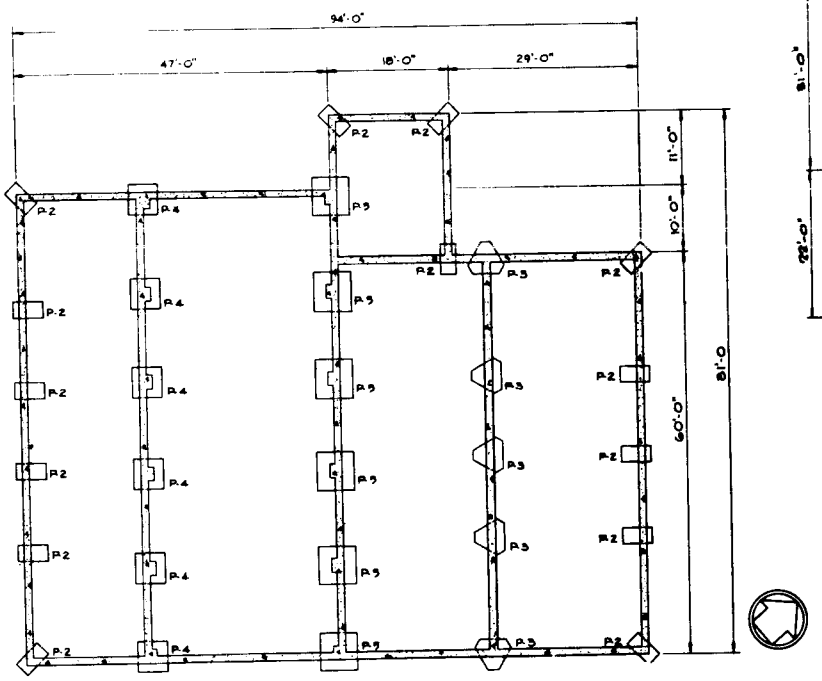
LEGEND

- CONCRETE
- CONCRETE MASONRY
- PREFINISHED ALUMINUM SANDWICH WALL
- TRANSLUCENT PLASTIC CURTAIN WALL

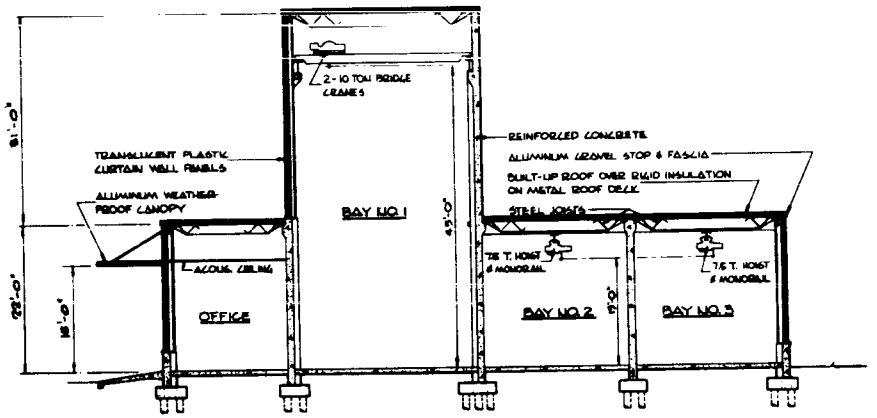
BUILDING	CONTENTS
AREA	6,800 SQUARE FEET
VOLUME	512,100 CUBIC FEET

WALLOPS STATION PROPOSED ASSEMBLY SHOP - FISCAL YEAR 1965

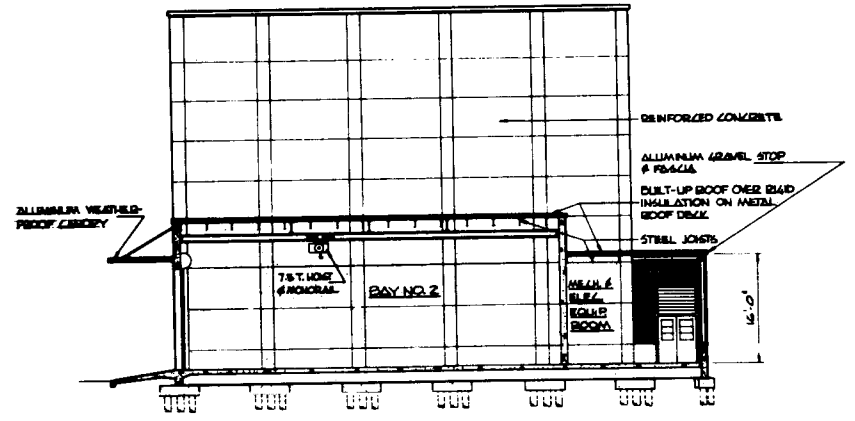
CF 12-15



FOUNDATION PLAN



SECTION "A-A"



SECTION "B-B"

WALLOPS STATION PROPOSED ASSEMBLY SHOP - FISCAL YEAR 1966

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1966 ESTIMATES

FACILITY PLANNING AND DESIGN

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 19 66 BUDGET ESTIMATES

(Dollars in thousands)

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

INSTALLATION MISSION

See Justification.

PERSONNEL STRENGTH	FY 19	FY 19	FY 19
NASA PERSONNEL *(End of Year)*			
CONTRACTOR AND OTHER PERSONNEL			
TOTAL ALL PERSONNEL	Not Applicable		

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

TOTAL CAPITAL INVESTMENT *(Including NASA-Owned Land) (as of June 30, 19)*	$

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 19 62 THRU CURRENT YEAR	FY 19 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Facility Planning and Design	AA	$43,937.0	$7,500.0	Not Applicable	Not Applicable
ALL OTHER PROJECTS					
TOTALS		1/ ($43,937.0)	$7,500.0		

CF 13-1

NASA FORM 1029 (REV. NOV 64) PREVIOUS EDITIONS ARE OBSOLETE.

1/ This amount is "non-add"; has been distributed in the appropriate installation summary sheets.

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1966 ESTIMATES

FACILITY PLANNING AND DESIGN

AUTHORIZATION LINE ITEM: **Facility Planning and Design**

PROGRAM OFFICE: **Office of the Associate Administrator (NASA General)**

FUNDING:

FY 1965 and Prior Years	$43,937,000
FY 1966 Estimate	7,500,000
Total Funding Through FY 1966	$51,437,000

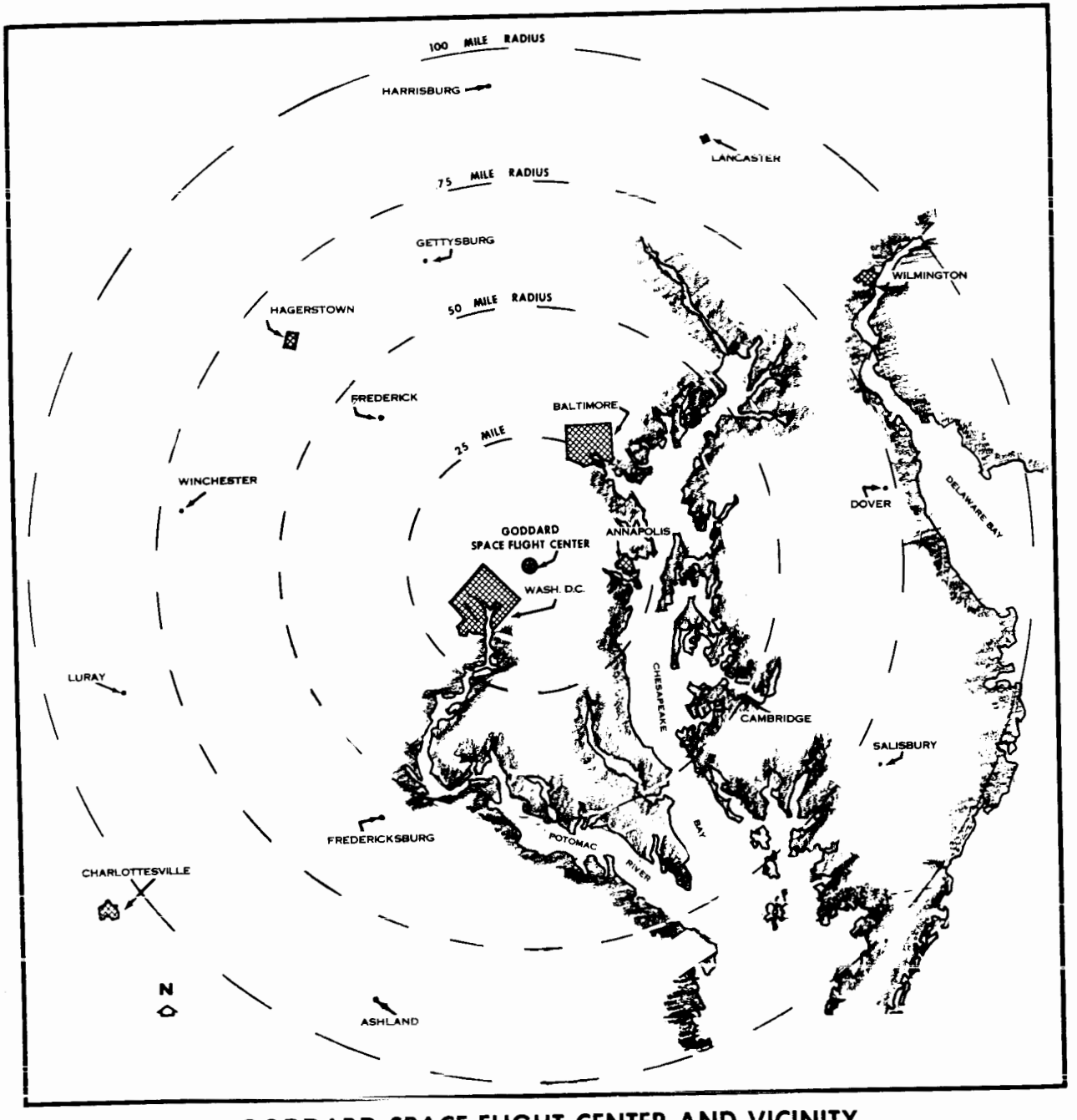
DESCRIPTION:

The funds requested under this item are required for advanced facility planning and design on projects for which construction funds may be requested in subsequent budgets.

JUSTIFICATION:

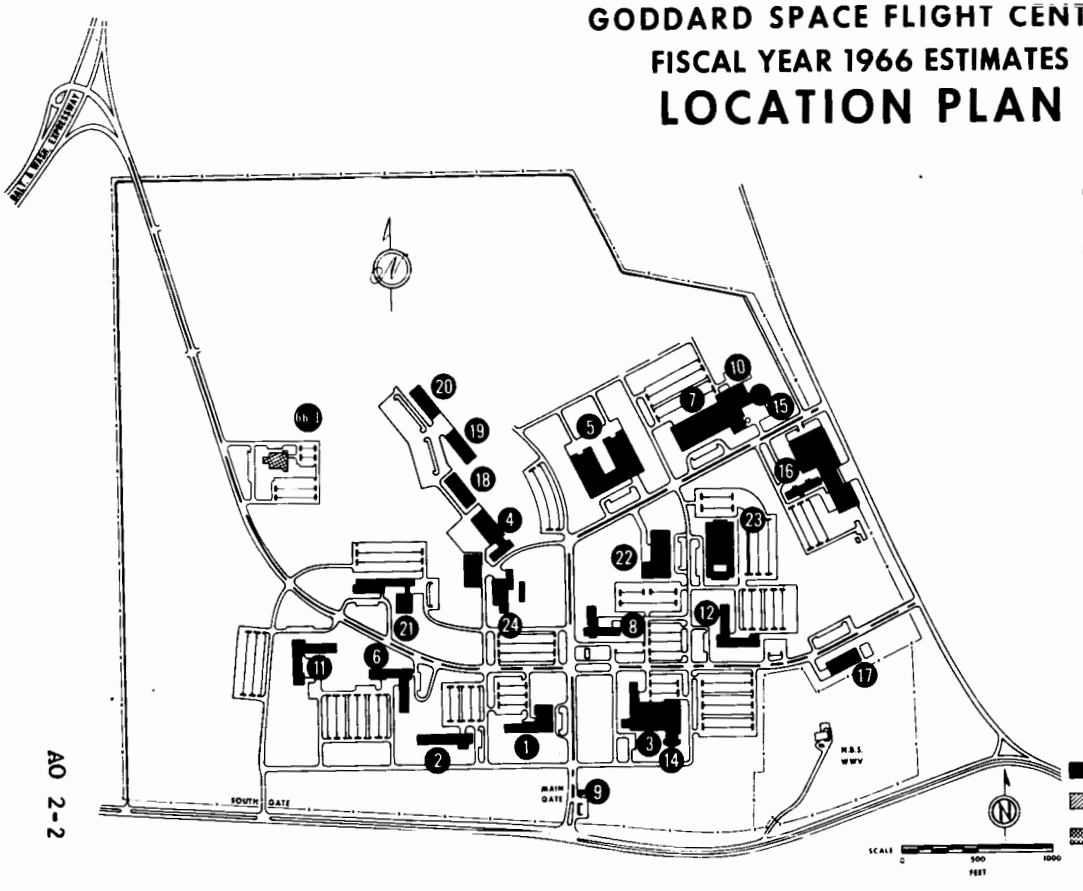
Long-range plans in several program areas must anticipate the need for the construction of facilities beyond the budget year for which estimates are being submitted. A considerable saving in time and an increase in the accuracy of construction cost estimates is possible with the availability of a facility planning and design fund which can be used to initiate the design of high-priority facilities prior to the enactment of project authorization and the appropriation of funds.

With these funds, NASA will continue as an on-going and continuing activity the general activity of facility planning and design of future construction projects which have not as yet been authorized or for which appropriations have not been made. NASA will also continue to make special project studies, feasibility studies, and other studies necessary to develop and improve overall criteria and standards for the design and construction of facilities.



GODDARD SPACE FLIGHT CENTER AND VICINITY

GODDARD SPACE FLIGHT CENTER
FISCAL YEAR 1966 ESTIMATES
LOCATION PLAN



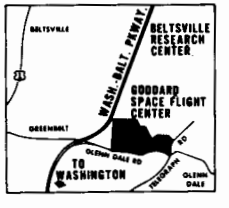
1. SPACE PROJECTS BUILDING
2. RESEARCH PROJECTS LABORATORY
3. CENTRAL FLIGHT CONTROL AND RANGE OPERATIONS LABORATORY
4. BOILER HOUSE AND ELECTRIC SUBSTATION
5. INSTRUMENT CONSTRUCTION AND INSTALLATION LABORATORY
6. SPACE SCIENCES LABORATORY
7. PAYLOAD TESTING FACILITY
8. SATELLITE SYSTEMS LABORATORY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

66-1 NASA SPACE SCIENCE DATA CENTER

EXISTING FACILITIES

FACILITIES UNDER CONSTRUCTION

FACILITIES PROPOSED IN 1966 ESTIMATES



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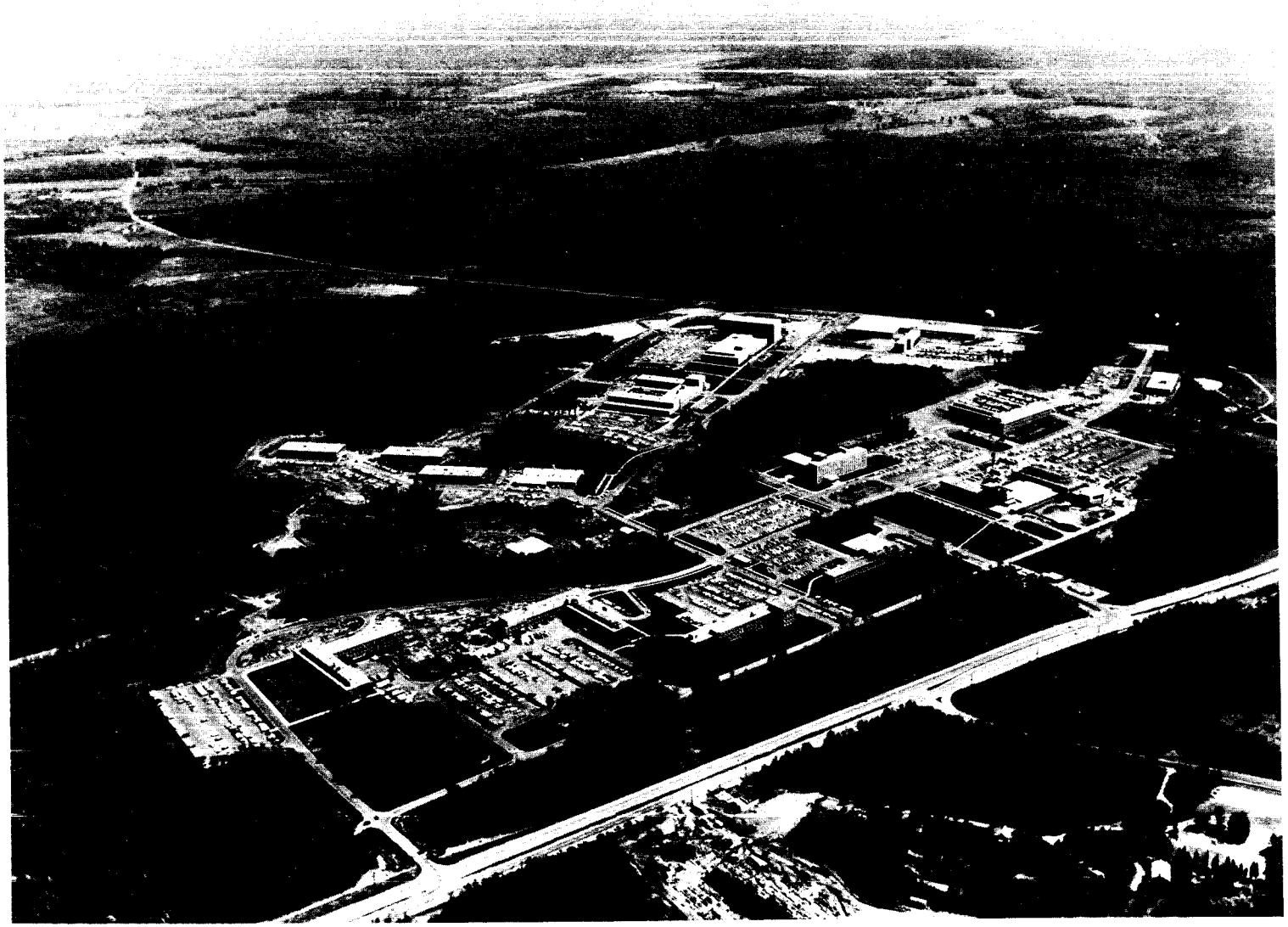
GODDARD SPACE FLIGHT CENTER



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ORGANIZATION AND STAFFING CHART

GODDARD SPACE FLIGHT CENTER

STAFFING SUMMARY

	65	66
Excepted	40	40
GS-16	21	21
GS-15	190	190
GS-14	383	383
All other GS	2,771	2,771
Wage Board	272	272
Total Permanent	3,677	3,677
Temporary	48	48
Total Positions	3,725	3,725

OFFICE OF THE DIRECTOR
ASSOCIATE DIRECTOR

	65	66
Excepted	2	2
GS-16	-	-
GS-15	-	-
GS-14	-	-
All other GS	4	4
Wage Board	-	-
Total	6	6

ASSISTANT DIRECTOR FOR ADMINISTRATION

	65	66
Excepted	2	2
GS-16	-	-
GS-15	3	3
GS-14	8	8
All other GS	44	44
Wage Board	-	-
Total	57	57

PROGRAM SUPPORT DIVISION

	65	66
Excepted	-	-
GS-16	-	-
GS-15	1	1
GS-14	8	8
All other GS	79	79
Wake Board	-	-
Total	88	88

FINANCIAL MANAGEMENT DIVISION

	65	66
Excepted	-	-
GS-16	-	-
GS-15	2	2
GS-14	2	2
All other GS	111	111
Wage Board	-	-
Total	115	115

ORGANIZATION AND PERSONNEL DIVISION

	65	66
Excepted	-	-
GS-16	-	-
GS-15	1	1
GS-14	5	5
All other GS	61	61
Wage Board	-	-
Total	67	67

MANAGEMENT SERVICES AND SUPPLY DIVISION

	65	66
Excepted	-	-
GS-16	-	-
GS-15	1	1
GS-14	2	2
All other GS	120	120
Wage Board	17	17
Total	140	140

PROCUREMENT DIVISION

	65	66
Excepted	1	1
GS-16	-	-
GS-15	4	4
GS-14	15	15
All other GS	269	269
Wage Board	-	-
Total	289	289

TECHNICAL INFORMATION DIVISION

	65	66
Excepted	-	-
GS-16	-	-
GS-15	-	-
GS-14	1	1
All other GS	65	65
Wage Board	22	22
Total	88	88

CHIEF OF TECHNICAL SERVICES

	65	66
Excepted	1	1
GS-16	-	-
GS-15	-	-
GS-14	-	-
All other GS	2	2
Wage Board	-	-
Total	3	3

FACILITIES ENGINEERING DIVISION

	65	66
Excepted	1	1
GS-16	-	-
GS-15	1	1
GS-14	7	7
All other GS	58	58
Wage Board	107	107
Total	174	174

TEST AND EVALUATION DIVISION

	65	66
Excepted	1	1
GS-16	-	-
GS-15	6	6
GS-14	27	27
All other GS	227	227
Wage Board	-	-
Total	261	261

FABRICATION DIVISION

	65	66
Excepted	-	-
GS-16	-	-
GS-15	1	1
GS-14	1	1
All other GS	38	38
Wage Board	126	126
Total	166	166

ASSISTANT DIRECTOR TRACKING AND DATA SYSTEMS

	65	66
Excepted	2	2
GS-16	2	2
GS-15	14	14
GS-14	18	18
All other GS	51	51
Wage Board	-	-
Total	87	87

ADVANCED DEVELOPMENT DIVISION

	65	66
Excepted	1	1
GS-16	1	1
GS-15	12	12
GS-14	17	17
All other GS	96	96
Wage Board	-	-
Total	127	127

DATA SYSTEMS DIVISION

	65	66
Excepted	3	3
GS-16	1	1
GS-15	11	11
GS-14	22	22
All other GS	243	243
Wage Board	-	-
Total	280	280

NETWORK ENGINEERING AND OPERATIONS DIVISION

	65	66
Excepted	1	1
GS-16	2	2
GS-15	15	15
GS-14	33	33
All other GS	201	201
Wage Board	-	-
Total	252	252

MANNED FLIGHT OPERATIONS DIVISION

	65	66
Excepted	-	-
GS-16	2	2
GS-15	14	14
GS-14	25	25
All other GS	108	108
Wage Board	-	-
Total	149	149

NASA COMMUNICATIONS DIVISION

	65	66
Excepted	-	-
GS-16	-	-
GS-15	3	3
GS-14	4	4
All other GS	53	53
Wage Board	-	-
Total	60	60

ASSISTANT DIRECTOR SPACE SCIENCES AND SATELLITE APPLICATIONS

	65	66
Excepted	3	3
GS-16	-	-
GS-15	2	2
GS-14	2	2
All other GS	11	11
Wage Board	-	-
Total	18	18

INSTITUTE FOR SPACE STUDIES

	65	66
Excepted	1	1
GS-16	1	1
GS-15	1	1
GS-14	6	6
All other GS	29	29
Wage Board	-	-
Total	38	38

SPACECRAFT INTEGRATION AND SOUNDING ROCKET DIVISION

	65	66
Excepted	1	1
GS-16	1	1
GS-15	14	14
GS-14	25	25
All other GS	174	174
Wage Board	-	-
Total	215	215

SPACE SCIENCES DIVISION

	65	66
Excepted	6	6
GS-16	2	2
GS-15	10	10
GS-14	22	22
All other GS	143	143
Wage Board	-	-
Total	183	183

SPACECRAFT SYSTEMS AND PROJECTS DIVISION

	65	66
Excepted	7	7
GS-16	2	2
GS-15	29	29
GS-14	66	66
All other GS	240	240
Wage Board	-	-
Total	344	344

SPACECRAFT TECHNOLOGY DIVISION

	65	66
Excepted	1	1
GS-16	4	4
GS-15	15	15
GS-14	21	21
All other GS	110	110
Wage Board	-	-
Total	149	149

THEORETIGAL DIVISION

	65	66
Excepted	2	2
GS-16	2	2
GS-15	9	9
GS-14	4	4
All other GS	79	79
Wage Board	-	-
Total	96	96

AERONOMY AND METEOROLOGY DIVISION

	65	66
Excepted	4	4
GS-16	3	3
GS-15	21	21
GS-14	42	42
All other GS	155	155
Wage Board	-	-
Total	225	225

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ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

GODDARD SPACE FLIGHT CENTER

MISSION AND CAPABILITIES:

The Goddard Space Flight Center was established on May 1, 1959. It is the first major United States laboratory established for the investigation and peaceful exploration of space.

Goddard personnel number more than 3,700. While the majority are at the Greenbelt site and at various continental United States installations (e.g., the Institute for Space Studies in New York City), other members of the Goddard team are located throughout the world, operating satellite tracking and communication network stations.

This Installation is responsible for: development of sounding rockets for scientific investigations; the management of application satellite projects (e.g., NIMBUS, TIROS, ECHO, SYNCOM, RELAY and the Applications Technology Satellite) and scientific satellite projects (e.g., OAO, OGO, OSO, AOSO and Explorers); world-wide NASA tracking and data acquisition operations; pre-flight testing and evaluation of spacecraft under simulated flight conditions; design, development and management of experiments; spacecraft design and construction; project management and launch of NASA's Delta launch vehicle; and launch of Centaur and Atlas-Agena vehicles on behalf of other NASA Centers.

Goddard is one of the few installations in the world capable of conducting a full-range space science experimentation program. This involves carrying a concept from theoretical work to experimental design and engineering to payload fabrication and assembly, to a complete test and evaluation program, to vehicle launch and satellite tracking, data acquisition and data reduction. As an example IMP I was designed, built, tested, and launched by Goddard personnel.

More satellite and sounding rocket launchings than ever before were accomplished in 1964. Some noteworthy achievements of the Goddard flight program were:

Scientific Satellites - The successful orbiting of nine scientific satellites, including the Orbiting Geophysical Observatory (OGO), the nation's largest and most advanced scientific spacecraft, contributed to a better understanding of earth-sun relationships (OGO, ARIEL II), provided new knowledge on the mechanics of the ionosphere (Explorers XX, XXI); and observed in detail the earth's magnetosphere (IMP I).

Sounding Rockets - Additional knowledge was gained from a continued series of sounding rocket flights---small, inexpensive payloads launched into and above the earth's atmosphere to study space science phenomena for short periods of time. For example, one Aerobee sounding rocket obtained ultraviolet spectra on the atmospheres of Venus and Jupiter.

Meteorological Satellites - The second generation weather satellite NIMBUS I, NASA's first satellite whose control system always kept the spacecraft looking at earth, was launched and took very high quality infra-red photographs of the earth's weather conditions in total darkness. The TIROS VII and VIII satellites continued to take cloud cover pictures of the world for use by the Weather Bureau in daily forecasting. These two satellites have taken over 150,000 pictures.

Communication Satellites - The results of the three successful launches of RELAY II, ECHO II and SYNCOM III have moved ahead the timetable for an operational system of intercontinental communication satellites allowing cancellation of further projected launches in the research and development series, and have made it possible to proceed with advanced research in applications technology satellites. RELAY II has been used for demonstrations, such as the political conventions, the national elections and Olympic Games. ECHO I is still functioning as a radiowave reflector after almost four years in space. SYNCOM III was used to bring television transmissions of the Olympic Games from Japan to the United States and Europe.

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Number of Positions, end of year..	3,675	3,725	3,725
Average Number of All Employees...	3,477	3,681	3,698
Administrative Operations.....	$62,466,000	$85,923,000	$69,591,000

INSTALLATION DESCRIPTION:

The Goddard Space Flight Center occupies a main site of 530 acres located 15 miles northeast of Washington, D.C., one mile off the Baltimore-Washington Expressway near Greenbelt, Maryland. Four separate areas totaling 652 acres located within two miles of the Center are used for the antenna test range, magnetic test area, the optical and ground plane facility, operation of a STADAN engineering and real-time station and operation of a manned flight network training facility. The total capital investment as of June 30, 1964 was $118,739,000.

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION:

		1964	1965	1966
11.	Personnel Compensation.....	$32,481,000	$38,391,000	$38,544,000
12.	Personnel Benefits.....	2,287,000	2,707,000	2,716,000
	Total, personnel costs....	$34,768,000	$41,098,000	$41,260,000
21.	Travel and Transportation of Persons.....	2,409,000	2,730,000	2,740,000
22.	Transportation of Things....	1,458,000	1,195,000	1,107,000
23.	Rents, Communications, and Utilities.....	10,790,000	9,936,000	9,745,000
24.	Printing and Reproduction...	622,000	317,000	342,000
25.	Other Services.....	5,802,000	4,850,000	6,923,000
	Services of other agencies	438,000	334,000	443,000
26.	Supplies and Materials.....	2,228,000	1,796,000	1,974,000
31.	Equipment.....	3,356,000	23,201,000	4,532,000
32.	Lands and Structures.....	595,000	466,000	525,000
41.	Grants, Subsidies and Contributions.....	---	---	---
42.	Insurance Claims and Indemnities.....	---	---	---
	Total.....	$62,466,000	$85,923,000	$69,591,000

JUSTIFICATION BY OBJECT CLASSIFICATION:

Personnel Distribution

	1964	1965	1966
Direct Personnel by Program			
Space Science and Applications			
Physics and astronomy.....	1,025	1,074	1,086
Meteorological satellites.....	236	241	235
Communication satellites.....	91	50	40
Applications technology satellites.....	53	95	104
Lunar and planetary exploration.....	19	29	24
Bioscience.....	3	6	6
Launch vehicle development.....	13	15	15
Launch vehicle procurement.....	81	86	86

	1964	1965	1966
Advanced Research and Technology			
Space vehicle systems	40	49	49
Electronics systems	58	64	64
Nuclear-electric systems	3	5	5
Chemical propulsion	7	7	7
Solar and chemical power	18	24	24
Basic research	17	17	17
Tracking and Data Acquisition	677	632	632
Technology Utilization	3	2	2
Sub-total, direct positions	2,344	2,396	2,396
Support personnel			
Director and Staff	6	6	6
Administration	602	680	680
Research and development support	658	595	595
Sub-total, support positions	1,266	1,281	1,281
Total, permanent positions	3,610	3,677	3,677
Other positions:			
Positions under cooperative training agreements	36	36	36
Other temporary positions	29	12	12
Total, all positions	3,675	3,725	3,725

Personnel requirements

The new generation of satellites with their complex problems and experiments are making peak demands for highly skilled scientific, engineering and administrative support personnel. The changing emphasis in work requires the reassignment of personnel from projects where the workload is declining (e.g., RELAY, ECHO, etc.) to areas where the workload is increasing. The requirements generated by the establishment of manned flight network stations and development of the Applications Technology Satellite will be met as other projects are phased out.

The FY 1966 estimate of personnel compensation is shown on the next page.

Civilian personnel benefits for fiscal years 1965 and 1966 are estimated at 7.4% of the net cost of permanent positions. This represents the actual percentage experienced in FY 1964.

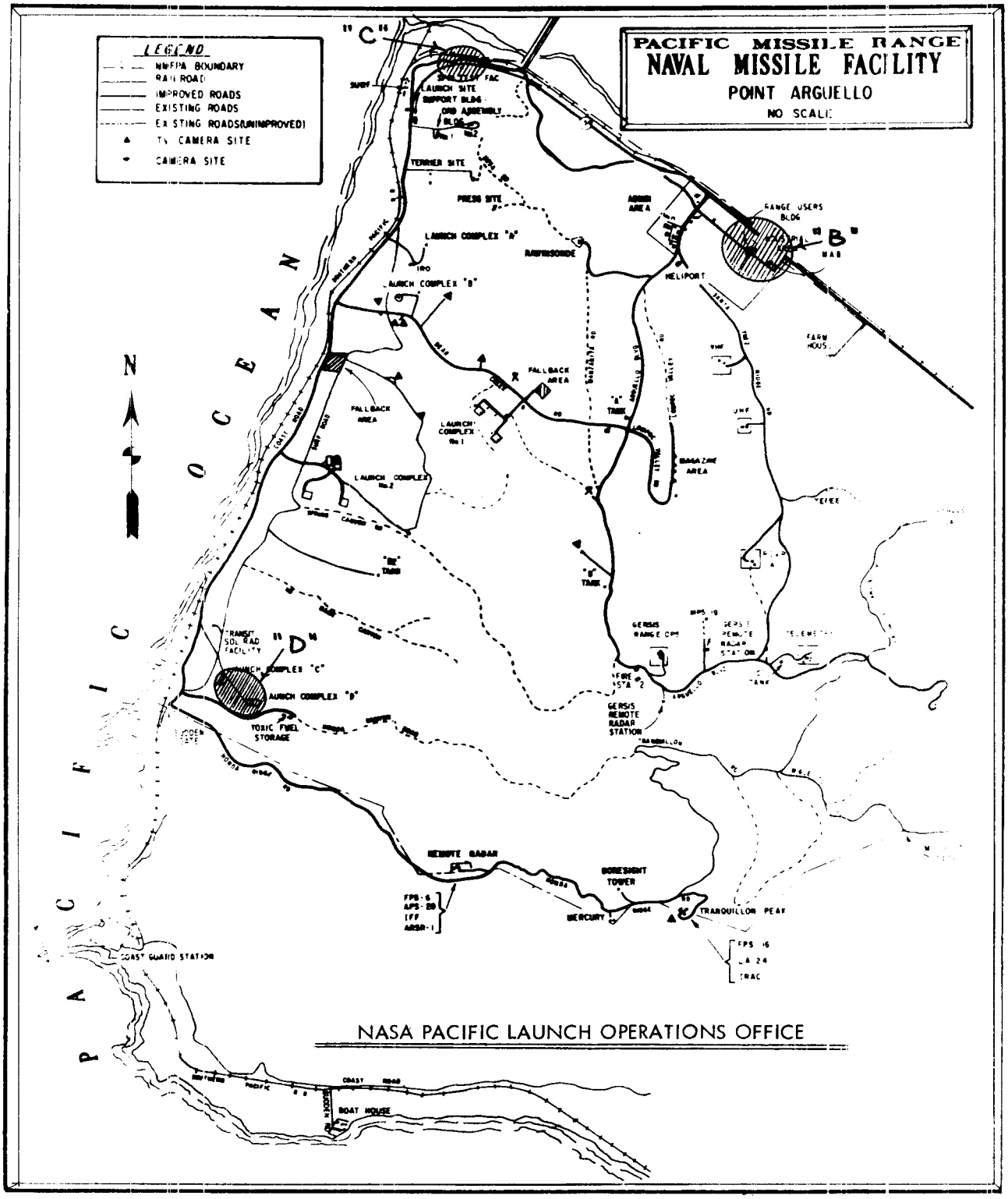
Personnel Costs

	1964	1965	1966
Total Positions	3,675	3,725	3,725
Permanent	3,610	3,677	3,677
Other	65	48	48
Personnel Compensation:			
Annual cost of permanent positions	$33,986,000	$36,939,000	$36,936,000
Pay above the stated annual rate	270,000	134,000	137,000
Lapses (deduct)	-3,059,000	-376,000	-192,000
Net cost of permanent positions	$31,197,000	$36,697,000	36,881,000
Other personnel compensation	1,758,000	2,204,000	2,376,000
Total compensation	32,955,000	38,901,000	39,257,000
NASA funded	32,481,000	38,391,000	38,544,000
Reimbursable	474,000	510,000	713,000
Personnel benefits	2,308,000	2,750,000	2,766,000
NASA funded	2,287,000	2,707,000	2,716,000
Reimbursable	21,000	43,000	50,000
Total personnel costs	35,263,000	41,651,000	42,023,000
NASA funded	34,768,000	41,098,000	41,260,000
Reimbursable	495,000	553,000	763,000
Average Number of All Employees (Man Years)	3,477	3,681	3,698

The estimates for Goddard Space Flight Center for FY 1966 are $16,332,000 less than in FY 1965. Exclusive of the FY 1965 computer purchase program of approximately $22 million, the FY 1966 estimates reflect an overall increase of $5,477,000.

This increase includes $162,000 for personnel costs related to the additional 17 man-years of civil service employment, and $1,935,000 for increased contractor services related to the maintenance and operation of additional facilities coming into initial operation in FY 1966, and the full year costs of facilities placed in operation during FY 1965.

The balance of the increase, $3,380,000, is for non-recurring costs associated with the purchase of additional computer equipment where studies have indicated that it is more economical to purchase this equipment than it is to acquire the items by lease.

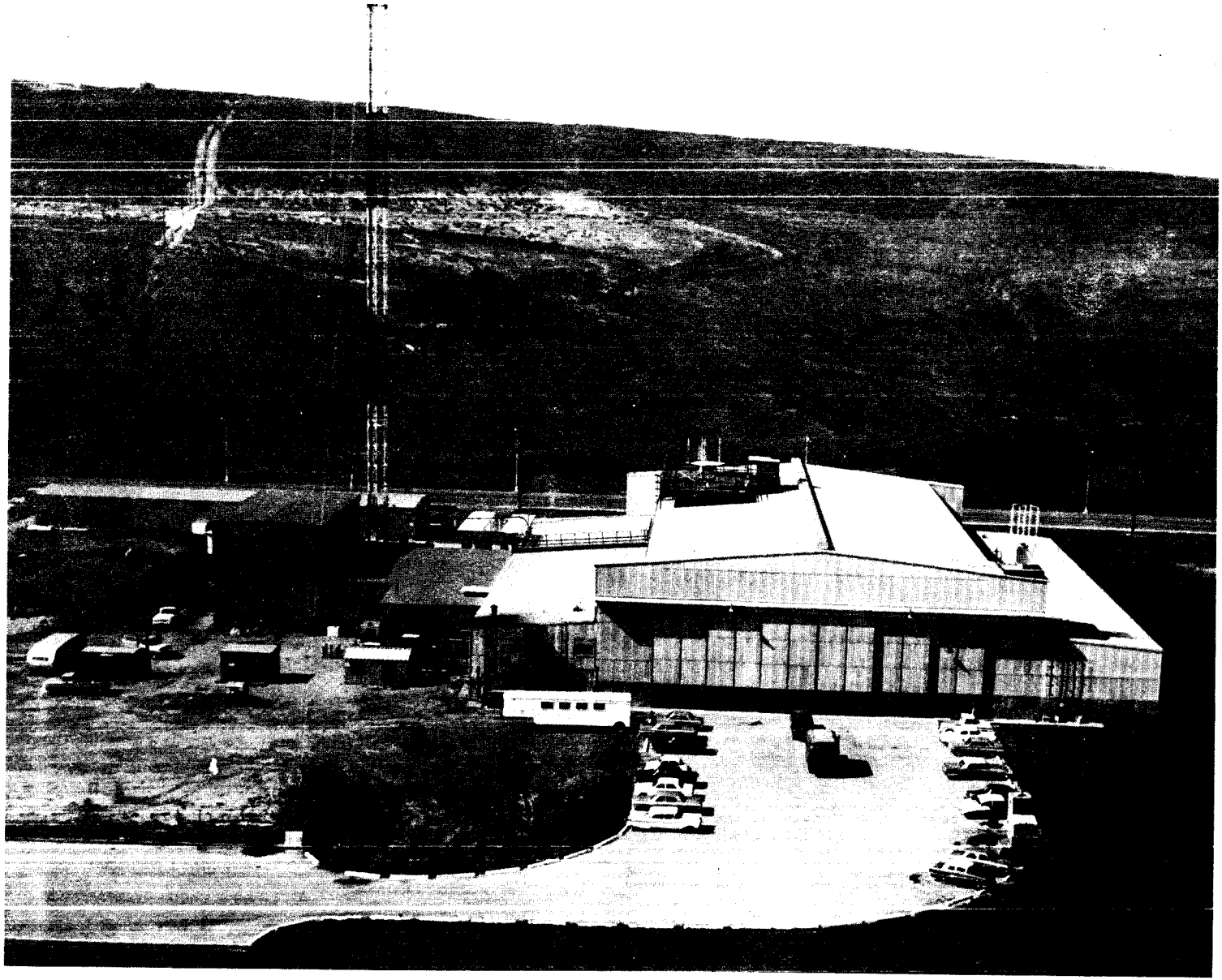

PACIFIC MISSILE RANGE
NAVAL MISSILE FACILITY
POINT ARGUELLO
NO SCALE
LEGEND
NMFPA BOUNDARY
RAILROAD
IMPROVED ROADS
EXISTING ROADS
EXISTING ROADS(UNIMPROVED)
TV CAMERA SITE
CAMERA SITE
PACIFIC OCEAN
N
LAUNCH SITE
SUPPORT BLDG
TERRIER SITE
PRESS SITE
LAUNCH COMPLEX "A"
LAUNCH COMPLEX "B"
RAMROD
HELIPORT
RANGE USERS BLDG
FALLBACK AREA
LAUNCH COMPLEX No 1
LAUNCH COMPLEX No 2
MAGAZINE AREA
TRANSIT SOL RAD FACILITY
LAUNCH COMPLEX "C"
LAUNCH COMPLEX "D"
YOXIC FUEL STORAGE
GERSIS REMOTE RADAR STATION
REMOTE RADAR
FPS-16
APS-80
IFF
ARSR-1
BORESIGHT TOWER
MERCURY
TRANQUILLON PEAK
FPS 16
LA 24
TRAC
COAST GUARD STATION
BOAT HOUSE
COAST ROAD
NASA PACIFIC LAUNCH OPERATIONS OFFICE

AO 2-10

LAUNCH COMPLEX 75-1

AO 2-11

MISSILE ASSEMBLY BUILDING



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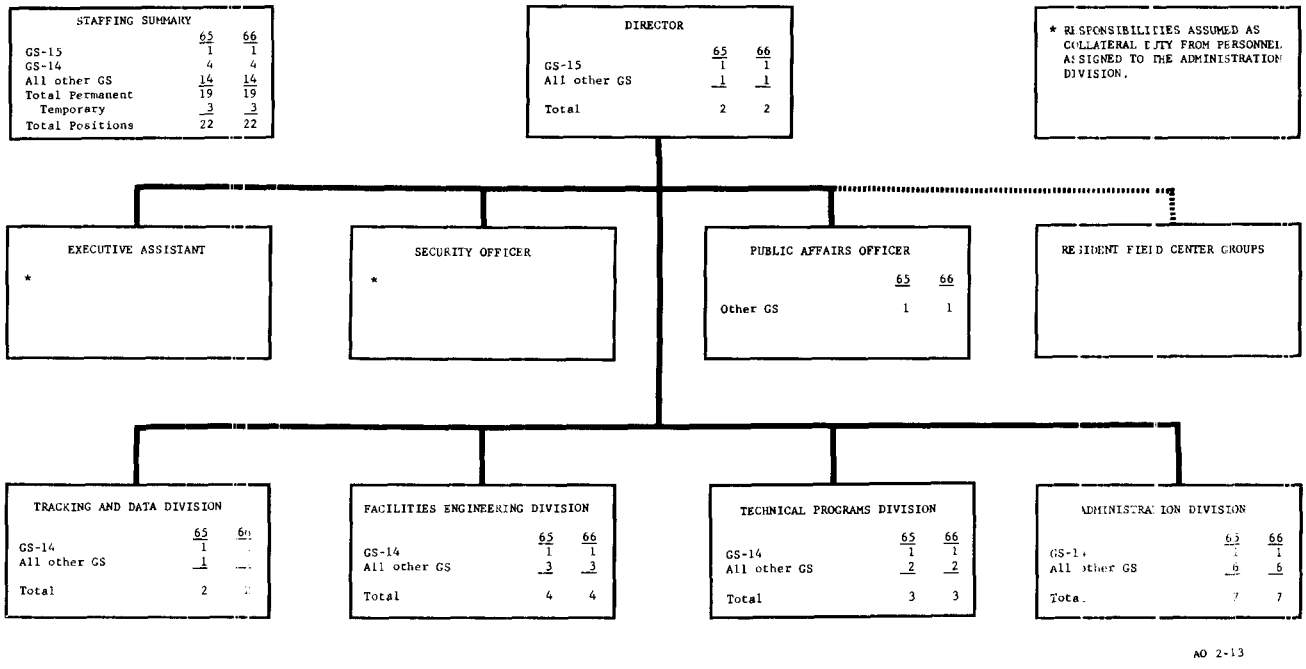
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ORGANIZATION AND STAFFING CHART

PACIFIC LAUNCH OPERATIONS OFFICE



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ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

PACIFIC LAUNCH OPERATIONS OFFICE

MISSION AND CAPABILITIES:

The mission of the Pacific Launch Operations Office covers the following areas:

1. Representing NASA in its west coast relationships with the Department of Defense range management agencies.

2. Negotiating for and coordinating the use of range services and facilities.

3. Providing administrative, logistic and technical support for NASA programs and projects at the DOD west coast ranges.

4. Providing central coordination of matters pertaining to support requirements developed by field installation groups located at the Pacific launch site.

During past months, NASA activities at the Pacific Missile Range/Western Test Range have included a number of major launches, recording of on-orbit data from Tiros and other spacecraft, metric tracking of Saturn and Centaur, manned space flight network support of the first Gemini launch, and miscellaneous support of several minor projects. On August 25, 1964, the Ionosphere Explorer was launched utilizing a Scout Vehicle; on August 28, 1964, the first Nimbus was launched by a Thor-Agena; and on October 9, 1964, the first successful Beacon Explorer was placed into an almost nominal orbit by a Scout. Educationally, the Pacific Launch Operations Office works closely with Unified School Districts in the three counties located in this area as a member of the Northern California Industry-Education Council providing NASA publications, films, exhibits, and educational material.

Increased launch activity using the Scout, Thor-Agena, and Thrust-Augmented Thor-Agena is planned. In addition, current plans include extending the Delta Program to the Western Test Range. Spacecraft to be launched include OGO, ISIS-X, Nimbus, Air-Density/INJUN, Pageos, and the French FR-1A. The support of Gemini, Saturn, Centaur, Tiros, and other orbiting spacecraft or vehicles will continue.

Geographically, from no other point within the continental United States can a vehicle be launched southward, into a polar orbit, without passing over populated areas during the hazardous launching and climb out stages, as land mass does not exist between the launch pads and Antarctica. The relatively flat terrain near the ocean, with protective hills inland, is ideal for

launching large boosters, as it provides both security control and minimal danger to adjacent communities. Launch facilities include the following:

1. Existing:

   NASA - Thor-Agena, Thrust-Augmented Thor (TAT), Scout, Probes

   Air Force (available to NASA) - Atlas-Agena and Thor-Able Star

2. Planned:

   NASA - Improved Delta

   Air Force (available to NASA) - Titan IIIC

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Number of Positions, end of year.	22	22	22
Average Number of All Employees..	22	22	22
Administrative Operations.....	$1,037,000	$835,000	$804,000

INSTALLATION DESCRIPTION:

The Pacific Launch Operations Office, established in March 1962, is located at Vandenberg Air Force Base, California, approximately 150 miles northwest of Los Angeles. Part of the organization is currently located at Point Mugu, California, a Naval Base approximately 40 miles north of Los Angeles. Because of a transfer of range responsibilities from the Navy to the Air Force during FY 1965, personnel assigned to the Point Mugu office will transfer to VAFB on or about March 1, 1965. The physical plant comprises various facilities, all located on land owned by other government agencies, including: (1) The Spin Test Facility; (2) the NASA/DOD Scout Launch Pad, including the NASA Operation Support Building and the PMR Probe Complex (1800 SF of Block House space assigned to NASA); (3) 1/2 (20,600 SF) of the PMR Missle Assembly Building plus a 7500 SF NASA addition; (4) Component Storage & Supply Building; (5) 10,900 SF of the PMR Range Users Engineering Building assigned to NASA for administrative space. The NASA physical plant value at Vandenberg Air Force Base as of June 30, 1964, was $1,865,000.

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION:

	1964	1965	1966
11. Personnel Compensation.....	$193,000	$231,000	$234,000
12. Personnel Benefits.....	12,000	16,000	16,000
Total, personnel costs....	$205,000	$247,000	$250,000
21. Travel and Transportation of Persons.....	38,000	50,000	40,000
22. Transportation of Things....	7,000	12,000	10,000
23. Rents, Communications, and Utilities.....	111,000	90,000	90,000
24. Printing and Reproduction...	6,000	8,000	8,000
25. Other Services.....	70,000	166,000	160,000
Services of other agencies	94,000	74,000	80,000
26. Supplies and Materials.....	141,000	85,000	85,000
31. Equipment.....	55,000	46,000	46,000
32. Lands and Structures.....	310,000	57,000	35,000
Total.....	$1,037,000	$835,000	$804,000

JUSTIFICATION BY OBJECT CLASSIFICATION:

Personnel Distribution

	1964	1965	1966
Direct Personnel by Program	---	---	---
Support Personnel			
Director and Staff.....	3	3	3
Administration.....	10	7	7
Research and development support.	9	9	9
Sub-total, support positions...	22	19	19
Total, permanent positions.....	22	19	19
Other Positions:			
Positions under cooperative training agreements.....	---	---	---
Other temporary positions.....	---	3	3
Total, all positions.....	22	22	22

Personnel requirements

The mission of the Pacific Launch Operations Office is to administratively support the NASA missions launched from the Western Test Range. Requirements for personnel remain constant although three personnel shown as permanent in FY 1964 are reflected as temporary in FY 1965 and FY 1966.

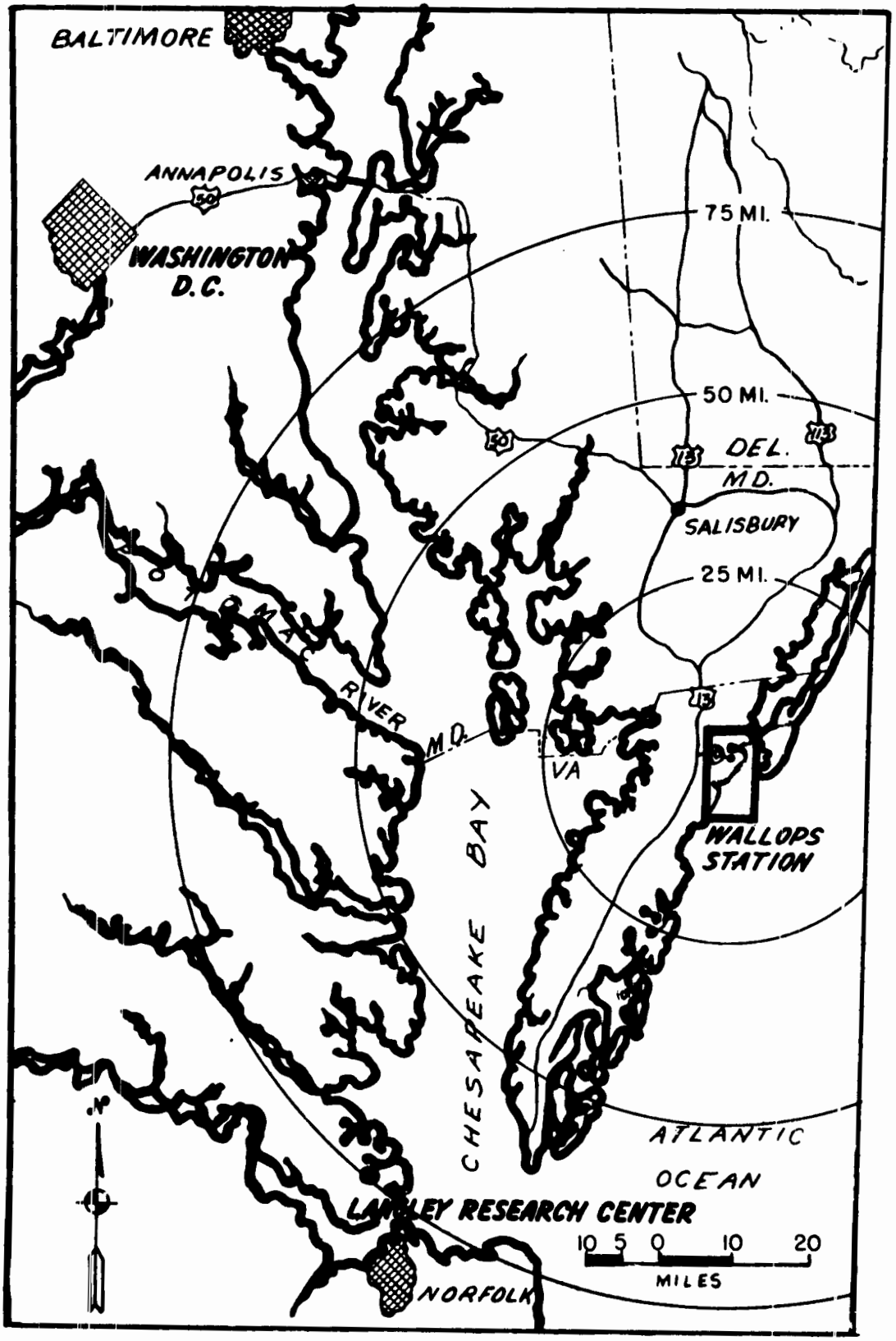
Personnel Costs

	1964	1965	1966
Total Positions	22	22	22
Permanent	22	19	19
Other	--	3	3
Personnel Compensation:			
Annual cost of permanent positions	$194,000	$208,000	$211,000
Pay above the stated annual rate	2,000	1,000	1,000
Lapses (deduct)	-13,000	-6,000	-1,000
Net cost of permanent positions.	183,000	203,000	211,000
Other personnel compensation	10,000	28,000	23,000
Total compensation	193,000	231,000	234,000
NASA funded	193,000	231,000	234,000
Reimbursable	---	---	---
Personnel benefits	12,000	16,000	16,000
NASA funded	12,000	16,000	16,000
Reimbursable	---	---	---
Total personnel costs	205,000	247,000	250,000
NASA funded	205,000	247,000	250,000
Reimbursable	---	---	---
Average Number of All Employees (Man Years)	22	22	22

The FY 1966 estimate increase results from within grade salary increases, reduction in lapse since the full complement is expected to be on-board during the entire year, offset by a decrease in compensation for temporary employment and a decrease in overtime requirements.

The other requirements for the Pacific Launch Operations Office in FY 1966 are $34,000 less than in FY 1965. This is due primarily to a reduction of $22,000 in lands and structures, brought about by changes in requirements for minor construction. There is also a reduction of $10,000 in travel and transportation of persons due to reduced travel requirements.

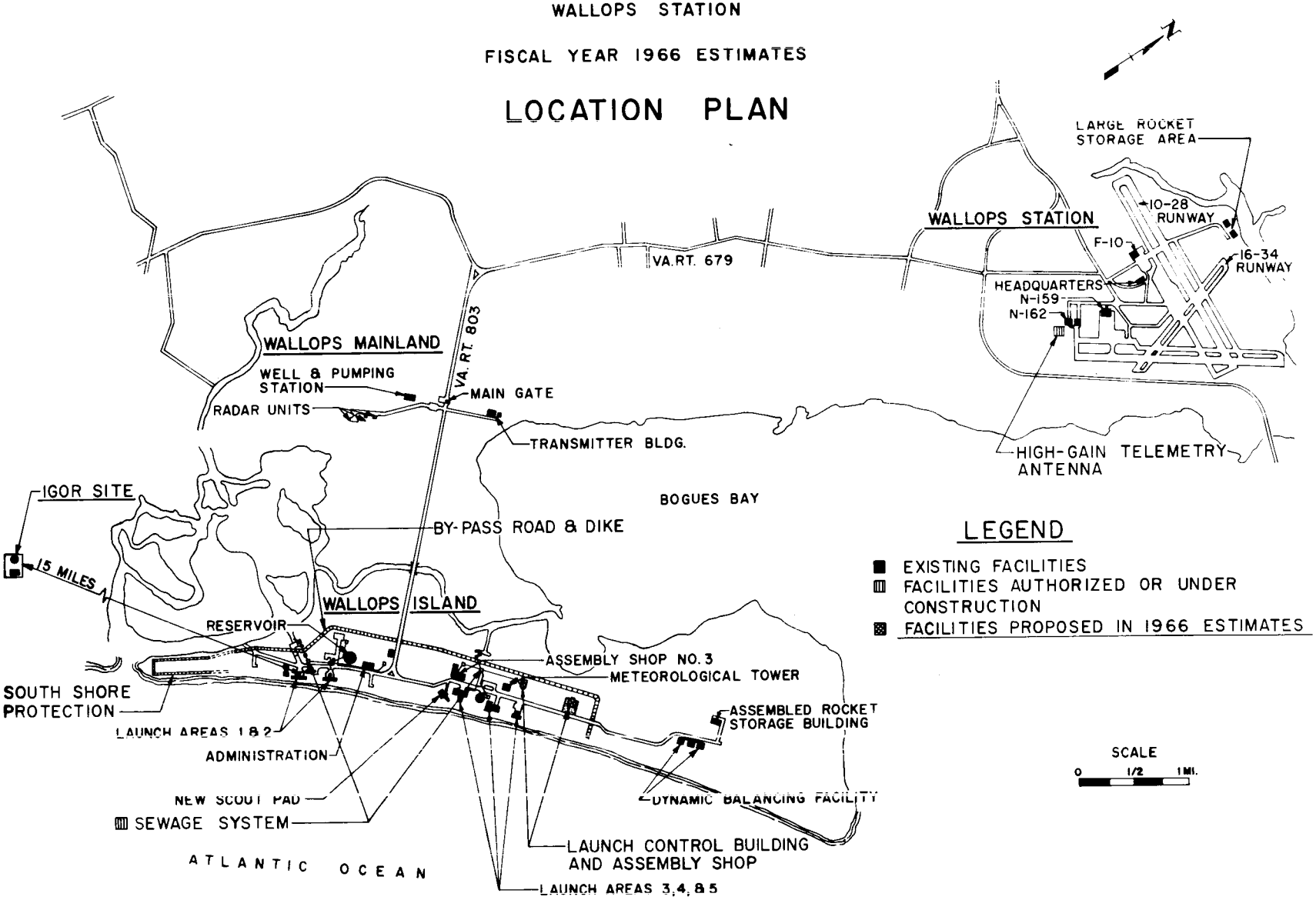
WALLOPS STATION LOCATION



WALLOPS STATION

FISCAL YEAR 1966 ESTIMATES

LOCATION PLAN



LEGEND

- ■ EXISTING FACILITIES
- ▥ FACILITIES AUTHORIZED OR UNDER CONSTRUCTION
- ▩ FACILITIES PROPOSED IN 1966 ESTIMATES

SCALE

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AO 2-19

Aerial View of Wallops Station

Aerial View of Radars Mainland - Spandar, MIT, FPQ6

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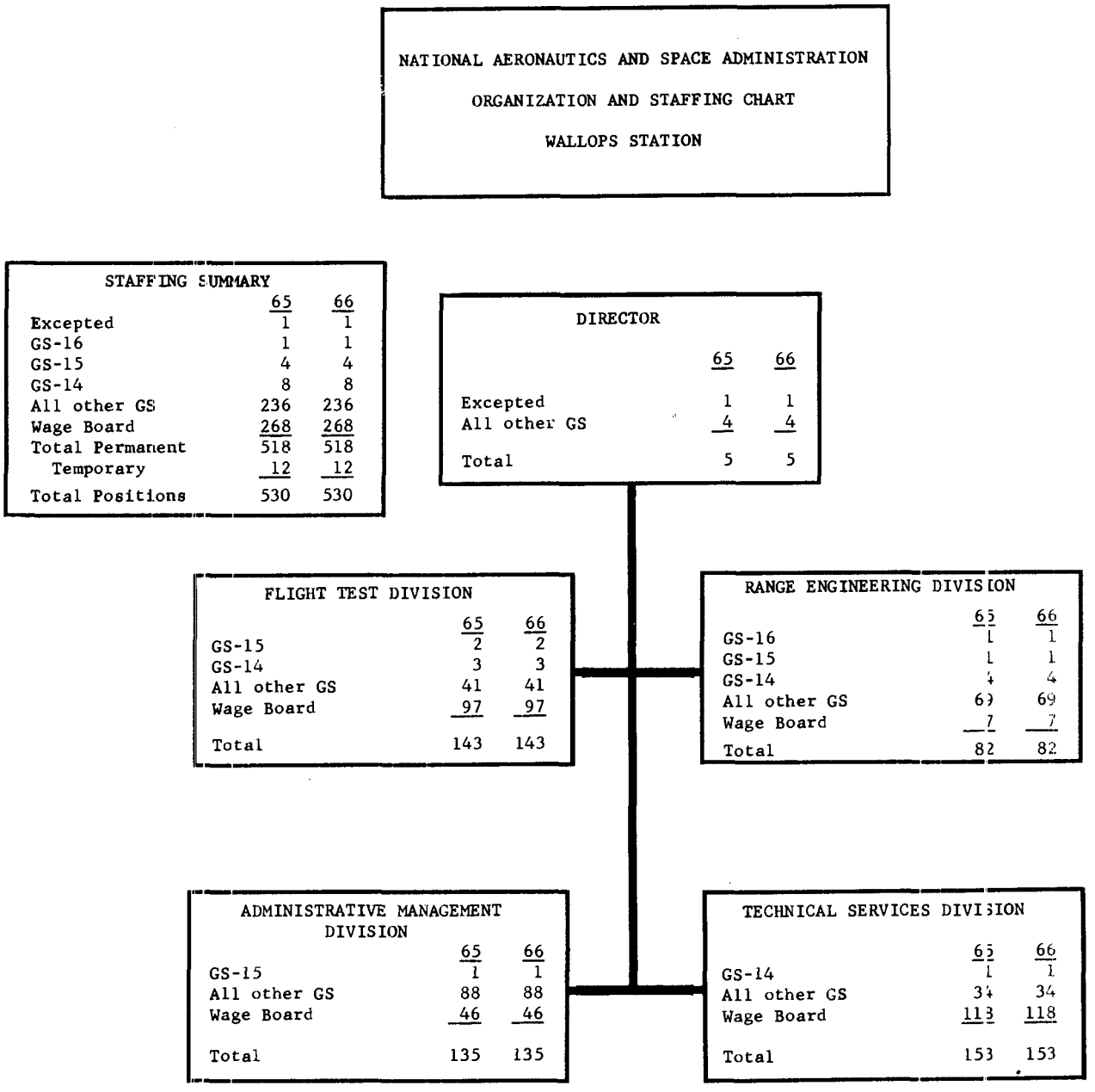
AO 2-22

Aerial view of Wallops Island south looking north

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ORGANIZATION AND STAFFING CHART

WALLOPS STATION



ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

WALLOPS STATION

MISSION AND CAPABILITIES:

Wallops Island was first established as a launch site in 1945 and designated as the Pilotless Aircraft Research Station of the National Advisory Committee for Aeronautics. Its early mission included wind tunnel and laboratory investigations which explored the aerodynamic problems of flight. The Research Station was redesignated as Wallops Station when the National Aeronautics and Space Administration was established in 1958.

Wallops Station is one of the most active launch sites in the world. There have been, since 1945, more than 5,000 research vehicles launched which provided scientific and technical data ranging from flight characteristics of aircraft, launch vehicles and spacecraft to information on the upper atmosphere and the space environment. The Station has the ability to launch vehicles ranging in size from the small Hasp meteorological rocket to the four stage Scout which has orbital capability. Wallops launches about 300 vehicles a year including re-entry spacecraft, sounding rockets and scientific satellites. Past achievements include successful launches of two scientific satellites in conjunction with the United Kingdom; the orbiting of Explorer XXIII, which is measuring micrometeoroid activity in the environment of outer space; the launching of SERT I, the first U.S. test in space of an electric ion engine; and the launching of San Marco I for the Italian Government.

The basic mission of Wallops Station is to plan and conduct the integration, test, checkout and launch of space probes and to track, acquire, record, reduce and analyze the data which is sought. In addition, Wallops is responsible for conducting recovery operations for sub-orbital launches; assisting and training foreign nationals in launch techniques; assisting in tracking and acquiring data on spacecraft launched from other facilities; providing project management for specific flight projects; and providing necessary administration and management support for carrying out approved programs.

Project management responsibility for several scientific satellites in the University Explorer class will be undertaken by Wallops Station for the first time in the near future. This responsibility will provide Wallops the unique capability of managing a project from initial design to the ultimate launch, tracking and data acquisition phases.

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Number of Positions, end of year...	530	530	530
Average Number of All Employees....	508	524	524
Administrative Operations.....	$9,715,000	$11,442,000	$9,800,000

INSTALLATION DESCRIPTION:

Wallops Station consists of three separate areas on the Atlantic Coast of Virginia's eastern shore: The main base (formerly a Naval Air Station), the Wallops Island Launching site and the Wallops mainland. The Administrative Offices, the Range Control Center, support shops and the main telemetry building are located on the main base. Wallops Island is about seven miles southeast of the main base and is connected by a causeway and bridge. The Island is about five miles long and its widest point is only one-half mile. Located on the Island are rocket storage buildings, blockhouses, assembly shops and the launch sites. The Wallops mainland is a one-half mile strip west of the Island and houses the radar and optical tracking sites. Wallops Station, totalling 6,561 acres, consists of 2,313 acres on the main base, 108 acres on the mainland area, 3,000 acres on the island, and 1,140 acres of unusable marsh land. This land is government owned and the total capital investment as of June 30, 1964 was $42,978,000.

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION:

		1964	1965	1966
11.	Personnel Compensation.....	$3,806,000	$4,361,000	$4,361,000
12.	Personnel Benefits.....	268,000	313,000	313,000
	Total Personnel Costs....	$4,074,000	$4,674,000	$4,674,000
21.	Travel and Transportation of Persons.....	140,000	160,000	160,000
22.	Transportation of Things...	65,000	83,000	83,000
23.	Rents, Communications, and Utilities.....	485,000	626,000	465,000
24.	Printing and Reproduction..	-	15,000	15,000
25.	Other Services.....	915,000	1,233,000	1,633,000
	Services of other agencies	17,000	50,000	50,000
26.	Supplies and Materials.....	1,344,000	1,234,000	1,234,000
31.	Equipment.....	1,017,000	2,546,000	760,000
32.	Lands and Structures.....	1,658,000	820,000	725,000
41.	Grants, Subsidies and Contributions.....	-	1,000	1,000
42.	Insurance Claims and Indemnities.....	-	-	-
	Total.....	$9,715,000	$11,442,000	$9,800,000

JUSTIFICATION BY OBJECT CLASSIFICATION:

Personnel Distribution

	1964	1965	1966
Direct Personnel by Program			
Space Science and Applications			
Meteorological satellites	19	20	20
Physics and astronomy	60	66	66
Advanced Research and Technology			
Space vehicle systems	19	19	19
Electronics systems	8	8	8
Basic research	12	12	12
Solar and chemical power	16	17	17
Aeronautics	17	17	17
Tracking and Data Acquisition	43	42	42
Sub-total, direct positions	194	201	201
Support Personnel			
Director and staff	5	5	5
Administration	74	65	65
Research and development support	243	247	247
Sub-total, support positions	322	317	317
Total, permanent positions	516	518	518
Other positions:			
Positions under cooperative training agreements	12	12	12
Other temporary positions	2	-	-
Total, all positions	530	530	530

Personnel Costs

	1964	1965	1966
Total Positions	530	530	530
Permanent	516	518	518
Other	14	12	12
Personnel Compensation:			
Annual cost of permanent positions...	$3,586,000	$3,904,000	$3,904,000
Pay above the stated annual rate.....	28,000	15,000	15,000
Lapses (deduct).....	-235,000	-81,000	-81,000
Net cost of permanent positions.....	3,379,000	3,838,000	3,838,000
Other personnel compensation.....	427,000	523,000	523,000
Total compensation.....	3,806,000	4,361,000	4,361,000
NASA funded.....	3,806,000	4,361,000	4,361,000
Reimbursable.....	-	-	-
Personnel benefits.....	268,000	313,000	313,000
NASA funded.....	268,000	313,000	313,000
Reimbursable.....	-	-	-
Total personnel costs.....	4,074,000	4,674,000	4,674,000
NASA funded.....	4,074,000	4,674,000	4,674,000
Reimbursable.....	-	-	-
Average Number of All Employees (Man Years).....	508	524	524

The Wallops Station requirements for FY 1966 are $1,642,000 less than in FY 1965. This is due primarily to a reduction of $1,786,000 in equipment and $161,000 in rents, communications and utilities. Both decreases were the result of the purchase of a general purpose computer during FY 1965. The purchase was funded under equipment in FY 1965 and resulted in a decrease in rental during FY 1966. There is also a decrease of $95,000 in lands and structures due to a reduction in minor construction requirements in FY 1966. These reductions are offset by an increase of $400,000 in other services, required for increased maintenance and repair of aging facilities and to cover increased contractual shop support related to the installation and maintenance of special launch equipment.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ORGANIZATION AND STAFFING CHART

NASA HEADQUARTERS

STAFFING SUMMARY

NASA-Wide	65	66
Excepted	170	169
GS-16	39	39
GS-15	384	384
GS-14	302	302
All other GS	1,242	1,243
Wage Board	19	19
Total	2,156	2,156
Temporary	65	65
Total Positions	2,221	2,221

ADMINISTRATOR

	65	66
Excepted	5	5
GS-16	-	-
GS-15	-	-
GS-14	-	-
All other GS	7	7
Wage Board	1	1
Total	13	13

LEGISLATIVE AFFAIRS

	65	66
Excepted	3	3
GS-16	-	-
GS-15	4	4
GS-14	2	2
All other GS	20	20
Wage Board	1	1
Total	30	30

INTERNATIONAL AFFAIRS

	65	66
Excepted	2	2
GS-16	1	1
GS-15	3	3
GS-14	-	-
All other GS	21	21
Wage Board	-	-
Total	27	27

EXECUTIVE SECRETARIAT

	65	66
Excepted	1	1
GS-16	-	-
GS-15	2	2
GS-14	3	3
All other GS	29	29
Wage Board	-	-
Total	35	35

POLICY PLANNING

	65	66
Excepted	4	4
GS-16	-	-
GS-15	4	4
GS-14	3	3
All other GS	13	13
Wage Board	-	-
Total	24	24

TECHNOLOGY UTILIZATION

	65	66
Excepted	3	3
GS-16	-	-
GS-15	10	10
GS-14	11	11
All other GS	53	53
Wage Board	-	-
Total	77	77

GENERAL COUNSEL

	65	66
Excepted	5	5
GS-16	-	-
GS-15	11	11
GS-14	8	8
All other GS	27	27
Wage Board	-	-
Total	51	51

PUBLIC AFFAIRS

	65	66
Excepted	3	3
GS-16	-	-
GS-15	16	16
GS-14	23	23
All other GS	73	73
Wage Board	-	-
Total	115	115

ASSOCIATE ADMINISTRATOR

	65	66
Excepted	3	3
GS-16	-	-
GS-15	2	2
GS-14	2	2
All other GS	8	8
Wage Board	-	-
Total	15	15

INDUSTRY AFFAIRS

	65	66
Excepted	5	5
GS-16	1	1
GS-15	15	15
GS-14	25	25
All other GS	79	79
Wage Board	-	-
Total	125	125

PROGRAMMING

	65	66
Excepted	7	7
GS-16	-	-
GS-15	15	15
GS-14	15	15
All other GS	50	50
Wage Board	-	-
Total	87	87

DEFENSE AFFAIRS

	65	66
Excepted	3	3
GS-16	-	-
GS-15	1	1
GS-14	1	1
All other GS	5	5
Wage Board	-	-
Total	10	10

ADMINISTRATION

NASA-Wide	65	66
Excepted	10	10
GS-16	1	1
GS-15	43	43
GS-14	50	50
All other GS	181	185
Wage Board	-	-
Total	285	289

Headquarters Operations		
Excepted	4	4
GS-16	-	-
GS-15	4	4
GS-14	6	6
All other GS	201	197
Wage Board	17	17
Total	229	225

DSACASR*

	65	66
Excepted	-	-
GS-16	-	-
GS-15	1	1
GS-14	11	11
All other GS	8	8
Wage Board	-	-
Total	20	20

TRACKING AND DATA ACQUISITION

	65	66
Excepted	5	5
GS-16	2	2
GS-15	20	20
GS-14	7	7
All other GS	26	26
Wage Board	-	-
Total	60	60

MANNED SPACE FLIGHT

	65	66
Excepted	44	43
GS-16	7	7
GS-15	120	120
GS-14	84	84
All other GS	206	207
Wage Board	-	-
Total	461	461

SPACE SCIENCE AND APPLICATIONS

	65	66
Excepted	33	33
GS-16	14	14
GS-15	53	53
GS-14	26	26
All other GS	144	144
Wage Board	-	-
Total	270	270

ADVANCED RESEARCH AND TECHNOLOGY

	65	66
Excepted	33	33
GS-16	13	13
GS-15	60	60
GS-14	25	25
All other GS	91	91
Wage Board	-	-
Total	222	222

* NASA Staffing for:

Defense Supply Agency Contract Administration Services Regions

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ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

NASA HEADQUARTERS

MISSION AND CAPABILITIES:

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

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

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

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

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

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

The Office of Manned Space Flight - Responsible for all NASA activities directly involving manned space flight missions. Programs include Gemini - to develop an operational capability to fly a two-man spacecraft in near-earth orbit for periods up to fourteen days and to learn new techniques, including rendezvous, docking and extra-vehicular activity; Apollo - to develop a three-man operational capability in near-earth orbit, in lunar environment, including manned landing on the lunar surface, and return to earth; and Advanced Missions - to plan a broad program of exploration which will achieve and maintain a position of space leadership for the United States.

This office also has overall institutional responsibility for the three installations primarily concerned with the manned Space flight programs. These installations are: George C. Marshall Space Flight Center, including Mississippi Test Facility, Michoud Plant, and at Slidell where a computer facility is located; the Manned Spacecraft Center, including NASA activities at the White Sands Missile Range; and the John F. Kennedy Space Center.

The Office of Space Science and Applications - Responsible for all NASA programs for the unmanned scientific investigation of space with sounding rockets, earth satellites, and deep space probes to the moon, planets and interplanetary space and for the scientific experiments to be conducted by man in space; for research and development of useful applications of space flight in the areas of meteorology, communications, navigation, geodesy, and for the support of operational systems using these developments; for the development and procurement of the light and medium class of launch vehicles up to and including the Atlas/Centaur; and for the sustaining university program.

In addition to the foregoing, this Office has overall institutional responsibility for the installations primarily involved in carrying out NASA's space science and applications programs. These installations are: Goddard Space Flight Center, Wallops Station, Pacific Launch Operations Office; and the NASA Resident Office at JPL, which administers the NASA contract with the California Institute of Technology for the operation of the Jet Propulsion Laboratory.

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

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

The Office of Tracking and Data Acquisition - Responsible for the development, implementation, and operation of tracking, data acquisition, communications, and data processing facilities, systems,

and services required for NASA flight programs. In addition, the Office is responsible for the agency-wide coordination of the management of automatic data processing.

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Number of Positions, end of year.	2,133	2,221	2,221
Average Number of All Employees..	1,944	2,070	2,150
Administrative Operations:			
NASA Headquarters.....	$49,115,000	$52,668,000	$56,103,000
Jet Propulsion Laboratory (purchase of computers).....	---	20,587,000	---
Total, Administrative Operations.....	$49,115,000	$73,255,000	$56,103,000

INSTALLATION 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 space leased in the Universal North Building and a storage area in Virginia, personnel occupy Government-owned buildings.

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION:

	1964	1965	1966
11. Personnel Compensation.....	$22,302,000	$25,897,000	$26,822,000
12. Personnel Benefits.....	1,678,000	1,834,000	1,912,000
Total, personnel costs....	$23,980,000	$27,731,000	$28,734,000
21. Travel and Transportation of Persons.....	2,607,000	2,634,000	2,627,000
22. Transportation of Things....	456,000	460,000	281,000
23. Rents, Communications, and Utilities.....	1,969,000	2,058,000	2,218,000
24. Printing and Reproduction...	1,233,000	1,640,000	1,701,000
25. Other Services.....	17,747,000	16,767,000	19,875,000
26. Supplies and Materials.....	566,000	421,000	414,000
31. Equipment.....	555,000	21,534,000[a/]	243,000

a/ Includes $20,587,000 for purchase of ADP equipment for the Jet Propulsion Laboratory, Pasadana, California.

	1964	1965	1966
32. Land and Structures	1,000	---	---
42. Insurance Claims and Indemnities.....	1,000	10,000	10,000
Total.....	$49,115,000	$73,255,000	$56,103,000

The above estimates, other than for personnel compensation and benefits and travel, have been distributed between NASA-wide support functions with all centers benefiting and for operation of Headquarters. The following table shows this comparison by object classification.

Analysis of Funding for NASA-wide Support and Headquarters Operations

Object Class	FY 1965 Total	FY 1965 NASA-wide Support	FY 1965 Hdqrts. Operat.	FY 1966 Total	FY 1966 NASA-wide Support	FY 1966 Hdqrts. Operat.
	(In thousands of dollars)					
22. Transportation of Things.....	$460	$400	$60	$281	$221	$60
23. Rents, Communications and Utilities.....	2,058	882	1,176	2,218	1,116	1,102
24. Printing and Reproduction..	1,640	1,454	186	1,701	1,511	190
25. Other Services..	16,767	15,592	1,175	19,875	18,646	1,229
26. Supplies and Materials.....	421	30	391	414	23	391
31. Equipment.....	21,534	20,699[a/]	835	243	74	169
32. Lands and Structures.....	---	---	---	---	---	---
42. Insurance Claims and Indemnities.....	10	---	10	10	---	10
Total.....	$42,890	$39,057	$3,833	$24,742	$21,591	$3,151

a/ Includes $20,587,000 for purchase of ADP equipment for the Jet Propulsion Laboratory, Pasadena, California.

JUSTIFICATION BY OBJECT CLASSIFICATION:

Personnel Distribution

	1964	1965	1966
Direct Personnel by Program			
Manned Space Flight			
Gemini	73	104	104
Apollo	286	297	297
Advanced missions	60	60	60
Space Science and Applications			
Bioscience	23	23	23
Sustaining university program	68	73	73
Physics and astronomy	56	52	52
Lunar and planetary exploration	54	57	57
Communication satellites	14	10	9
Launch vehicle development	12	13	13
Meteorological satellites	20	20	20
Launch vehicle procurement	14	14	14
Applications technology satellites	3	8	9
Advanced Research and Technology			
Nuclear rockets	27	28	28
Nuclear-electric systems	4	4	4
Chemical propulsion	21	21	21
Space vehicle systems	44	46	46
Electronics systems	35	35	35
Aeronautics	22	26	26
Human factor systems	22	23	23
Basic research	26	27	27
Solar and chemical power	10	12	12
Tracking and Data Acquisition	51	60	60
Technology Utilization	14	13	13
Sub-total, direct positions	959	1,026	1,026

	1964	1965	1966
Support personnel:			
NASA-wide support	865	901	905
Administration	267	229	225
Sub-total, support positions	1,132	1,130	1,130
Total, permanent positions	2,091	2,156	2,156
Other positions:			
Positions under cooperative training agreements	---	---	---
Other temporary positions	42	65	65
Total, all positions	2,133	2,221	2,221

Personnel Costs

	1964	1965	1966
Total Positions	2,133	2,221	2,221
Permanent	2,091	2,156	2,156
Other	42	65	65
Personnel Compensation:			
Annual cost of permanent positions	$22,249,000	$25,652,000	$25,645,000
Pay above the stated annual rate	160,000	99,000	99,000
Lapses (deduct)	-1,448,000	-1,272,000	-355,000
Net cost of permanent positions	20,961,000	24,479,000	25,389,000
Other personnel compensation	1,341,000	1,418,000	1,433,000
Total compensation	22,302,000	25,897,000	26,822,000
NASA funded	22,302,000	25,897,000	26,822,000
Reimbursable	---	---	---
Personnel benefits	1,678,000	1,834,000	1,912,000
NASA funded	1,678,000	1,834,000	1,912,000
Reimbursable	---	---	---
Total personnel costs	23,980,000	27,731,000	28,734,000
NASA funded	23,980,000	27,731,000	28,734,000
Reimbursable	---	---	---
Average Number of All Employees (Man Years)	1,944	2,070	2,150

Personnel Costs - $28,734,000

The personnel costs for FY 1966 are estimated to be $1,003,000 above the requirement for FY 1965, of which $925,000 is for personnel compensation and $78,000 for personnel benefits, to cover the cost of 80 man years resulting from full year employment in FY 1966 of personnel hired in FY 1965.

Travel and Transportation of Persons - $2,627,000

There is a slight decrease below the FY 1965 level for travel and transportation of persons during FY 1966. The estimate includes $2,322,000 for NASA employee travel, of which, $2,150,000 will be used for direction and coordination of program and administrative activities; $107,000 for the contract charter airlift service; $30,000 for costs relating to initial duty stations, temporary assignments and transfers; and $35,000 for meetings of NASA technical committees and working panels. The balance of $305,000 is for non-NASA employee travel of technical and research advisory committees; and for costs of local transportation and rental of passenger motor vehicles.

Transportation of Things - $281,000

The FY 1966 estimate for transportation of things is projected at $179,000 below the FY 1965 level primarily as a result of a reduction in the transportation of exhibits and for cargo airlift costs.

The requirement of $281,000 in FY 1966 under this object class includes $140,000 for the domestic and overseas shipment of exhibits and spacemobiles; $42,000 for the "cargo" portion of the charter airlift service; $56,000 for costs of transportation of household goods and personal effects; and $43,000 for freight, express, drayage and parcel post costs of shipments to NASA installations, and rental of trucks from GSA.

The distribution of $281,000 in FY 1966 includes $221,000 for NASA-wide support and $60,000 for Headquarters operations.

Rents, Communications, and Utilities - $2,218,000

The FY 1966 estimate for rents and communications reflects a net increase of $160,000 over FY 1965 -- $107,000 for rents and $53,000 for communications.

The net increase of $107,000 for rents includes: 1) an increase of $278,000 for rental of space to house the NASA Scientific and Technical Information Facility on a full year basis in FY 1966. This space will be acquired through the General Services Administration during the latter part of FY 1965. In previous years, the rental of space was included as a part of the contract with Documentation, Inc.; and 2) a decrease of $171,000 for rental of ADP equipment.

The increase of $53,000 for communications costs reflects minor increases for local telephone and exchange services, Federal Telecommunications systems lines, telegraph and TWX service and for postage costs.

The request of $2,218,000 in FY 1966 includes $1,116,000 for NASA-wide support and $1,102,000 for Headquarters operations.

The following table reflects changes for this object classification:

	Increase or Decrease
Rents	$+107,000
Space	+278,000
ADP equipment	-171,000
Other equipment	---
Office equipment	---
Communications	+53,000
Leased lines	-16,000
Local telephone and exchange service	+39,000
Long distance tolls	-10,000
FTS charges	+10,000
Telegraph	+10,000
TWX	+10,000
Postage	+10,000
Total	$+160,000

Printing and Reproduction - $1,701,000

The FY 1966 estimates reflect an increase of $61,000 over FY 1965 for these services. About 89 per cent, or $1,511,000 of the $1,701,000 requested covers printing costs for NASA-wide support activities associated with the scientific and technical documentation programs; such as printing of scientific and technical aerospace reports covering world-wide interdisciplinary report literature in the aerospace field, special publications on research program developments and integrated reports of orbital, lunar, and planetary flights; and proceedings of symposia and conferences on selected scientific topics; and for printing of educational media concerning the Agency's program results in formats suitable for dissemination to the educational community and to the general public. The remaining 11 per cent, or $190,000, is required for Headquarters operations for printing and reproduction of forms, regulations and general printing and reproduction services.

About 93 per cent, or $1,577,000 of the FY 1966 estimate is for printing and allied services which will be performed through Government sources. The remaining 7 per cent, or $124,000, is for printing and photostating to be done by commercial sources.

Other Services - $19,875,000

The FY 1966 estimate for other services is $3,108,000 higher than for FY 1965. The following table shows an analysis of the major increases in this area:

	Increases
NASA scientific and technical information facility	$800,000
Technical documentation program	1,000,000
Scientific information systems development	200,000
Preparation of manuscript material for specialized scientific and technical publications and monographs	490,000
Audio visual processing/depository service	180,000
International graduate fellowship program	170,000
Various minor adjustments in other Headquarters programs and projects	268,000
Total	$3,108,000

Of the net increase of $3,108,000, about 80 per cent, or $2,490,000, is requested for the scientific and technical information program. This includes:

1. $800,000 to provide for the documentation in NASA's contractor-operated Scientific and Technical Information Facility of the greatly increasing volume of scientific and technical data required for direct use in NASA's research and development programs. The FY 1966 workload is expected to be at least 25% greater than the FY 1965 level.

2. $1,000,000 for documentation of world-wide aerospace journal literature, primarily to align the funding of a contract to a full fiscal year basis in FY 1966. In addition, it would provide a small expansion in the program to process this literature for immediate use in the NASA technical programs. The global output of aerospace literature is increasing at an accelerated rate.

3. $200,000 for information systems development to increase the effectiveness of the NASA technical information program and to permit the most economical interchange of NASA computerized documentation output with those of Department of Defense, Atomic Energy Commission, and other government agencies.

4. $490,000 for preparation of manuscript material for specialized scientific and technical publications, handbooks, data compilations, and monographs on aerospace subjects such as radio propagation through re-entry systems, design of meteorological sounding rockets, stabilization standards for interplanetary probes, space probe instrumentation, satellite scientific instrumentation, and launch facilities.

The remaining 20 per cent, or $618,000, includes an increase of $170,000 for the International Graduate Fellowship program sponsored by foreign countries and administered by the National Academy of Sciences; $180,000 for services in connection with the processing, indexing, storage, and distribution of audio visual material including maintenance of control over receipt cataloging and storage of film; and $268,000 for various items such as, reliability and quality assurance studies of selected assessments of hardware design, security reinvestigation program, toxicity studies relating to the NASA-wide occupational medical program, and procurement programs, policies and procedures studies.

Of the total $19,875,000 requested for this object classification in FY 1966, about 94 per cent will be used for NASA-wide activities and 6 per cent for Headquarters Operations.

Supplies and Materials - $414,000

The estimate for FY 1966 for this category is $7,000 less than in FY 1965. Funds requested are for the purchase of expendable and non-expendable items such as: office supplies and materials, pamphlets and documents for the technical documentation and educational services programs, periodical subscriptions for the law and technical libraries, and photographic and drafting supplies.

Of the $414,000 about 6 per cent, or $23,000, is used for NASA-wide activities and 94 per cent, or $391,000 for Headquarters Operations.

Equipment - $243,000

The FY 1966 estimate reflects a reduction from FY 1965 requirements. The principal reason is the non-recurring item of $21,200,000 in FY 1965 for the purchase of ADP equipment ($20,587,000 for the Jet Propulsion Laboratory and $613,000 for NASA Headquarters). In addition, a reduction of $91,000 is estimated for the requirement for the purchase of miscellaneous office and other equipment.

The estimate of $243,000 for office and other equipment in FY 1966 includes $74,000 for the procurement of 10 replacements for existing spacemobiles and for the purchase of models and equipment needed in support of spacemobile lecturers. The balance of $169,000 is required for purchase of office furniture and equipment for Headquarters Operations.

Insurance Claims and Indemnities - $10,000

The FY 1966 requirement is estimated at the same level as for FY 1965. These funds are to cover payment of claims of $2,500 or less under the provisions of 28 U.S.C. 2672 for injury or loss of property, personal injury, or death caused by the negligent or wrongful act or omission of any employee of NASA while acting within the scope of the responsibility of his office or employment.

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

NORTH EASTERN OFFICE

MISSION AND CAPABILITIES:

The North Eastern Office was merged with the Electronics Research Center effective September 1, 1964. The fiscal year 1965 and 1966 requirements of this office are included with the estimates for the Electronics Research Center.

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Number of Positions, end of year.	33	---	---
Average Number of All Employees..	30	---	---
Administrative Operations.....	$379,000	---	---

INSTALLATION DESCRIPTION:

The North Eastern Office was located in Cambridge, Massachusetts.

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION:

		1964	1965	1966
11.	Personnel Compensation.....	$280,000	---	---
12.	Personnel Benefits.....	20,000	---	---
	Total, personnel costs....	$300,000	---	---
21.	Travel and Transportation of Persons.....	27,000	---	---
22.	Transportation of Things....	1,000	---	---
23.	Rents, Communications, and Utilities.....	28,000	---	---
24.	Printing and Reproduction...	4,000	---	---
25.	Other Services.....	3,000	---	---
	Services of other agencies	3,000	---	---
26.	Supplies and Materials.....	10,000	---	---
31.	Equipment.....	3,000	---	---
	Total.....	$379,000	---	---

JUSTIFICATION BY OBJECT CLASSIFICATION:

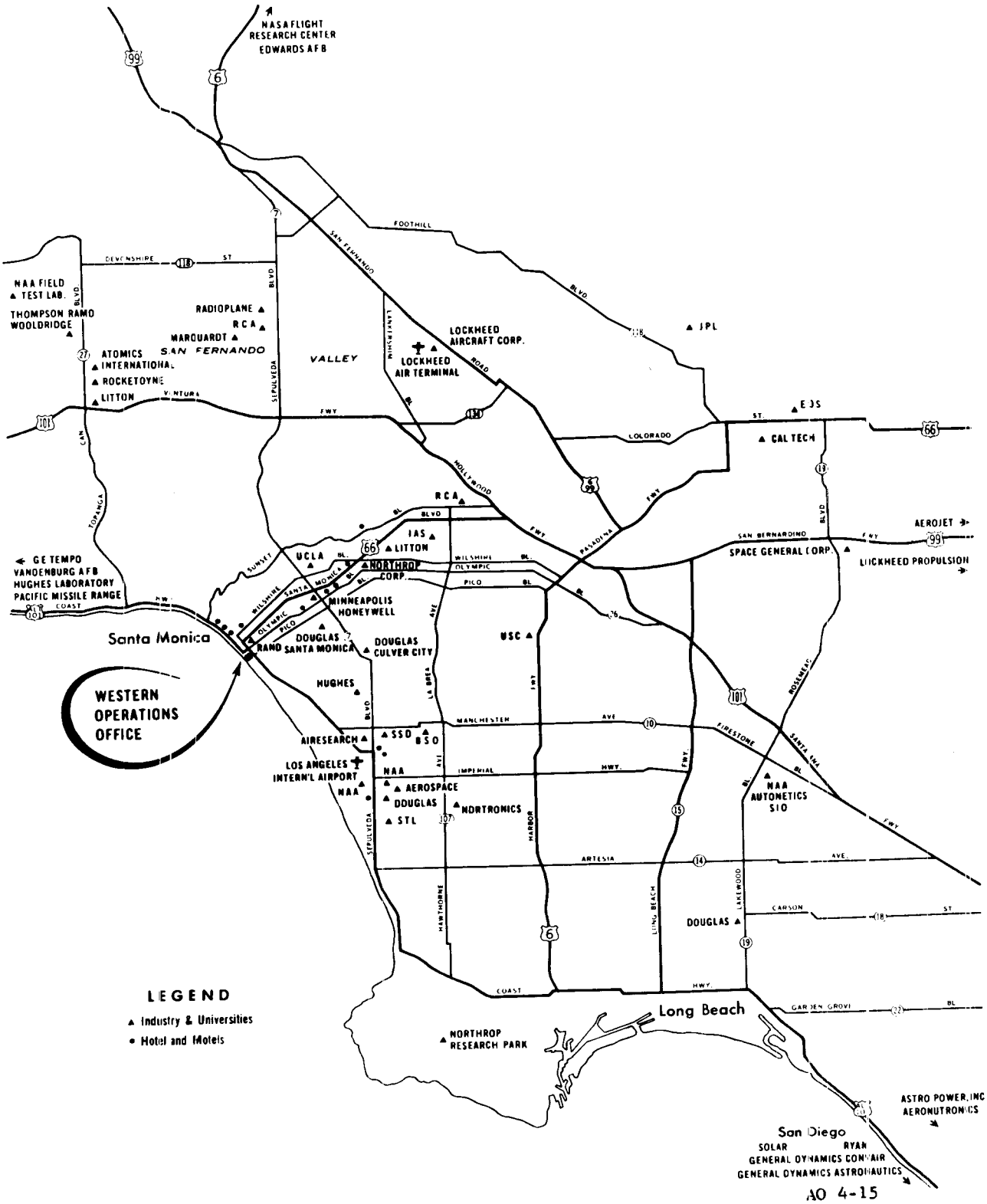
Personnel Distribution

Support personnel

	1964	1965	1966
Director and staff.....	2	---	---
NASA-wide support.....	30	---	---
Sub-total, support positions....	32	---	---
Total, permanent positions.....	32	---	---
Other positions:			
Positions under cooperative training agreements.....	--	---	---
Other temporary positions.....	1	---	---
Total, all positions.....	33	---	---

Personnel Costs

	1964	1965	1966
Total Positions.....	33	---	---
Permanent.....	32	---	---
Other.....	1		
Personnel Compensation:			
Annual cost of permanent positions	$305,000	---	---
Pay above the stated annual rate..	2,000	---	---
Lapses (deduct).....	-39,000	---	---
Net cost of permanent positions...	268,000	---	---
Other personnel compensation.....	12,000	---	---
Total compensation.....	280,000	---	---
NASA funded.....	280,000	---	---
Reimbursable.....	---	---	---
Personnel benefits.....	20,000	---	---
NASA funded.....	20,000	---	---
Reimbursable.....	---	---	---
Total personnel costs.....	300,000	---	---
NASA funded.....	300,000	---	---
Reimbursable.....	---	---	---
Average Number of All Employees (Man Years).....	30	---	---


NASA FLIGHT RESEARCH CENTER EDWARDS AFB
NAA FIELD TEST LAB.
THOMPSON RAMO WOOLDRIDGE
RADIOPLANE
RCA
MARQUARDT
ATOMICS INTERNATIONAL
ROCKETOYNE
LITTON
SAN FERNANDO VALLEY
LOCKHEED AIRCRAFT CORP.
LOCKHEED AIR TERMINAL
JPL
EDS
CAL TECH
RCA
IAS
LITTON
UCLA
NORTHROP CORP.
MINNEAPOLIS HONEYWELL
DOUGLAS SANTA MONICA
RAND
DOUGLAS CULVER CITY
USC
HUGHES
AIRESEARCH
SSD
BSO
LOS ANGELES INTERN'L AIRPORT
NAA
AEROSPACE
DOUGLAS
STL
NORTRONICS
NAA AUTONETICS S10
DOUGLAS
AEROJET
SPACE GENERAL CORP.
LOCKHEED PROPULSION
GE TEMPO
VANDENBURG AFB
HUGHES LABORATORY
PACIFIC MISSILE RANGE
Santa Monica
WESTERN OPERATIONS OFFICE
NORTHROP RESEARCH PARK
Long Beach
ASTRO POWER, INC
AERONUTRONICS
San Diego
SOLAR
RYAN
GENERAL DYNAMICS CONVAIR
GENERAL DYNAMICS ASTRONAUTICS
LEGEND
▲ Industry & Universities
• Hotel and Motels

AO 4-15

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ORGANIZATION AND STAFFING CHART

WESTERN OPERATIONS OFFICE

STAFFING SUMMARY

	65	66
Excepted	3	3
GS-16	1	1
GS-15	15	15
GS-14	49	49
All other GS	333	333
Wage Board	-	-
Total Permanent	401	401
Temporary	5	5
Total	406	406

PROFESSIONAL STAFFING

	65	66
Other GS	2	2
Total	2	2

DIRECTOR

	65	66
Excepted	2	2
Other GS	5	5
Total	7	7

NASA RESIDENCY OFFICE - JPL

	65	66
GS-15	7	7
GS-14	6	6
All other GS	14	14
Total	27	27

NASA-O

	65	66
GS-15	2	2
GS-14	6	6
Other GS	129	129
Total	137	137

CONTRACT MANAGEMENT

	65	66
Excepted	1	1
GS-15	-	-
GS-14	6	6
Other GS	48	48
Total	55	55

TECHNICAL DIVISION

	65	66
GS-16	1	1
GS-15	4	4
GS-14	25	25
Other GS	52	52
Total	82	82

LEGAL DIVISION

	65	66
GS-15	2	2
GS-14	4	4
Other GS	4	4
Total	10	10

FINANCIAL MANAGEMENT DIVISION

	65	66
GS-14	1	1
Other GS	23	23
Total	24	24

EDUCATIONAL PROGRAMS

	65	66
GS-14	1	1
Other GS	3	3
Total	4	4

ADMINISTRATIVE SERVICES

	65	66
Other GS	38	38
Total	38	38

PUBLIC INFORMATION

	65	66
Other GS	6	6
Total	6	6

PERSONNEL DIVISION

	65	66
Other GS	9	9
Total	9	9

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ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

WESTERN OPERATIONS OFFICE

MISSION AND CAPABILITIES:

The primary mission of the Western Operations Office is to provide technical, contractual, and administrative support to NASA field centers and NASA Headquarters for programs and projects located in Southern California and other areas west of Denver. The Western Operations Office functions as a field service in such areas as procurement, technical and contract administration, legal and patent reviews, and personnel, administrative support, and financial management activities in the area west of Denver.

Technical management support as assigned by field centers and NASA project managers includes the technical management and administration of research and development and facilities contracts; monitoring of related quality assurance requirements; quality assurance surveys of industrial plants and organizations; monitoring of advanced technology contracts; negotiation of contracts; procurement of pressurants and propellants for NASA and contractor requirements; and the operation of a contract administration and quality assurance organization for the Apollo and Saturn projects at the North American Aviation, Inc., plant at Downey, California.

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

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Number of Positions, end of year...	376	406	406
Average Number of All Employees....	336	390	405
Administrative Operations.....	$4,924,000	$5,989,000	$6,337,000

INSTALLATION DESCRIPTION:

The main Western Operations Office is located at 150 Pico Boulevard, Santa Monica, California. The Office occupies a group of leased buildings and no Government investment in buildings or acreage is involved at this location. In about two years, the main office will move to a new GSA Federal Office Building to be constructed in nearby West Los Angeles.

Over one-third of the Western Operations Office staff is located in Government-owned facilities at Downey, California, which are currently being utilized by the Space Information Systems Division of North American Aviation, Inc. The Government-owned portion of the North American Aviation Downey complex is located on 166 acres and the land and plant acquisition value is approximately $44 million as of June 30, 1964. The responsibility for management of property and facilities was transferred from the Air Force to NASA on July 1, 1964. A few additional Western Operations personnel are assigned to other contractor locations within the Los Angeles area where full time project support is required. The map on page AO 4-15 shows the location of the Western Operations Office in the Los Angeles area and the Downey Operations Office is identified therein as NAA Autonetics - SID.

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION:

		1964	1965	1966
11.	Personnel Compensation.....	$3,378,000	$4,155,000	$4,378,000
12.	Personnel Benefits.....	231,000	291,000	304,000
	Total, personnel costs....	$3,609,000	$4,446,000	$4,682,000
21.	Travel and Transportation of Persons.....	243,000	296,000	303,000
22.	Transportation of Things....	13,000	24,000	20,000
23.	Rents, Communications and Utilities.....	315,000	448,000	469,000
24.	Printing and Reproduction...	13,000	17,000	17,000
25.	Other Services.....	456,000	567,000	672,000
	Services of other agencies	173,000	50,000	38,000
26.	Supplies and Materials.....	51,000	65,000	65,000
31.	Equipment.....	51,000	76,000	71,000
32.	Lands and Structures.....	-	-	-
42.	Insurance Claims and Indemnities.....	-	-	-
	Total.....	$4,924,000	$5,989,000	$6,337,000

JUSTIFICATION BY OBJECT CLASSIFICATION:

Personnel Distribution

	1964	1965	1966
Direct Personnel by Program			
Manned Space Flight			
Gemini.....	1	1	1
Apollo.....	146	149	149
Advanced Manned Missions.....	4	4	4

	1964	1965	1966
Space Science and Applications			
Lunar and planetary exploration.....	8	19	19
Communication satellites.....	6	5	5
Launch vehicle development.....	3	4	4
Launch vehicle procurement.....	4	4	4
Meteorological satellites.....	13	15	15
Advanced Research and Technology			
Solar and chemical power.....	27	30	30
Chemical propulsion.....	5	5	5
Space vehicle systems.....	3	3	3
Technology Utilization.....	2	2	2
Sub-total, direct positions.....	222	241	241
Support Personnel			
Director and Staff.....	9	10	10
NASA-wide support.....	144	150	150
Sub-total, support positions.....	153	160	160
Total, permanent positions.....	375	401	401
Other positions:			
Positions under cooperative training agreements.....	-	-	-
Other temporary positions.....	1	5	5
Total, all positions.....	376	406	406

Personnel Costs

	1964	1965	1966
Total Positions.....	376	406	406
Permanent.....	375	401	401
Other.....	1	5	5

	1964	1965	1966
Personnel Compensation:			
Annual cost of permanent positions..	$3,551,000	$4,077,000	$4,078,000
Pay above the stated annual rate....	31,000	16,000	15,000
Lapses (deduct).....	-498,000	-231,000	-1,000
Net cost of permanent positions.....	3,084,000	3,862,000	4,092,000
Other personnel compensation.....	294,000	293,000	286,000
Total compensation.....	3,378,000	4,155,000	4,378,000
NASA funded.....	3,378,000	4,155,000	4,378,000
Reimbursable.....	---	---	---
Personnel benefits.....	231,000	291,000	304,000
NASA funded.....	231,000	291,000	304,000
Reimbursable.....	---	---	---
Total personnel costs.....	3,609,000	4,446,000	4,682,000
NASA funded.....	3,609,000	4,446,000	4,682,000
Reimbursable.....	---	---	---
Average Number of All Employees (Man Years).....	336	390	405

Personnel Compensation and Benefits - $4,682,000

Personnel costs in FY 1966 are estimated to be $236,000 higher than in FY 1965, of which $223,000 is for personnel compensation and $13,000 is for personnel benefits. The higher estimate primarily reflects full year employment in FY 1966 for personnel hired during the last half of FY 1965.

Travel and Transportation of Persons - $303,000

Employee travel requirements are estimated to increase $7,000 in FY 1966 due to a larger professional staff on-board at the end of FY 1965. The total estimate includes $256,000 for the travel of staff personnel. This amount is needed for program and administrative direction and coordination, for attendance at NASA technical meetings and working panels; and for costs of temporary assignments and transfers and travel to initial duty stations. The balance of $47,000 covers expenses of local transportation and toll charges and the rental of passenger motor vehicles from the General Services Administration.

Transportation of Things - $20,000

The FY 1966 estimate is projected $4,000 below the FY 1965 requirements primarily for movement of household goods for new employees and for local drayage costs.

The estimate of $20,000 consists of $14,000 for movement of household and personal effects; $4,000 for commercial shipments by land, water, and air; and $2,000 for local drayage and parcel post.

Rents, Communications and Utilities - $469,000

The estimate of $469,000 for this category is $21,000 higher than for FY 1965. The FY 1966 request includes $190,000 for the commercial lease of real estate and the term rental of equipment. This is the same funding level as the projected FY 1965 requirement. These rental costs cover the lease of 45,120 square feet of building space for $170,000 or an average annual cost of $3.75 a square foot. The balance of the estimate, amounting to $20,000, is needed for the rental of office and other types of equipment.

The cost of communications services is expected to increase $21,000 in FY 1966. The increase includes additional funding of $16,000 for the installation of more leased teletype circuits at the West Coast Communications Center required for effective communication with major project offices located in contractor plants. The remaining $5,000 of the increase is required for local telephone and exchange services. The major categories of communications services requirements are the following:

	FY 1966
Leased lines	$103,000
Long distance tolls	45,000
Local telephone and exchange	90,000
All other communications	30,000
Total	$268,000

The balance of the estimate for FY 1966 is related to the $11,000 required for utilities.

Printing and Reproduction - $17,000

Funding of FY 1966 requirements for the printing and reproduction of technical and administrative reports, publications and forms is expected to remain at the FY 1965 level. Approximately 90 per cent of the estimate, or $15,000, is for commercial printing of technical documents and related materials. The remaining $2,000 will cover printing of administrative and educational materials by other Government agencies.

Other Services - $672,000

The estimate for other services in FY 1966 reflects an increase of $105,000 over FY 1965 requirements, of which $50,000 is for supplementary technical support in evaluating advanced technological data required for accomplishment of mission operations, $42,000 is for enlarging the capacity of the reliable electrical connections school to meet the increasing demand

of aerospace contractors for certified instructors to train their production employees for compliance with more stringent quality assurance requirements. The balance of the increase, amounting to $13,000, will be used to finance the operation of the technical reference library on a full year basis and for various minor contractual services of a non-recurring nature.

The following table shows FY 1966 funding requirements by category of service:

ADP equipment operation	$50,000
Custodial services	19,000
Advanced technology support	50,000
JPL administrative aircraft lease and operation	247,000
Technical reference library	65,000
Reliable electrical connections school	210,000
Miscellaneous minor services	31,000
Total	$672,000

Services of Other Agencies - $38,000

Reimbursable services provided by other Government agencies are estimated to decrease $12,000 in FY 1966 to $33,000 as a result of a projected reduction in the requirement for contract administration services by the NASA resident office at the Jet Propulsion Laboratory. An additional $5,000 is required to support continuation of consulting engineering services to the resident office by the Army Corps of Engineers.

Supplies and Materials - $65,000

The FY 1966 requirement for supplies and materials is expected to remain at the FY 1965 level. $53,000 of the amount requested is for office use; the remaining $12,000 will be used for procurement of expendable electrical, photographic, maintenance and operating supplies. Purchase of non-expendable items will be necessary only for inventory replacement.

Equipment - $71,000

The amount of $71,000 requested is to provide for the purchase of passenger-carrying vehicles, photographic and non-capitalized equipment, and replacement of unserviceable office equipment and furniture. The FY 1966 requirements for these items is $5,000 less than in FY 1965.

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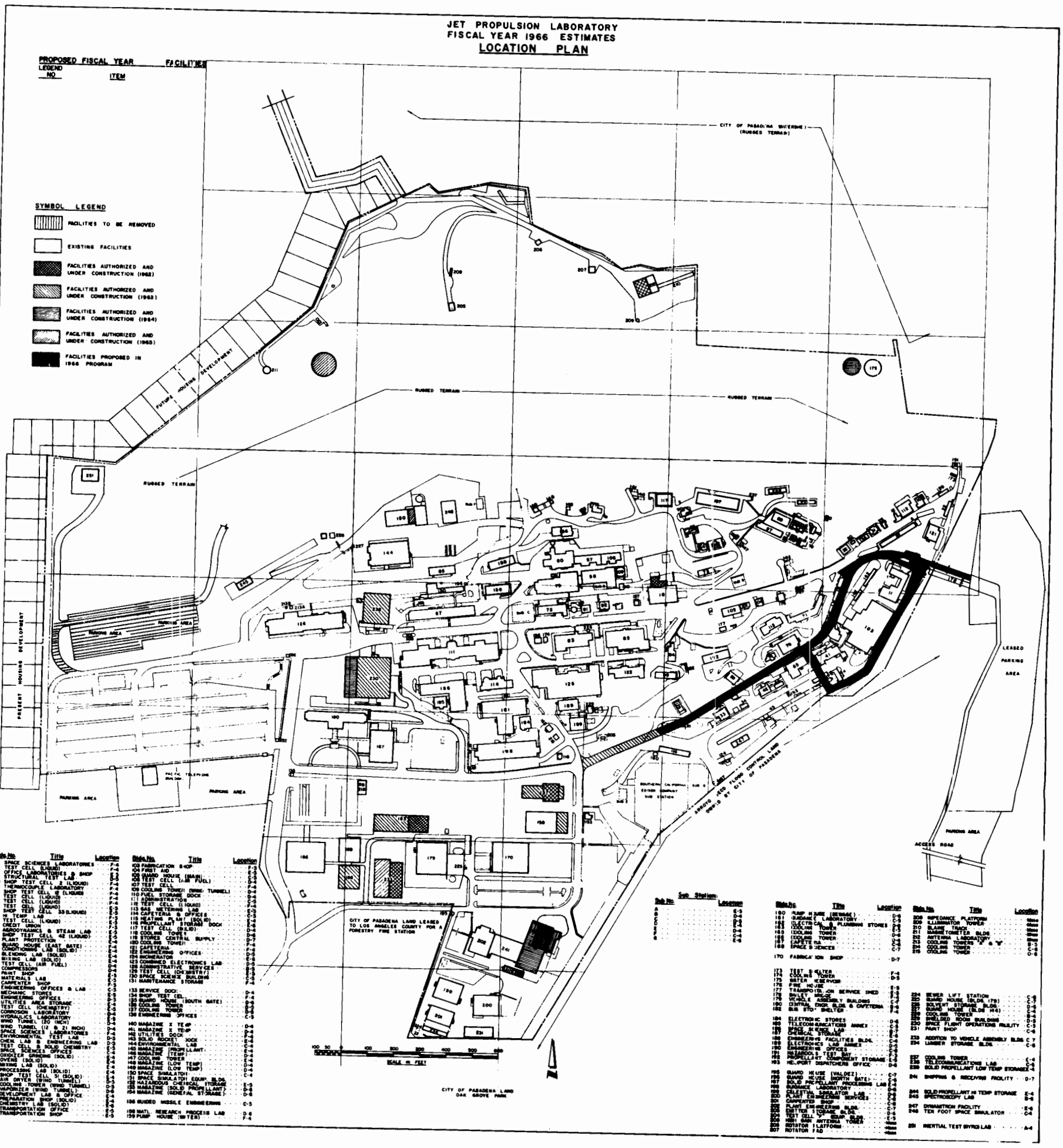
JET PROPULSION LABORATORY
FISCAL YEAR 1966 ESTIMATES
LOCATION PLAN



Bldg. No.	Title	Location
11	SPACE SCIENCES LABORATORIES	F-4
12	TEST CELL (LIQUID)	F-4
15	OFFICE LABORATORIES & SHOP	F-3
16	STRUCTURAL TEST LAB	F-3
20	SHOP TEST CELL 'Z' (LIQUID)	F-4
22	THERMOCOUPLE LABORATORY	F-4
30	SHOP TEST CELL 'B' (LIQUID)	F-4
31	TEST CELL (LIQUID)	F-4
32	TEST CELL (LIQUID)	F-4
33	TEST CELL (LIQUID)	F-4
34	SHOP TEST CELL '33 (LIQUID)	F-4
41	'H' TEMP LAB	F-3
42	TEST CELL (LIQUID)	F-3
44	CREDIT UNION	F-3
45	AERODYNAMICS & STEAM LAB	F-3
46	SHOP TEST CELL '42 (LIQUID)	F-3
47	PLANT PROTECTION	F-3
50	GUARD HOUSE (EAST GATE)	F-3
51	CONDITIONING LAB (SOLID)	F-3
54	BLENDING LAB (SOLID)	F-3
55	MIXING LAB (SOLID)	F-3
57	TEST CELL (AIR FUEL)	F-4
58	COMPRESSORS	F-4
59	PAINT SHOP	F-4
60	MATERIALS LAB	F-4
66	CARPENTER SHOP	F-4
67	ENGINEERING OFFICES & LAB	F-3
71	MECHANIC STORES	F-3
72	ENGINEERING OFFICES	F-3
73	UTILITIES AREA STORAGE	F-3
74	TEST CELL 'CHEMISTRY'	F-3
77	CORROSION LABORATORY	F-3
78	HYDRAULICS LABORATORY	F-3
79	WIND TUNNEL (20 INCH)	F-3
80	WIND TUNNEL (12 & 21 INCH)	F-3
81	SPACE SCIENCES LABORATORIES	F-3
82	ENVIRONMENTAL TEST LAB	F-3
83	CHEM. LAB & ENGINEERING LAB	F-3
84	TEST CELL 'B' SOLID CHEMISTRY	F-3
85	SPACE SCIENCES OFFICES	F-3
86	OXIDIZER GRINDING (SOLID)	F-3
87	OVENS (SOLID)	F-3
88	MIXING LAB (SOLID)	F-3
89	PROCESSING LAB (SOLID)	F-3
90	SHOP TEST CELL 'S' (SOLID)	F-3
91	AIR DRYER (WIND TUNNEL)	F-3
92	COOLING TOWER (WIND TUNNEL)	F-3
93	VAPORIZER (WIND TUNNEL)	F-3
97	DEVELOPMENT LAB & OFFICE	F-3
98	PREPARATION SHOP (SOLID)	F-3
99	CHEMISTRY LAB (SOLID)	F-3
101	TRANSPORTATION OFFICE	F-3
102	TRANSPORTATION SHOP	F-3
103	FABRICATION SHOP	F-3
104	FIRST AID	F-3
105	GUARD HOUSE (MAIN)	F-3
106	TEST CELL (AIR FUEL)	F-4
107	TEST CELL	F-4
108	COOLING TOWER (WIND TUNNEL)	F-3
110	FUEL STORAGE DOCK	F-3
111	ADMINISTRATION	F-3
115	TEST CELL (LIQUID)	F-4
123	GAS METERING LAB	F-3
124	CAFETERIA & OFFICES	F-3
125	HEAT TREAT (SOLID)	F-3
126	PROPELLANT STORAGE DOCK	F-3
127	TEST CELL (SOLID)	F-4
128	COOLING TOWER	F-4
135	STORES CENTRAL SUPPLY	F-3
150	COOLING TOWER	F-3
151	CAFETERIA	F-3
152	ENGINEERING OFFICES	F-3
154	INCINERATOR	F-3
125	COMBINED ELECTRONICS LAB	F-3
126	ADMINISTRATIVE SERVICES	F-3
129	TEST CELL (CHEMISTRY)	F-4
130	SPACE SCIENCES BUILDING	F-3
131	MAINTENANCE & STORAGE	F-3
133	SERVICE DOCK	F-3
134	SHOP TEST CELL	F-4
135	GUARD HOUSE (SOUTH GATE)	F-3
136	COOLING TOWER	F-4
137	COOLING TOWER	F-4
138	ENGINEERING OFFICES	F-3
140	MAGAZINE 'X' TEMP	F-4
141	MAGAZINE 'X' TEMP	F-4
145	UTILITIES DOCK	F-3
153	SOLID FUEL DOCK	F-3
154	ENVIRONMENTAL LAB	F-3
165	MAGAZINE (PROPELLANT)	F-4
166	MAGAZINE (TEMP)	F-4
167	COOLING TOWER	F-4
168	MAGAZINE (LOW TEMP)	F-4
169	MAGAZINE (LOW TEMP)	F-4
170	SPACE SIMULATOR	F-3
171	SPACE SIMULATOR EQUIP. BLDG.	F-3
180	HAZARDOUS CHEMICAL STORAGE	F-3
183	MAGAZINE (SOLID PROPELLANT)	D-6
184	MAGAZINE (GENERAL STORAGE)	D-6
186	GUIDED MISSILE ENGINEERING	C-5
188	MATL. RESEARCH PROCESS LAB	D-6
189	PUMP HOUSE (WATER)	F-4

Sub Station:	
Bldg. No.	Location
A	C-5
B	C-5
C	D-5
D	D-5
E	D-5
F	D-5
G	D-5

Bldg. No.	Title	Location
180	PUMP HOUSE (SEWAGE)	F-3
181	GUIDANCE LABORATORY	C-5
182	ELECTRICAL & PLUMBING STORES	C-5
183	COOLING TOWER	D-5
184	COOLING TOWER	D-5
185	COOLING TOWER	D-5
186	CAFETERIA	D-5
188	SPACE SCIENCES	D-5
170	FABRICATION SHOP	D-7
172	TEST & FILTER	D-7
173	COOLING TOWER	D-7
174	WATER REMOVER	D-7
175	FIRE HOUSE	D-7
177	TRANSPORTATION SERVICE SHED	D-7
178	BULLET HOUSE	D-7
179	VEHICLE ASSEMBLY BUILDING	D-7
180	CENTRAL ENGR. BLDG. & CAFETERIA	D-7
181	GAS STOP SHELTER	D-7
186	ELECTRONIC STORES	D-5
187	TELECOMMUNICATIONS ANNEX	D-5
188	SPACE SCIENCES LAB	D-5
189	CHEMICAL STORAGE	D-5
190	ENGINEERING FACILITIES BLDG.	C-5
191	ELECTRONICS LAB ANNEX	C-5
192	ENGINEERING OFFICES	C-5
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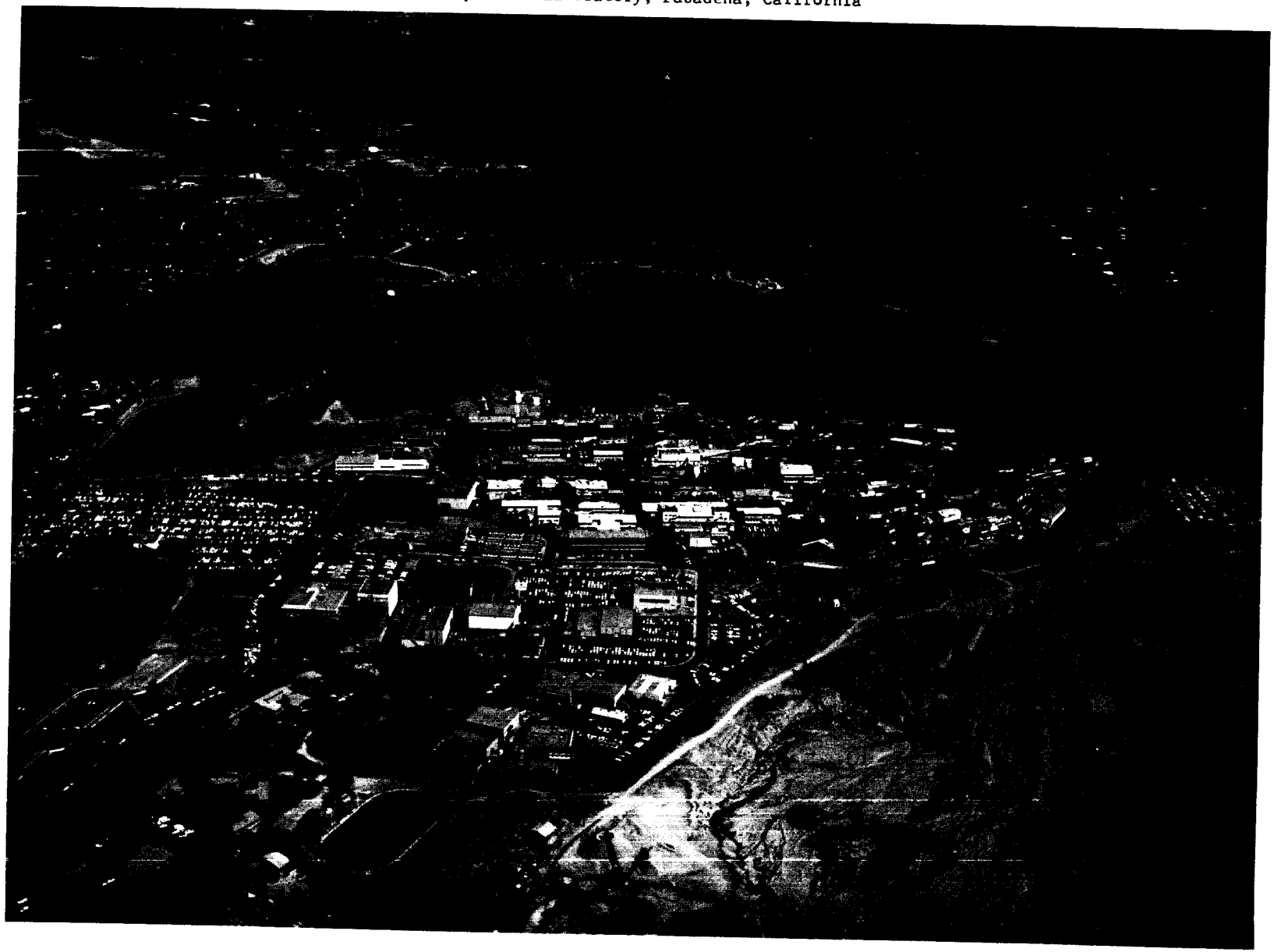
AO 5-1

Jet Propulsion Laboratory, Pasadena, California



AO 5-2

STAFFING SUMMARY	65	66
Direct Positions		
Arms Control	6	6
Tracking & Data Acquisition	352	363
Research & Advanced Development	764	683
Lunar & Planetary Projects	1,088	1,078
Total Direct Positions	2,210	2,130
Administration and Support Positions	1,890	1,870
Total Positions	4,100	4,000

CALIFORNIA INSTITUTE OF TECHNOLOGY

JET PROPULSION LABORATORY
LABORATORY DIRECTOR

	65	66
Total	22	21

ARMS CONTROL

	65	66
Total	6	6

ASSISTANT LABORATORY DIRECTOR TRACKING AND DATA ACQUISITION

	65	66
Total	16	16

DEEP SPACE INSTRUMENTATION FACILITY

	65	66
Total	204	283

SPACE FLIGHT OPERATIONS FACILITY

	65	66
Total	72	-

MANNED SPACE FLIGHT

	65	66
Total	76	80

ASSISTANT LABORATORY DIRECTOR RESEARCH AND ADVANCED DEVELOPMENT

	65	66
Total	11	11

SPACE SCIENCE AND APPLICATIONS

	65	66
Total	268	268

ADVANCED RESEARCH AND TECHNOLOGY

	65	66
Total	354	279

TRACKING AND DATA ACQUISITION

	65	66
Total	102	102

OTHER

	65	66
Total	40	34

ASSISTANT LABORATORY DIRECTOR LUNAR AND PLANETARY PROJECTS

	65	66
Total	5	5

RANGER

	65	66
Total	83	-

SURVEYOR

	65	66
Total	500	500

MARINER

	65	66
Total	145	14

VOYAGER

	65	66
Total	360	564

ASSISTANT LABORATORY DIRECTOR TECHNICAL DIVISIONS

	65	66
Total	5	5

TECHNICAL DIVISIONS SUPPORT

	65	66
Total	366	360

ASSISTANT LABORATORY DIRECTOR OFFICE OF ADMINISTRATION

	65	66
Total	12	12

PERSONNEL AND TECHNICAL SERVICES

	65	66
Total	395	395

PLANT ENGINEERING

	65	66
Total	282	282

MATERIAL SERVICES

	65	66
Total	227	227

FABRICATION SERVICES

	65	66
Total	120	120

FACILITIES

	65	66
Total	20	16

PUBLIC INFORMATION AND EDUCATION

	65	66
Total	10	8

MANAGEMENT INFORMATION

	65	66
Total	12	9

ADVANCED TECHNICAL STUDIES

	65	66
Total	6	6

QUALITY ASSURANCE AND RELIABILITY

	65	66
Total	62	58

PROCUREMENT

	65	66
Total	191	191

FINANCIAL MANAGEMENT

	65	66
Total	128	128

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

JET PROPULSION LABORATORY

The Jet Propulsion Laboratory is a contractor operated facility. Personnel and costs of operating this installation are funded under the Research and Development appropriation, except for the lease of administrative aircraft, the purchase of passenger carrying vehicles, and the FY 1965 ADP purchase program. These costs are included elsewhere in the "Administrative Operations" budget. The "Administrative Operations" type costs for JPL are shown in this volume for information purposes only and are not to be considered a part of the NASA Administrative Operations budget.

MISSION AND CAPABILITIES:

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

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

The primary emphasis of the Laboratory's effort is to carry out lunar, planetary, and deep space unmanned scientific missions. The Ranger and Surveyor programs are directed toward conducting unmanned investigations of the moon. The Mariner and Voyager projects are concerned with the planetary and deep space unmanned scientific missions. The Mariner IV spacecraft is expected to fly by Mars in July 1965. The objectives of the Voyager program, which is in the planning stage, will be to provide information on the existence of extra-terrestrial life on the planet Mars, as well as acquiring scientific data in the vicinity of the planets and on the interplanetary medium.

Other major functions in the JPL program include:

1. Tracking, data acquisition, data reduction and analysis as required by lunar and deep space flights.

2. Advanced spacecraft guidance and control systems.

3. Advanced solid propellant and liquid propellant spacecraft engines.

4. Integration of advanced propulsion systems into spacecraft.

SUMMARY OF RESOURCES REQUIREMENTS:

	1964	1965	1966
Number of Positions, end of year..	4,222	4,100	4,000
Average Number of All Employees...	4,131	4,233	4,050
Administrative Type Cost.....	$61,626,000	$62,646,000	$58,735,000

INSTALLATION DESCRIPTION:

The Jet Propulsion Laboratory is located in Pasadena, California, approximately twenty miles from downtown Los Angeles. Subsidiary facilities are located at Goldstone, California; Edwards Air Force Base in Muroc, California; and at Table Mountain, California.

At Pasadena, the Laboratory occupies 145.9 acres. At Goldstone, facilities are located on 50 square miles of land occupied under permit from the Army. At Edwards Air Force Base, facilities are located on 600 acres of land occupied under permit from the Air Force. The Table Mountain facilities of the Laboratory are located on five acres of land occupied under permit from the Forest Service of the Department of Agriculture. The total capital investment as of June 30, 1964 was $101,100,000.

ANALYSIS OF RESOURCES REQUIREMENTS BY OBJECT CLASSIFICATION:

		1964	1965	1966
11.	Personnel Compensation.....	$42,030,000	$44,153,000	$43,079,000
12.	Personnel Benefits.....	2,491,000	2,609,000	2,517,000
	Total, personnel costs....	$44,521,000	$46,762,000	$45,596,000
21.	Travel and Transportation of Persons.....	2,301,000	2,367,000	2,290,000
22.	Transportation of Things....	311,000	371,000	363,000
23.	Rents, Communications, and Utilities.....	7,856,000	6,733,000	4,323,000
24.	Printing and Reproduction...	104,000	116,000	113,000
25.	Other Services.....	2,541,000	2,062,000	1,913,000
26,	Supplies and Materials.....	2,514,000	2,638,000	2,591,000
31.	Equipment.....	1,064,000	1,120,000	1,071,000
32.	Lands and Structures.....	414,000	477,000	475,000
41.	Grants, Subsidies and Contributions.....	---	---	---
42.	Insurance Claims and Indemnities.....	---	---	---
	Total.....	$61,626,000	$62,646,000	$58,735,000

JUSTIFICATION BY OBJECT CLASSIFICATION:

The requirements estimated for FY 1966 reflect a reduction of $3,911,000. This reduction partially results from the planned decrease in the JPL manpower complement, which in FY 1966 will represent a decline of 183 man-years compared to FY 1965. Significant savings also result from decreased lease costs of automatic data processing equipment, reflecting the impact of the computer purchase program in FY 1965.

Personnel Distribution

	1964	1965	1966
Direct Personnel			
Flight Projects			
Ranger	303	83	-
Surveyor	184	500	500
Mariner	764	145	14
Voyager	-	360	564
Deep Space Network			
Deep space instrumentation facility	156	204	283
Space flight operations facility	-	72	-
Manned space flight	26	76	80
Supporting Research and Technology			
Space science and applications	151	268	268
Advanced research and technology	436	354	279
Tracking and data acquisition	100	102	102
Other	27	40	34
Arms Control	6	6	6
Sub-total, direct positions	2,153	2,210	2,130
Support Personnel			
Director and Staff	123	119	109
Technical divisions	382	366	360
Quality assurance and reliability	137	62	58
Personnel and technical division	425	395	395
Procurement	198	191	191
Financial management	129	128	128
Plant engineering	301	282	282

	1964	1965	1966
Material services	244	227	227
Fabrication services	130	120	120
Sub-total, support positions	2,069	1,890	1,870
Total, all positions	4,222	4,100	4,000

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