National Aeronautics and Space Administration

BUDGET ESTIMATES

FISCAL YEAR 1966

Volume I

SUMMARY DATA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

SUMMARY DATA

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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GENERAL STATEMENT

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

A total of $5,260,000,000 is requested to continue current programs and to support new programs considered necessary and desirable to implement the policy and purpose established by the Space Act.

The NASA continues to depend on industrial contractors, under the guidance of the NASA, to perform the major portion of the NASA program. A small but highly significant portion of the work is conducted by NASA installations, other government agencies and installations, by universities and by research contractors. The major program elements may be summarized as follows:

MANNED SPACE FLIGHT: Development of a manned space operations and exploration capability through the development of Gemini and Apollo and the study of possible future advanced missions.

SPACE SCIENCE: A broad program of spacecraft and instrumentation development for unmanned investigations of the Earth, Moon, Sun, planets, stars, and interplanetary space through the use of sounding rockets, earth orbiting spacecraft and interplanetary probes.

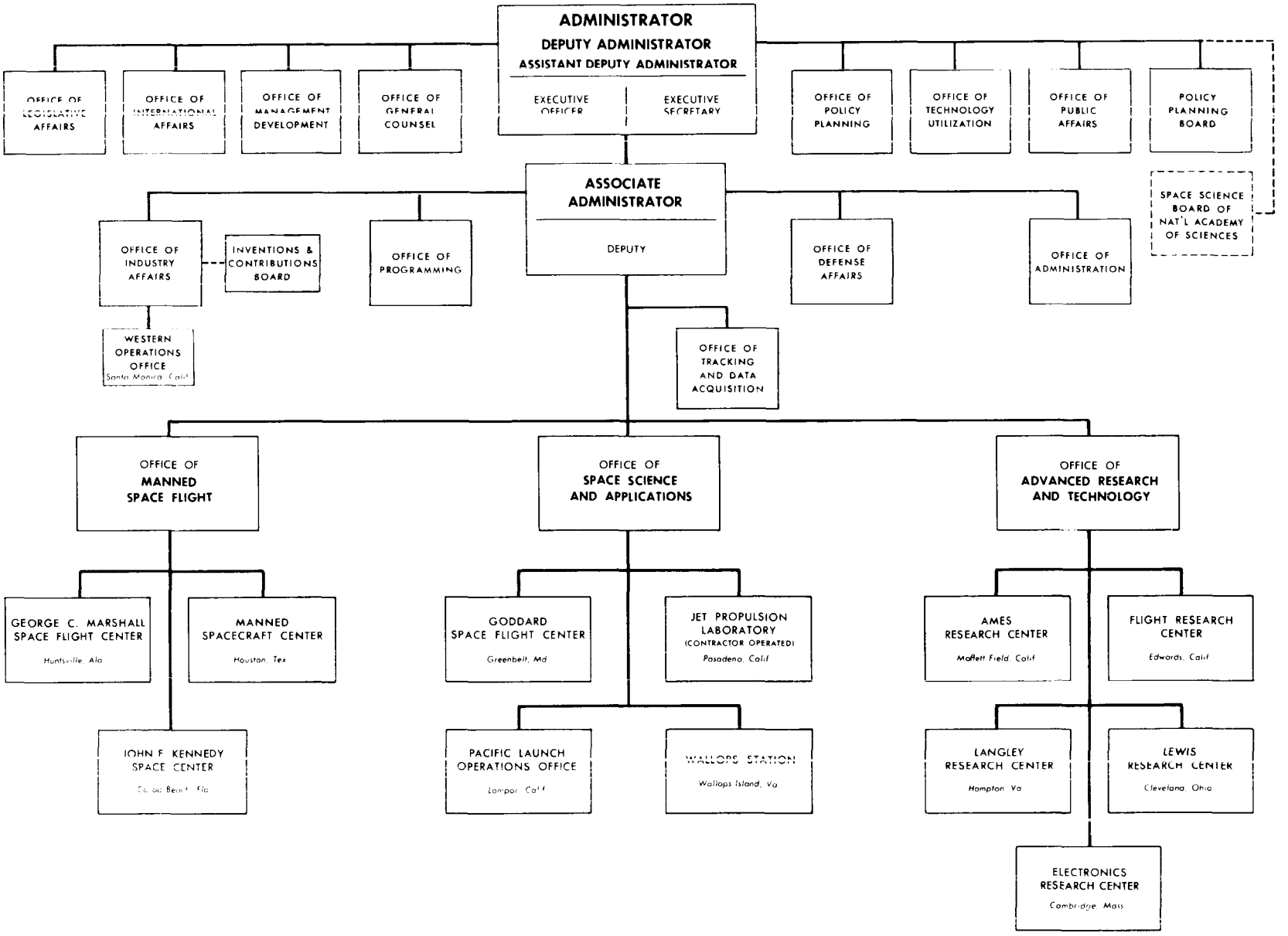
APPLICATIONS: Development of technology, spacecraft systems and concepts that can be applied to operational uses such as communications and meteorology through the use of specially designed spacecraft and on-board instrumentation.

ADVANCED RESEARCH AND TECHNOLOGY: Development of the basic information to support effective advancement of aeronautics and space activity.

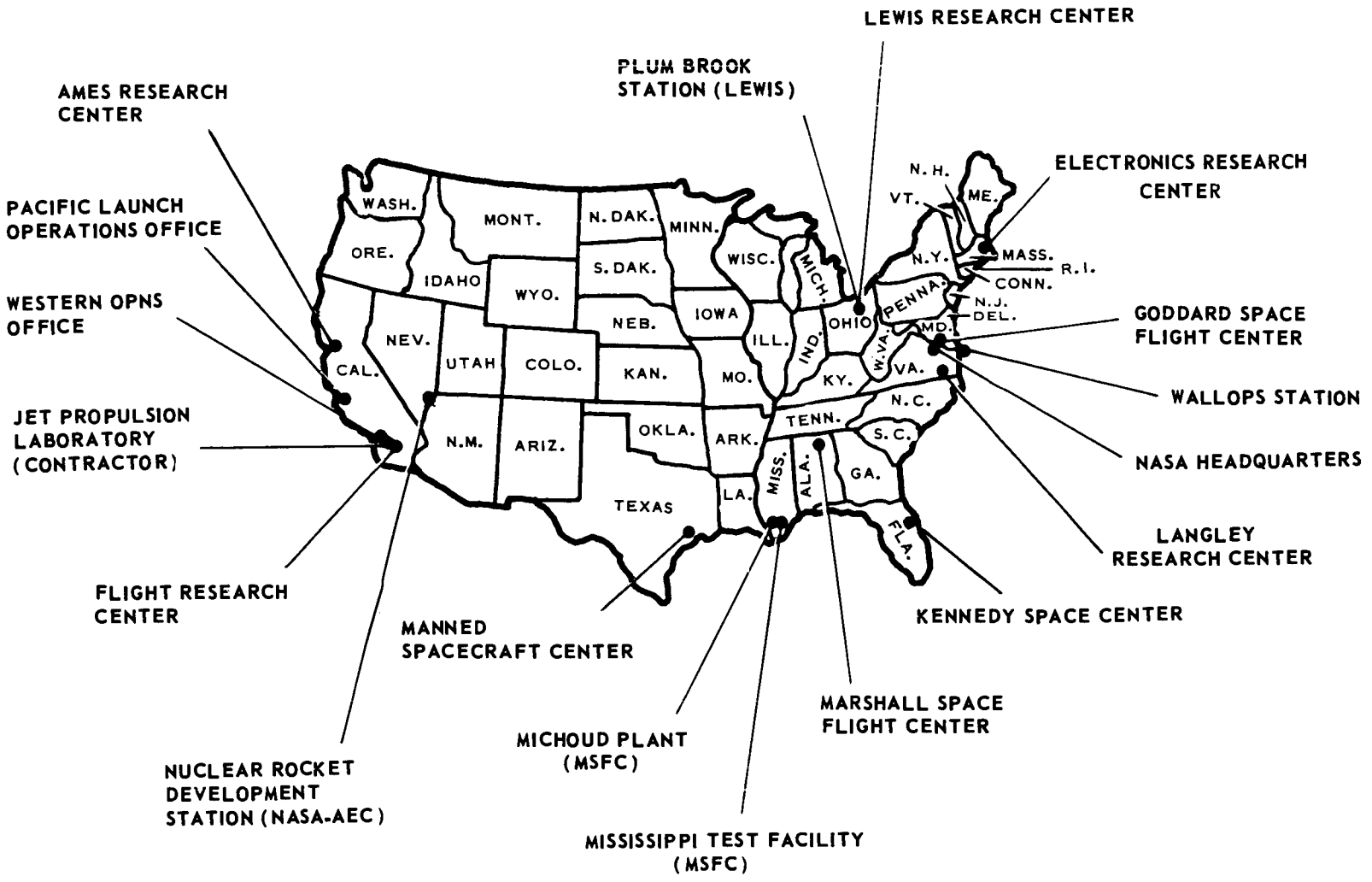
Detailed justification of the FY 1966 budget estimate for the total program of $5,260,000,000 is provided in the following three volumes:

Volume		Amount
II	Research and Development	$4,575,900,000
III	Construction of Facilities	74,700,000
IV	Administrative Operations	609,400,000
	TOTAL	$5,260,000,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



NASA INSTALLATIONS



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROPOSED AUTHORIZATION BILL

To authorize appropriations to the National Aeronautics and Space Administration for research and development, construction of facilities, and administrative operations, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there is hereby authorized to be appropriated to the National Aeronautics and Space Administration the sum of $5,260,000,000, as follows:

(a) For "Research and development," $4,575,900,000 for the following programs:

(1) Gemini, $242,100,000;

(2) Apollo, $2,997,385,000;

(3) Advanced missions, $10,000,000;

(4) Physics and astronomy, $172,100,000;

(5) Lunar and planetary exploration, $215,615,000;

(6) Bioscience, $31,500,000;

(7) Meteorological satellites, $42,700,000;

(8) Communication satellites, $2,800,000;

(9) Applications technology satellites, $28,700,000;

(10) Launch vehicle development, $63,600,000;

(11) Launch vehicle procurement, $194,500,000;

(12) Space vehicle systems, $35,000,000;

(13) Electronics systems, $34,400,000;

(14) Human factor systems, $14,900,000;

(15) Basic research, $22,000,000;

(16) Nuclear-electric systems, $27,000,000;

(17) Nuclear rockets, $58,000,000;

(18) Solar and chemical power, $14,200,000;

(19) Chemical propulsion, $30,000,000;

(20) Aeronautics, $42,200,000;

(21) Tracking and data acquisition, $246,200,000;

(22) Sustaining university program, $46,000,000;

(23) Technology utilization, $5,000,000.

(b) For "Construction of facilities," including land acquisitions, $74,700,000, as follows:

(1) Ames Research Center, Moffett Field, California, $2,749,000;

(2) Electronics Research Center, Cambridge, Massachusetts, $10,000,000;

(3) Goddard Space Flight Center, Greenbelt, Maryland, $2,400,000;

(4) John F. Kennedy Space Center, NASA, Cocoa Beach, Florida, $8,595,000;

(5) Langley Research Center, Hampton, Virginia, $8,250,000;

(6) Lewis Research Center, Cleveland and Sandusky, Ohio, $867,000;

(7) Manned Spacecraft Center, Houston, Texas, $4,400,000;

(8) George C. Marshall Space Flight Center, Huntsville, Alabama, $4,776,000;

(9) Michoud Plant, New Orleans and Slidell, Louisiana, $300,000;

(10) Mississippi Test Facility, Mississippi, $2,121,000;

(11) Wallops Station, Wallops Island, Virginia, $1,048,000;

(12) Various locations, $21,694,000;

(13) Facility planning and design not otherwise provided for, $7,500,000.

(c) For "Administrative operations," $609,400,000.

(d) Appropriations for "Research and development" may be used (1) for any items of a capital nature (other than acquisition of land) which may be required for the performance of research and development contracts and (2) for grants to nonprofit institutions of higher education, or to nonprofit organizations whose primary purpose is the conduct of scientific research, for purchase or construction of additional research facilities; and title to such facilities shall be vested in the United States unless the Administrator determines that the national program of aeronautical and space activities will best be served by vesting title in any such grantee institution or organization. Each such grant shall be made under such conditions as the Administrator shall determine to be

required to insure that the United States will receive therefrom benefit adequate to justify the making of that grant. None of the funds appropriated for "Research and development" pursuant to this Act may be used for construction of any major facility, the estimated cost of which, including collateral equipment, exceeds $250,000, unless the Administrator or his designee has notified the Committee on Science and Astronautics of the House of Representatives and the Committee on Aeronautical and Space Sciences of the Senate of the nature, location, and estimated cost of such facility.

(e) When so specified in an appropriation Act, (1) any amount appropriated for "Research and development" or for "Construction of facilities" may remain available without fiscal year limitation, and (2) any amount appropriated for "Administrative operations" may be available for contracts for maintenance and operation of facilities and other services to be provided during the fiscal year next after that for which appropriations are authorized herein.

(f) Appropriations made pursuant to subsection 1(c) may be used, but not to exceed $35,000, for scientific consultations or extraordinary expenses upon the approval or authority of the Administrator and his determination shall be final and conclusive upon the accounting officers of the Government.

(g) No part of the funds appropriated pursuant to subsection 1(c) for maintenance, repairs, alterations, and minor construction shall be used for the construction of any new facility the estimated cost of which, including collateral equipment, exceeds $100,000.

(h) When so specified in an appropriation Act, any appropriation authorized under this Act to the National Aeronautics and Space Administration may initially be used, during the fiscal year 1966, to finance work or activities for which funds have been provided in any other appropriation available to the Administration and appropriate adjustments between such appropriations shall subsequently be made in accordance with generally accepted accounting principles.

Sec. 2. Authorization is hereby granted whereby any of the amounts prescribed in paragraphs (1), (2), (3), (4), (5), (6), (7), (8), (9), (10), (11), and (12), of subsection 1(b) may, in the discretion of the Administrator of the National Aeronautics and Space Administration, be varied upward 5 per centum to meet unusual cost variations, but the total cost of all work authorized under such paragraphs shall not exceed a total of $67,200,000.

Sec. 3. Not to exceed 2 per centum of the funds appropriated pursuant to subsection 1(a) hereof may be transferred to the "Construction of facilities" appropriation, and, when so transferred, together with $30,000,000 of the funds appropriated pursuant to subsection 1(b) hereof (other than funds appropriated pursuant to paragraph (13) of such subsection) shall be available for expenditure to construct, expand, or modify laboratories and other installations at any location (including locations specified in subsection 1(b)), if (1) the Administrator determines such action

to be necessary because of changes in the national program of aeronautical and space activities or new scientific or engineering developments, and (2) he determines that deferral of such action until the enactment of the next authorization Act would be inconsistent with the interest of the Nation in aeronautical and space activities. The funds so made available may be expended to acquire, construct, convert, rehabilitate, or install permanent or temporary public works, including land acquisition, site preparation, appurtenances, utilities, and equipment. No portion of such sums may be obligated for expenditure or expended to construct, expand, or modify laboratories and other installations unless (A) a period of thirty days has passed after the Administrator or his designee has transmitted to the Committee on Science and Astronautics of the House of Representatives and to the Committee on Aeronautical and Space Sciences of the Senate a written report containing a full and complete statement concerning (1) the nature of such

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construction, expansion, or modification, (2) the cost thereof including the cost of any real estate action pertaining thereto, and (3) the reason why such construction, expansion, or modification is necessary in the national interest, or (B) each such committee before the expiration of such period has transmitted to the Administrator written notice to the effect that such committee has no objection to the proposed action.

Sec. 4. Notwithstanding any other provision of this Act --

(1) no amount appropriated pursuant to this Act may be used for any program deleted by the Congress from requests as originally made to either the House Committee on Science and Astronautics or the Senate Committee on Aeronautical and Space Sciences,

(2) no amount appropriated pursuant to this Act may be used for any program in excess of the amount actually authorized for that

particular program by sections 1(a) and 1(c), and,

(3) no amount appropriated pursuant to this Act may be used for any program which has not been presented to or requested of either such committee,

unless (A) a period of thirty days has passed after the receipt by each such committee of notice given by the Administrator or his designee containing a full and complete statement of the action proposed to be taken and the facts and circumstances relied upon in support of such proposed action, or (B) each such committee before the expiration of such period has transmitted to the Administrator written notice to the effect that such committee has no objection to the proposed action.

Sec. 5. The Administrator is hereby authorized to transfer, with the approval of the Bureau of the Budget, funds appropriated pursuant to this Act (other than funds appropriated pursuant to paragraph (13) of subsection 1(b)), to any other agency of the Government whenever the

Administrator determines such transfer necessary for the efficient accomplishment of the objectives for which the funds have been appropriated. Not more than $20,000,000 of the funds authorized by this Act may be transferred by the Administrator under this section, and no transfer in excess of $250,000 shall be made under this section unless the Administrator has transmitted to the Committee on Aeronautical and Space Sciences of the Senate and to the Committee on Science and Astronautics of the House of Representatives a written statement concerning the amount and purpose of, and the reason for, such transfer, and (1) each such committee has transmitted to the Administrator written notice to the effect that such committee has no objection to that transfer, or (2) thirty days have passed after the transmittal by the Administrator of such statement to those committees.

Sec. 6. This Act may be cited as the "National Aeronautics and Space Administration Authorization Act, 1966."

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

SUMMARY OF APPROPRIATIONS

(In thousands of dollars)

Appropriation	P.L. 88-215 Fiscal Year 1964	P.L. 88-507 Fiscal Year 1965	Fiscal Year 1966
Research and Development.....	$3,926,000	$4,363,594	$4,575,900
Construction of Facilities.....	680,000	262,880	74,700
Administrative Operations.....	494,000	623,526	609,400
TOTAL.....	$5,100,000	$5,250,000	$5,260,000

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

SUMMARY OF APPROPRIATIONS (ADJUSTED)

(Thousands of dollars)

	Total	Research and Development	Construction of Facilities	Administrative Operations
FISCAL YEAR 1964				
Independent Offices Appropriation Act, 1964 (77 Stat. 439).....	$5,100,000	$3,926,000	$680,000	$494,000
NASA Appropriation Transfers (77 Stat. 439).....	---	-35,731	33,346	2,385
Transfer to "Operating expenses, Public Buildings Service," General Services Administration (77 Stat. 436).....	-286	---	---	-286
Appropriation (adjusted).....	$5,099,714	$3,890,269	$713,346	$496,099
FISCAL YEAR 1965				
Independent Offices Appropriation Act, 1965 (78 Stat. 657-8).....	$5,250,000	$4,363,594	$262,880	$623,526
Transfer to "Operating expenses, Public Buildings Service," General Services Administration (78 Stat. 655).....	-273	---	---	-273
Appropriation (adjusted).....	$5,249,727	$4,363,594	$262,880	$623,253
FISCAL YEAR 1966				
Appropriation request.....	$5,260,000	$4,575,900	$74,700	$609,400

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

SUMMARY BY APPROPRIATION BY BUDGET ACTIVITY

(Thousands of dollars)

Appropriation Title	Total	Manned Space Flight	Scientific Investigations In Space	Space Applications	Space Technology	Aircraft Technology	Supporting Activities
Fiscal Year 1964.....	$5,202,039	$3,456,694	$686,254	$118,070	$486,641	$53,376	$401,004
Research and development..	3,974,979	2,713,052	603,142	100,451	298,692	21,795	237,847
Construction of facilities	715,450	496,842	16,698	3,933	60,950	2,585	134,442
Administrative operations.	511,610	246,800	66,414	13,686	126,999	28,996	28,715
Fiscal Year 1965.....	$5,177,233	$3,476,475	$701,844	$93,215	$451,212	$70,192	$384,295
Research and development..	4,268,632	2,941,178	609,949	73,165	283,600	35,240	325,500
Construction of facilities	262,880	213,481	5,765	---	23,812	4,452	15,370
Administrative operations.	645,721	321,816	86,130	20,050	143,800	30,500	43,425
Fiscal Year 1966.....	$5,260,000	$3,587,510	$730,292	$114,100	$399,735	$78,362	$350,001
Research and development..	4,575,900	3,249,485	656,915	94,600	235,500	42,200	297,200
Construction of facilities	74,700	27,825	8,377	---	20,435	762	17,301
Administrative operations.	609,400	310,200	65,000	19,500	143,800	35,400	35,500

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

PERSONNEL SUMMARY AND COSTS

	FY 1964	FY 1965	FY 1966
Personnel Data			
End year employment:			
Permanent positions	31,984	33,200	33,500
Other positions	515	600	600
Total	32,499	33,800	34,100
NASA funded	32,487	33,749	34,040
Reimbursable	12	51	60
Average number of all employees	30,448	32,879	33,599
Average GS grade	9.9	10.2	10.2
Average GS salary	$9,454	$10,085	$10,085
Average salary, grades established by the Administrator (Wage Board)	$6,980	$7,131	$7,150
Average salary of ungraded positions (Excepted)	$19,038	$22,029	$22,039
Personnel compensation	(In thousands of dollars)		
Net salary, permanent positions	$266,458	$311,932	$320,928
Other positions	2,279	3,346	3,017
Other compensation	19,823	21,931	21,978
Total compensation	$288,560	$337,209	$345,923
NASA funded	288,081	336,696	345,207
Reimbursable	479	513	716
Personnel benefits:			
Retirement	$17,088	$19,788	$20,394
Health benefits	1,873	2,116	2,172
Life insurance	833	955	986
All other (Incentive awards, uniforms, social security, contributions, etc.)	468	674	691
Total benefits	$20,262	$23,533	$24,243

	FY 1964	FY 1965	FY 1966
Total benefits	$20,262	$23,533	$24,243
NASA funded	20,241	23,490	24,193
Reimbursable	21	43	50
Total personnel costs	$308,822	$360,742	$370,166
NASA funded	308,322	360,186	369,400
Reimbursable	500	556	766

Manpower Requirements

It is estimated that NASA will require 33,500 permanent positions by the end of the fiscal year 1966 to carry out the program goals and responsibilities during the fiscal year 1966. This employment level represents an increase of 300 permanent positions over the comparable figure for the end of fiscal year 1965. The personnel filling these additional positions will be utilized for the conduct of comprehensive research programs at the Electronics Research Center. For all other NASA installations the estimate contemplates that the same level of authorized positions will be maintained for the fiscal years 1965 and 1966.

Components of Increases in Personnel Costs for Fiscal Year 1966

(In millions of dollars)

	Personnel Salaries	Personnel Benefits	Total Personnel Costs
Cost of 544 increased man-years in fiscal year 1966 over fiscal year 1965	$6.49	$.51	$7.00
Cost of 160 additional man-years for 300 new positions in FY 1966 for the Electronics Research Center	1.66	.14	1.80
Additional costs of pay raises in fiscal year 1966	.33	.02	.35
Other personnel compensation	.05	---	.05
Total increase in NASA funded personnel costs	$8.53	$.67	$9.20

Analysis of Increases in Personnel Costs for Fiscal Year 1966

Personnel costs for the fiscal year 1966 reflect an increase of $9.2 million over the funds needed to finance NASA funded manpower requirements in fiscal year 1965. Included in this amount is $7.0 million to cover the cost

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of 544 additional man-years resulting from full year employment in fiscal year 1966 of those personnel employed for part of the year in fiscal year 1965. In addition, $1.8 million is required to fund 160 man-years associated with the 300 new positions for the Electronics Research Center. Other minor increases amounting to $.4 million are included for the payment of full year funding in fiscal year 1966 of pay raises effective for part of the fiscal year 1965 and other miscellaneous personnel compensation costs.

As a result of an extensive review of the annual average salaries with the Bureau of the Budget, the fiscal year 1966 annual average salary for the general schedule positions, which represents approximately 80% of the total permanent workforce, has been maintained at the fiscal year 1965 level.

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	-192	-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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROPOSED APPROPRIATION BILL

RESEARCH AND DEVELOPMENT

For necessary expenses, not otherwise provided for, including research, development, operations, services, minor construction, supplies, materials, equipment; maintenance, repair, and alteration of real and personal property; and purchase, hire, maintenance, and operation of other than administrative aircraft necessary for the conduct and support of aeronautical and space research and development activities of the National Aeronautics and Space Administration, [$4,363,594,000] *$4,575,900,000*, to remain available until expended. (*42 U.S.C. 2451, et seq., 50 U.S.C. 151–160, 511–515; Independent Offices Appropriation Act, 1965; additional authorizing legislation to be proposed.*)

Note.—Excludes $24,800 thousand for activities transferred in the estimates to "Administrative operations." The amounts obligated in 1964 and 1965 are shown in the schedule as comparative transfers.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

RESEARCH AND DEVELOPMENT

Program and Financing (in thousands of dollars)

	Budget Plan			Obligations		
	1964	1965	1966	1964	1965	1966
Program by activities:						
Direct program:						
1. Manned space flight:						
(a) Gemini.....	418,900	308,400	242,100	419,151	302,300	243,500
(b) Apollo.....	2,272,952	2,606,778	2,997,385	2,215,859	2,642,800	2,989,900
(c) Advanced mission studies.....	21,200	26,000	10,000	13,927	34,100	10,300
2. Scientific investigations in space:						
(a) Physics and astronomy..	189,118	182,546	224,300	168,618	206,900	223,400
(b) Lunar and planetary exploration.....	267,445	281,803	294,515	258,335	287,000	294,300
(c) Bioscience.....	21,479	37,700	40,600	21,588	40,500	40,500
(d) Launch vehicle development.....	125,100	107,900	97,500	123,257	109,700	97,700
3. Space applications.....	100,451	73,165	94,600	96,920	87,100	94,300
4. Space technology.....	298,692	283,600	235,500	284,061	309,700	236,400
5. Aircraft technology.....	21,795	35,240	42,200	17,038	39,700	42,100
6. Supporting activities:						
(a) Tracking and data acquisition.....	194,347	274,750	246,200	148,780	334,700	246,600
(b) Sustaining university program.....	40,000	46,000	46,000	35,924	54,500	46,000
(c) Technology utilization.	3,500	4,750	5,000	3,192	5,500	5,000
Total direct.....	3,974,979	4,268,632	4,575,900	3,806,650	4,454,500	4,570,000

RESEARCH AND DEVELOPMENT

Program and Financing (in thousands of dollars) - Continued

	Budget Plan			Obligations		
	1964	1965	1966	1964	1965	1966
Reimbursable program:						
1. Manned space flight:						
(a) Gemini.....	3,940	3,337	1,242	2,652	4,800	1,242
(b) Apollo.....	95	300	300	.....	395	300
2. Scientific investigations in space:						
(a) Physics and astronomy.....	158	.....	.....	63	119	.....
(b) Launch vehicle development	.....	.....	.....	350	.....	.....
3. Space applications.....	17,581	48,653	42,200	208	72,743	42,458
4. Space technology.....	41,056	40,700	37,300	48,383	56,378	37,300
6. Supporting activities:						
(a) Tracking and data acquisition.....	73	.....	.....	8	65	.....
Total reimbursable.....	62,903	92,990	81,042	51,664	134,500	81,300
Total.....	4,037,882	4,361,622	4,656,942	3,858,314	4,589,000	4,651,300
Financing:						
Receipts and reimbursements from:						
Administrative budget accounts...	-62,818	-78,190	-69,842	-62,818	-78,190	-69,842
Non-Federal sources.....	-85	-14,800	-11,200	-85	-14,800	-11,200
Comparative transfer to other accounts.....	6,451	22,468	.....	17,757	22,468	.....
Unobligated balance available, start of year:						
For completion of prior year budget plans.....	.....	.....	.....	-146,750	-244,296	-87,633

RESEARCH AND DEVELOPMENT

Program and Financing (in thousands of dollars) - Continued

	Budget plan			Obligations		
	1964	1965	1966	1964	1965	1966
Available to finance new budget plans	-4,974	.....	.....	-4,974	.....	.....
Unobligated balance transferred from "Construction of facilities" (76 Stat. 731) and (75 Stat. 355)	-15,472	.....	.....	-15,472	.....	.....
Unobligated balance transferred to "Construction of facilities" (77 Stat. 439)	1,779	.....	.....	.....	1,779	.....
Reprogramming to prior year budget plan	-72,494	72,494	.....	.....	.....	.....
Unobligated balance available, end of year	.....	.....	.....	244,296	87,633	93,275
New obligational authority	3,890,269	4,363,594	4,575,900	3,890,269	4,363,594	4,575,900
New obligational authority:						
Appropriation	3,926,000	4,363,594	4,575,900	3,926,000	4,363,594	4,575,900
Transferred to -						
"Construction of facilities" (77 Stat. 439)	-20,046	.....	.....	-20,046	.....	.....
"Administrative operations" (77 Stat. 439)	-15,685	.....	.....	-15,685	.....	.....
Appropriation (adjusted)	3,890,269	4,363,594	4,575,900	3,890,269	4,363,594	4,575,900

RESEARCH AND DEVELOPMENT

Program and Financing (in thousands of dollars) (Continued)

	1964 actual	1965 estimate	1966 estimate
Note.—Reconciliation of budget plan to obligations:			
Total budget plan	4,037,882	4,361,622	4,656,942
Deduct portion of budget plan to be obligated in subsequent years	272,829	87,633	93,275
Add obligations of prior year budget plans	93,261	315,011	87,633
Total obligations	3,858,314	4,589,000	4,651,300

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

RESEARCH AND DEVELOPMENT

BUDGET PLAN BY PROGRAM BY COGNIZANT OFFICE

(In thousands of dollars)

BUDGET ACTIVITY		FY 1964	FY 1965	FY 1966
	MANNED SPACE FLIGHT.....	$2,713,052	$2,941,178	$3,249,485
1a	Gemini.....	418,900	308,400	242,100
1b	Apollo.....	2,272,952	2,606,778	2,997,385
1c	Advanced mission studies....	21,200	26,000	10,000
	SPACE SCIENCE AND APPLICATIONS	$746,879	$731,486	$797,515
2a	Physics and astronomy.....	148,623	136,814	172,100
2b	Lunar and planetary exploration.....	205,762	206,150	215,615
6b	Sustaining university program	40,000	46,000	46,000
2d	Launch vehicle development..	111,900	96,500	63,600
*	Launch vehicle procurement..	129,986	154,672	194,500
2c	Bioscience.....	21,479	28,700	31,500
3	Meteorological satellites...	63,177	31,200	42,700
3	Communications satellites...	8,413	8,055	2,800
3	Applications technology satellites.....	17,539	23,395	28,700
	ADVANCED RESEARCH AND TECHNOLOGY.....	$317,201	$316,468	$277,700
4	Basic research.....	22,653	21,231	22,000
4	Space vehicle systems.....	45,714	44,495	35,000
4	Electronic systems.....	28,700	25,422	34,400
4	Human factor systems.....	13,200	13,320	14,900
4	Nuclear-electric systems....	45,963	42,492	27,000
4	Nuclear rockets.....	79,176	56,731	58,000
4	Chemical propulsion.....	46,000	63,792	30,000
4	Solar and chemical power....	14,000	13,745	14,200
5	Aeronautics.....	21,795	35,240	42,200
6a	TRACKING AND DATA ACQUISITION.	$194,347	$274,750	$246,200
6c	TECHNOLOGY UTILIZATION.....	$3,500	$4,750	$5,000
	TOTAL PLAN.....	$3,974,979	$4,268,632	$4,575,900

*Funds for the procurement of launch vehicles are statistically distributed to unmanned flight programs (e.g. Physics and Astronomy, Space Vehicle Systems) in the program and financing schedule on page RD 2.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

NEW RESEARCH AND DEVELOPMENT PROJECT

	Fiscal Year 1965	Fiscal Year 1966
Apollo Program		
Saturn IB/Centaur	$5,000,000	$5,000,000

The purpose of this project is to provide a launch vehicle with an earth-lunar transfer capability of 12,000 to 14,000 pounds and a Mars or Venus trajectory payload capability of 9,500 pounds. The vehicle will be used for a variety of purposes such as highly-eccentric, multiple-launch orbiting geophysical observatories, applications technology satellites, and lunar and planetary scientific missions. Fiscal year 1965 and 1966 funds will be used for development of detailed designs and supporting plans in preparation for initiation of the hardware activity involved in the subsequent test and production programs.

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RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

OFFICE OF MANNED SPACE FLIGHT — GEMINI PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Gemini program objectives are to develop an operational capability in Manned Space Flight and through this capability to conduct specific experiments and tests which support Apollo, Department of Defense programs and scientific investigations. To accomplish these objectives, specific long-duration and rendezvous missions have been planned. During the long-duration missions, the astronauts will control and maneuver the spacecraft, thus providing performance data (on both systems and astronauts) after long exposures to space flight. The astronauts will perform a series of experiments generated by NASA, Department of Defense and the scientific community.

The Gemini effort in FY 1966 will be devoted primarily to the operational activities required for manned flights, including both long-duration and rendezvous missions.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1964	1965	1966
Spacecraft	$280,520	$165,300	$122,700
Launch Vehicles	122,700	115,400	88,600
Support	15,680	27,700	30,800
Total	$418,900	$308,400	$242,100

BASIS OF FUND REQUIREMENTS:

Spacecraft

The Gemini spacecraft is a two man capsule designed to sustain long-duration missions and provide capability for rendezvous and docking in earth orbit. Gemini systems are substantially more sophisticated and versatile than those used in the Mercury configuration. The spacecraft includes a number of subsystems which are being used for the first time in manned space flight. McDonnell Aircraft Corporation of St. Louis, is the principal contractor. FY 1966 estimate supports factory assembly, checkout, and launch preparation.

Launch Vehicles

Three separate vehicles are required for the Gemini program: the Gemini Launch Vehicle (GLV), the Atlas, and the Agena. The GLV is a Titan II intercontinental ballistic missile modified for manned flight.

The Atlas (the target launch vehicle) and the Agena (the rendezvous target vehicle) are also military vehicles modified or improved to meet the unique requirements of Gemini.

The Air Force Space Systems Division, acting similarly to a NASA prime contractor, is procuring the vehicles. The FY 1966 estimate provides for the incremental funding required by the Air Force for delivery and partial operational support of the vehicles to be launched in fiscal years 1966 and 1967.

Support

Since manned missions will be conducted in FY 1966, the emphasis given to Crew and Flight Operations will characterize the nature of the Gemini program during this intensive operational period.

Crew Operations consists of three main types of effort: simulation equipment and support, astronaut training, and specialized in-flight devices. Flight Operations includes the planning, support, and actual flight from lift-off to recovery. Spacecraft and Launch Vehicle Support is the remaining element of Gemini Support. It includes funding for the experiments to be performed on the various flights.

SCHEDULE OF LAUNCHES

Schedule of Significant Research and Development Events

Ground Tests

With respect to ground tests, the development and qualification program for major Gemini hardware will be essentially completed early in calendar year 1965.

Flights

GT-1	Successfully completed on April 8, 1964
GT-2 and GT-3	Early in CY 1965
GT-4; GT-5	Late in CY 1965

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

OFFICE OF MANNED SPACE FLIGHT — APOLLO PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The ultimate goal of the Manned Space Flight program is to provide a broad national capability for manned space exploration, which will achieve and maintain a position of leadership for the United States. A specific objective in acquiring this capability is to land man on the Moon and return him safely to Earth within this decade. The Apollo Program, in the course of meeting this specific objective, will provide a broad base of operational capability in Manned Space Flight and the associated technology; a valuable complex of development, manufacturing, test, and operational facilities; and an experienced Government and industrial team.

Major phases of the program include design and development of hardware, unmanned test flights, manned orbital flights, and manned lunar flights. In FY 1966, the Apollo Program will concentrate on ground and flight testing of major systems and their components:

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1964	1965	1966
Spacecraft	$876,575	$992,450	$1,118,840
Saturn I	187,077	55,450	4,400
Saturn IB	146,817	261,150	274,700
Saturn V	763,382	965,006	1,236,500
Engine development	166,000	153,400	140,700
Apollo mission support	133,101	179,322	222,245
Total	$2,272,952	$2,606,778	$2,997,385

BASIS OF FUND REQUIREMENTS:

Spacecraft

In FY 1966, the ground testing of boilerplate spacecraft will be completed and extensive ground testing will be conducted on Block I Command and Service Modules (CSM). Three Block I CSM will be delivered to Kennedy Space Center for flights on Saturn IB; two for supercircular re-entry tests in FY 1966; and one for long-duration flight in the following fiscal year. In addition, one Block I CSM will be delivered to White Sands Missile Range for

an intermediate altitude test of the launch escape system. The Block II spacecraft will have progressed to a point in its design phase where manufacturing will be initiated. It is this spacecraft that will be used for earth orbital rendezvous and the lunar missions.

Activity on the Lunar Excursion Module (LEM) will include the completion of design and engineering and component-development tests, plus the initiation of the qualification test program on prototype flight hardware. Two LEM Test Articles will be delivered, manufacture of the remaining three will be completed, and manufacturing of the first five flight vehicles will be in process.

Saturn I and IB

The Saturn I project will be concluded in FY 1966 with a micrometeoroid experiment launched from Kennedy Space Center. In the Saturn IB project during FY 1966, two vehicles will be launched from Kennedy Space Center to conduct re-entry tests and one launch vehicle will be delivered for launch in the next fiscal year. In addition, fabrication, assembly, and checkout of eight more launch vehicles will either be completed or in process. FY 1966 activity will also include design studies and supporting plans for Saturn IB/Centaur.

Saturn V

During FY 1966, major ground test programs for the Saturn V launch vehicle will be continued with All-Systems and Structural testing. Dynamic testing of the launch vehicle will be started, in addition to checkout of Launch Complex 39 at Kennedy Space Center using the Facilities Checkout vehicle. Manufacturing checkout of the first two flight vehicles is scheduled for completion and the first flight vehicle will enter its acceptance test phase. The assembly of follow-on flight stages also will be undertaken at the various contractor plants.

Engine Development

H-1 engine ground tests, launch support and post-flight evaluation will continue in support of the Saturn I and IB programs. Support of the RL-10 engine will be sustained through the final Saturn I launch and post-flight evaluation. During FY 1966, components qualification on the F-1 engine will be completed. In addition, tests will be conducted to demonstrate the F-1's ability to meet Saturn V requirements, such as achieving the necessary specific impulse while maintaining the ability to recover from induced combustion instability. Final design of the F-1 Qualification Engine will be released. Progress in development of the J-2 engine during FY 1966 will include complete qualification of the fuel turbopump, gas generator, liquid oxygen turbopump, engine controls, and engine flight instrumentation.

Apollo Mission Support

In FY 1966, support effort will be continued in the areas of Systems Engineering, Launch Operations and Instrumentation, Mission Control Systems, Apollo Space Operations, and Supporting Development.

SCHEDULE OF LAUNCHES

Schedule of Significant Research and Development Events

Events	Quarter	Calendar Year
Saturn I launch vehicle/SA-10 (last launch of Saturn I)	3	1965
Initiation of assembly of first Block II Spacecraft	3	1965
Delivery of Spacecraft 009 to KSC (first spacecraft qualification)	4	1965
J-2 engine qualification	1	1966
Saturn IB launch vehicle/SA-201	-	1966

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

OFFICE OF MANNED SPACE FLIGHT — ADVANCED MISSIONS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

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

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1964	1965	1966
Advanced missions program.....	$21,200	$26,000	$10,000

BASIS OF FUND REQUIREMENTS:

The Advanced Missions Program supports advanced studies of manned earth orbital, lunar and planetary missions. The fiscal year 1966 requirements reflect a major reduction from the fiscal year 1965 level because of the evolvement of extended Apollo systems from the broad definition and preliminary design phase to a more selective study and advanced development phase. Manned earth orbital studies will be continued to determine and evaluate potential experimental payloads, including: methods of remotely sensing the condition of the earth's atmosphere for use in weather prediction; methods of observing the earth's surface for use in cartography and in resources utilization planning; optical and radio telescopes for use in astronomy and astrophysics; and critical, long lead-time subsystems to be developed for other future missions. Manned earth orbital study efforts will also be directed to the determination and refinement of space station concepts. The first such system, using modified Apollo hardware, will enter detail design and critical subsystem advanced development during fiscal year 1966.

Manned lunar studies are now in process to define systems to support initial lunar orbital and surface reconnaissance operations in the immediate post-Apollo period, and to explore systems suited to more extensive lunar operations and scientific exploitation of the moon.

Manned planetary study effort will continue to place primary emphasis on analysis of system feasibility and concept of future planetary missions.

In addition, a number of studies will be made to define potential launch vehicles in each of the mission areas, including improved versions of vehicles presently under development, larger vehicles utilizing the major new propulsion systems under development, and more efficient vehicles embodying reusable concepts.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

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 Earth's magnetosphere, the region of interplanetary space beyond the boundaries of the Earth's magnetosphere, the solar radiation in these regions and their interactions with the regions, the Sun and its emission of radiations, stars and other celestial bodies open to observation from above the atmosphere, cosmic rays from beyond the solar system and the geodetic figure of the Earth.

Knowledge of these areas is necessary to an intelligent appreciation of the environment in which man lives. The atmosphere and its behavior are basic to weather and climate. The ionosphere is important in radio communications. The space beyond and its radiation affects the atmosphere and the ionosphere. The radiations in the space beyond are hazards that must be dealt with in interplanetary and lunar travel. The Sun appears to be the dominant factor in the activities taking place in interplanetary space and in the Earth's own outer atmosphere. Investigations of the stars and interstellar material reveal conditions that exist elsewhere in the universe, and these studies can provide additional insight into the conditions which exist in our immediate environment. Geodetic investigations are basic to maps and navigation, and they also help to provide a more complete picture of the fundamental nature of the universe.

SUMMARY OF RESOURCES REQUIREMENTS:

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

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BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

The supporting research and technology efforts are performed by universities and nonprofit organizations, NASA Installations, other government organizations, and private industry under the coordination of the Office of Space Science and Applications. The supporting research and technology program includes research, both experimental and theoretical; observations of the Sun and the stars made from the ground, from balloons and from aircraft; work leading to development of sounding rocket, satellite, and space probe instrumentation; and experiments and scientific support for manned space flight missions.

Advanced studies will range from conceptual studies for formulation of basic mission requirements and characteristics to specific feasibility studies of spacecraft and ground equipment design and project definition. Missions to be included will be advanced Explorers, advanced observatories, and interplanetary solar and galactic probes.

Solar Observatories

The first Orbiting Solar Observatory (OSO-1) was launched in 1962. Seven similar spacecraft are planned, of which two are to be launched in 1965. Spacecraft and experiments for the fourth and fifth missions are under development and experiments are currently being selected for the sixth mission. The OSO points one section toward the Sun with an accuracy of one minute of arc. A second section spins about an axis so that experiments housed in its rim scan the Sun with each revolution; and also scan the entire sky.

An Advanced Orbiting Solar Observatory (AOSO) is being developed for first launch in 1969. It will continuously point all of its instruments at the Sun with much greater accuracy than OSO. It will have increased dimensions that will permit use of optical instruments with better resolving power for observation of details of the solar surface.

The design phase of the AOSO project will be complete in FY 1965 and work will be initiated on the development of the prototype and four flight units. Design of experiments for the initial missions has also been initiated. FY 1966 funds will provide for full-scale development efforts to provide for a first launch during the period of maximum solar activity. This period is ideal for the detailed studies of solar activity made possible by AOSO.

Astronomical Observatories

The Orbiting Astronomical Observatory (OAO) is being developed to place astronomical instruments above the atmosphere and its restrictions on observations. The first OAO will be ready for flight in 1965 with

ultraviolet, gamma ray and X-ray telescopes. The experiments are under development for the first four observatories. Development of experiments for the fifth observatory will be initiated in FY 1966, and advance development work will be conducted on experiments for follow-on observatories. Observations will be made of galaxies, stars, interstellar matter, and planets with the objective of increasing our knowledge of their composition, structure and evolutionary processes.

Geophysical Observatories

The Orbiting Geophysical Observatory (OGO) project was conceived to meet the need for a spacecraft with higher data rates, more power and better orientation than the Explorer type satellite, and one that would be uniquely capable of carrying many correlative experiments for detailed, high resolution studies of the space environment. The first OGO was launched in 1964. As part of a comprehensive, coherent program to study Sun-Earth relationships, OGO satellites are planned for use in two types of orbits. One is highly elliptical to permit study of magnetic fields and energetic particles in the outer regions of the magnetosphere and interplanetary space. The other is a nearly circular polar orbit for specialized studies of the near Earth environment including the Earth's atmosphere, ionosphere, and magnetic field. A total of eleven spacecraft are planned with launches in each of the two types of orbits at approximately one year intervals. Spacecraft and experiments are under development for the second, third, fourth, and fifth missions, and experiments are currently being selected for the sixth mission. FY 1966 funds will continue these efforts and provide for initiating the development of experiments and spacecraft for the sixth observatory and for follow-on observatories.

Explorers

The Explorer satellite, as a class, is a relatively small spacecraft and carries a small group of closely related experiments. The Explorer is relatively inexpensive and has the advantage of a short lead time for the experimenter. Explorers continue to be used for research in the atmosphere, the ionosphere, the magnetosphere and interplanetary space, and for geodetic and astronomical measurements. They form the basis of international cooperative efforts with Canada, Great Britain, Italy, France and most recently ESRO (European Space Research Organization). Funds requested for FY 1966 are required to support the current level of activity in this program plus additional activity in four areas. First, a number of missions are being added to the program to take advantage of the opportunity during the 1967-1972 time period of the active Sun to study solar - terrestrial - interplanetary relationships. Second, the Radio Astronomy Explorers initiated in FY 1965 will provide a new research technique for fundamental research in space astronomy. Third, Explorers will be used to exploit recent important discoveries in X-ray astronomy. Fourth, the National Geodetic Satellite Program will be continued in support of Department of Defense, Department of Commerce and NASA requirements.

Sounding Rockets

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 can be used for instrumentation requiring recovery. These rockets are used for studies of the atmosphere, the ionosphere and the radiation that reaches the Earth, and serve as inexpensive carriers to test instrumentation prior to use on a satellite. Their usefulness for astronomical observations has been increased by the development of attitude control systems. They have been used to calibrate satellite measurements by being put into trajectories that carried them close to an orbiting satellite. A worldwide cooperative sounding rocket program has been developed for studying atmospheric movements at an altitude of 50 to 125 miles. An expedition to launch approximately 50 sounding rockets from a converted Navy aircraft transport ship is being conducted as a part of the cooperative effort during the International Quiet Sun Year. The level of effort in FY 1966 will provide for initiating work on experiments to be launched beginning in 1967 and 1968 as a part of a coordinated study of solar - terrestrial - interplanetary relationships during the period of the active Sun.

Data Analysis

NASA has the obligation of making 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. This new project will provide for operation of the data center at the Goddard Space Flight Center including cataloging the data and distribution of reduced data to interested researchers, and financial support for promising proposals that would further utilize the data in storage.

SCHEDULE OF LAUNCHES

Schedule of Significant Research and Development Events

Project	Events	Quarter	Calendar Year
Solar Observatories	- Launch second OSO spacecraft	1	1965
	Launch third OSO spacecraft	2	1965
	(launches at approximately nine month intervals thereafter)		
	Launch first AOSO spacecraft		1969

Project	Events	Quarter	Calendar Year
Astronomical Observatories	- Launch first OAO (launches at approximately one year intervals thereafter)	4	1965
Geophysical Observatories	- Launch OGO in polar orbit (launches at one year intervals thereafter)	4	1965
	Launch OGO in highly eccentric orbit (launches at one year intervals thereafter)	1	1966
Explorers	- Launch six Explorers for studies of the environment of the Earth, interplanetary medium, and Sun-Earth relationships		1965
	Launch Active Geodetic Explorer		1965
	Launch Active Geodetic Explorer		1966
	Launch 2 Passive Geodetic Explorers	2	1966
	Launch Interplanetary Explorer into orbit anchored to the moon		1966
	Launch five other Explorers for studies of the environment of the Earth and the Interplanetary medium		1966
	Launch first integrated Canadian/US International Satellite for Ionospheric Studies (ISIS)		1967
	Launch first Radio Astronomy Explorer		1967
	Launch first X-ray Astronomy Explorer		1967
	Launch Active Geodetic Explorer		1967
	Launch seven other Explorers for coordinated solar - terrestrial - interplanetary studies		1967

Project	Events	Quarter	Calendar Year
	- Launch eight Explorers for coordinated solar - terrestrial - interplanetary studies, one for astronomical observations, and one for geodesy		1968
	Launch eight Explorers for coordinated solar - terrestrial - interplanetary studies, two for astronomical observations, and two for geodesy		1969
Data Analysis	- Initiate distribution of reduced data and financial support of research proposals	3	1965
Sounding Rockets	- Conduct coordinated international geophysical measurements during IQSY		1965
	Collect cosmic dust samples during meteor showers		1965
	Obtain moderate resolution photographic spectra of stars		1965
	Obtain first radio observations of Jupiter from above the ionosphere		1966
	Conduct coordinated geophysical measurements to study solar - terrestrial - interplanetary relationships during the period of the active Sun.		1967 - 1972

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS

LUNAR AND PLANETARY EXPLORATION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objectives of the Lunar and Planetary Exploration program are to carry out the scientific exploration of the solar system and to extend the spacecraft technology and environmental design data for future manned and unmanned missions.

The lunar program consists of three types of missions: Ranger, Surveyor, and Lunar Orbiter. The Ranger program will provide initial data about the surface of the moon by means of high resolution television pictures. The Surveyor missions will demonstrate soft landing techniques on the surface of the moon and will initially be used for selecting suitable landing areas for future manned flights. The Lunar Orbiter program will complement the Ranger and Surveyor programs by providing data best obtained from the vantage point of an orbiting spacecraft.

The planetary program, beginning with the successful Mariner II flight to the planet Venus and including the Mariner IV spacecraft currently on a trajectory to pass close to the planet Mars, is providing invaluable scientific data concerning the planetary and interplanetary environments. Mariner IV will also provide relatively close-up photographs of the planet Mars. 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 planned to be larger and more sophisticated than previous planetary spacecraft and will perform experiments in orbit about the planet and on the planetary surface. This project, named Voyager, will be the first to concentrate on studying the existence of extraterrestrial life. The FY 1965 and 1966 funding will provide for phase I project definition and preliminary design efforts only. Flight hardware development will await successful conclusion of the design effort and will not be undertaken prior to FY 1967.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1964	1965	1966
Supporting research and technology and advanced studies	$22,000	$28,749	$36,800
Ranger	30,306	15,251	1,415
Surveyor	70,704	76,000	85,600

	1964	1965	1966
Lunar orbiter	$20,000	$42,400	$37,000
Mariner	49,152	21,000	3,800
Voyager	---	7,750	43,000
Pioneer	13,600	15,000	8,000
Total	$205,762	$206,150	$215,615

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

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 supporting research program provides the initial information necessary for the design of experiments and spacecraft. It also provides the data necessary for interpretation and cross checking of flight project results. Ground based observatories are utilized to study the moon and near planets. A portion of this effort is directed toward the development and advancement of the technology and reliability of spacecraft systems. Also included in this program are the advanced studies of future unmanned missions which are used for future mission planning and serve as a basis for future mission selection decisions. This program also provides for the space science activities directly related to Apollo, including crew training, mission planning, lunar environmental data collation and Apollo flight experiment development.

Ranger

There are two flights remaining in this program. The objective of this series of flights will be to obtain television pictures of the lunar surface similar to those taken by Ranger VII. However, these Rangers will probably photograph different areas of the moon under different lighting conditions. The FY 1966 funds will be used primarily for post-flight evaluation of engineering data and interpretation and analysis of the photographs obtained.

Surveyor

The Surveyor spacecraft is being developed to accomplish the first soft landing on the moon. A series of seventeen flights are planned, the objectives of which are to survey various landing areas for manned landings and to make measurements including high resolution television pictures of the lunar terrain to improve our understanding of the nature of the moon. FY 1966 funds will provide for spacecraft development, fabrication of the

initial series of Surveyor spacecraft, and for mission peculiar ground equipment and operations. These funds will also be used for the development and testing of the follow-on series of Surveyor spacecraft.

Lunar Orbiter

The Lunar Orbiter will be the first lunar orbiting satellite. Its primary mission will be to conduct photo reconnaissance of the moon. In addition to its photographic mission, it will make scientific measurements of the lunar surface while in orbit. Analysis of its orbit will disclose much about the nature of the moon, its shape, its mass distribution, and its internal structure. The Lunar Orbiter will be used to define landing sites for the Surveyor, and then it will team with the landed Surveyor in the verification of suitable sites for Apollo landings. FY 1966 funds will be used for the assembly of flight spacecraft, test, and preparation for launch, ground support equipment, and training of the launching and operating crew.

Mariner

The objectives of the Mariner program are to conduct flight missions in the vicinity of the planets Venus and Mars to obtain information about their surfaces and atmospheres. Mariner II, which performed the successful flyby of the planet Venus, provided significant additional knowledge of this planet. The Mariner IV spacecraft currently on a flight path to Mars will provide close-up television pictures of this planet. This series of spacecraft completes the Mariner program. The next step in unmanned planetary exploration will be accomplished by the Voyager program, which is discussed in the following paragraph. FY 1966 funds requested for the Mariner program will provide support through the Mars encounter and post-encounter phases of Mariner IV, and in addition will provide for the major part of the extensive post-flight analysis of data and for the preparation of final reports of this mission.

Voyager

The Voyager program would have as its prime objective the performance of experiments on the surface of and in orbit about the planet Mars. Experiments for this mission will be designed to obtain information about the existence and nature of extraterrestrial life, the atmosphere and surface characteristics, and the planetary environment. A secondary objective would be to obtain scientific information on the interplanetary medium. Voyager will be designed as a much larger and more sophisticated system than the previous Mariner missions, with three major systems: the spacecraft bus, retropropulsion, and capsule modules. Spacecraft test flights for this program could be planned for 1969 with the first complete Voyager mission planned for the 1971 Mars opportunity. FY 1966 funds will be used to complete the spacecraft system project definition.

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Pioneer

Pioneer missions are planned to measure the interplanetary phenomena in deep space simultaneously with earth satellites to enable a better understanding of these phenomena and their interrelation and interactions near Earth. A series of four flights are planned under this program to begin near the period of minimum solar activity. FY 1966 funds are requested to cover the final testing, launch, and post-launch operations for the first two flight spacecraft. These funds will also provide for the assembly and start of testing for the third and fourth spacecraft.

SCHEDULE OF LAUNCHES

Schedule of Significant Research and Development Events

Project	Event	Quarter	Calendar Year
Ranger	Ranger C launch	1	1965
Ranger	Ranger D launch	1	1965
Pioneer	Pioneer A launch	3	1965
Mariner	Mars encounter	3	1965
Surveyor	First Surveyor test flight	4	1965
Orbiter	First Lunar Orbiter flight	-	1966
Surveyor	First Operational Surveyor flight	-	1967
Voyager	Test flights	-	1969
Voyager	First Voyager flight	-	1971

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS — SUSTAINING UNIVERSITY PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATIONS:

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 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 multidisciplinary 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:

	(Thousands of Dollars)		
	1964	1965	1966
Training	$19,812	$25,000	$25,000
Research facilities	12,000	10,000	8,000
Research	8,188	11,000	13,000
Total	$40,000	$46,000	$46,000

BASIS OF FUND REQUIREMENTS:

Training

The space program continues to place increasingly severe demands on the supply of highly trained scientists and engineers. The President's Science Advisory Committee has emphasized the need for more trained manpower, particularly in the fields of engineering, mathematics and the physical sciences, and has recommended action to increase the number of persons receiving Ph.D's to a total of 7,500 per year by 1970. In 1963 the number of persons receiving the Ph.D degree in the engineering, mathematical, and physical sciences totalled 4,250.

In order to train a commensurate share of the needed personnel holding Ph.D's, who will become involved in the space program, about 1,300 new students should be brought into the program to commence their three years of training in FY 1966, at a cost of about $25 million. In September 1964, 1,071 new students began their three years of training under the NASA pre-doctoral program. About 1,275 new students will begin their three years of training in September 1965. 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.

Research Facilities

Research and training in space-related science and technology are often impeded by inadequate or complete lack of laboratory space in many institutions. An increasing number of universities will be constrained from accommodating a great deal more NASA work unless reasonably adequate facilities can be acquired under this program. This expansion of graduate research laboratories for the use of many disciplines is essential to the successful accomplishment of the national program of space exploration. Most of the scientists performing 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 for space-related research. Therefore, facility acquisitions initiated through FY 1965 for this project will add approximately 1.25 million square feet of laboratory space at a cost of only $39 million. A continued, orderly and deliberate acquisition rate to help fulfill part of the remaining needs requires $8 million for construction of an additional 250 thousand square feet of laboratory space during FY 1966.

Research

There is an urgent need to expand and improve the capabilities of the nation's universities to conduct research in the space sciences and technology in order to meet the long-range goals of the space program and remain a world leader in the exploration and conquest of space. Positive action is

being taken to meet this need by supporting broad programs of space and aeronautical research which have been specifically tailored to the individual characteristics of each university, thus affording maximum opportunity for the adoption of new approaches, balancing and strengthening existing work, and stimulating the development and growth of new talent. In addition, by supporting quality research at selected institutions not currently participating in the space program, the number of universities involved in attacking some of the fundamental problems is permitted to grow and thus broaden the base of the nation's total university research capability. To carry out this program, the $13 million request for FY 1966 special purpose research projects will be used to award about sixty-six grants to approximately sixty universities. Fifty-six of these grants will be for the continuation of projects supported in FY 1965, and the remainder will be awarded to universities participating in this program for the first time.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS — LAUNCH VEHICLE DEVELOPMENT PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of Launch Vehicle Development 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 systems 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:

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

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

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 and guidance) and operational techniques which may be applied to vehicle improvements or new vehicle development, as required, to meet new mission requirements.

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 the use of computer program work in launch vehicle planning and technology.

Centaur Development

The Centaur Development program is to provide a high performance liquid hydrogen fueled launch vehicle for unmanned lunar and planetary missions which are beyond the capabilities of the Atlas-Agena launch vehicle. It will be used principally for the Surveyor series of unmanned soft lunar landings. Four of the eight scheduled flight tests in this development program, which extends through 1966, have been completed.

Funding for FY 1966 is for continuation of the development effort and flight testing of the Centaur vehicle. In addition, improvement effort on the RL-10-A3 engine has been included in the Centaur Development project.

SCHEDULE OF LAUNCHES

Schedule of Significant Research and Development Events

Project	Event	Quarter	Calendar Year
Centaur	Launch of AC-5 to demonstrate direct ascent to lunar impact	1	1965
	Launch of AC-6 to demonstrate the operational configuration	2	1965
	Launch of AC-8 to demonstrate Centaur two-burn capability	4	1965
	Launch of AC-9 to demonstrate the Centaur two-burn to lunar impact capabilities	1	1966

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS LAUNCH VEHICLE PROCUREMENT PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

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

In this submission, vehicle costs are shown as non-add notations with the specific missions to permit assessment of total project costs. However, for the first time the total vehicle procurement funding requirements are presented as a separate program.

SUMMARY OF RESOURCES REQUIREMENTS:

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

BASIS OF FUND REQUIREMENTS:

Scout Procurement

The Scout Procurement program provides a reliable, relatively inexpensive vehicle for general space research. The vehicle's capabilities include orbital, probe, and reentry missions. It is the smallest of the basic NASA family of launch vehicles and meets the requirements for a variety of small sized payloads for NASA, Department of Defense, and Atomic Energy Commission missions.

The FY 1966 funds for Scout Procurement will be applied to existing procurement actions for the purchase of vehicles, motors, and services.

New procurement actions will be initiated using FY 1966 funds to meet mission requirements beginning in FY 1966.

Delta Procurement

The purpose of the Delta Procurement program is to provide a reliable launch vehicle for medium payload satellites and small space probes. The Delta vehicle is used for a variety of scientific and applications satellites, and small scientific probes. Improved performance of the Delta vehicle will be obtained through improvements in the Delta second stage and the use of thrust augmentation with the Thor booster.

Funds requested for FY 1966 will provide for launch services requirements, procurement of Thor boosters, Delta second stages, X-258 third stages and supporting services to meet launch schedule requirements for the Delta vehicle.

Agena Procurement

The Agena second stage used with Atlas or Thor boosters is employed extensively for scientific and applications satellites, lunar, and planetary missions. The restartable Agena stage provides considerable latitude in mission capability among the various earth-orbital and lunar or planetary missions.

Funds requested for FY 1966 will provide for continued procurement of the basic Agena stage, Atlas and Thor boosters, the modifications necessary to adapt the Agena stages to the missions, launch services, and other supporting services.

Centaur Procurement

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. The Centaur vehicle is a high performance, general purpose launch vehicle to be used for unmanned lunar and planetary missions beyond the capability of the Atlas-Agena vehicle.

FY 1966 funds provide for continuation of Atlas booster procurement, RL-10-A3 engine procurement, guidance procurement, adaptation of the vehicles to the Surveyor mission, and supporting services.

Atlas Procurement

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 assigned to the Lewis Research Center.

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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.

SCHEDULE OF LAUNCHES

The mission plan for launches during 1965, 1966 and 1967 is:

Vehicle	Calendar Year 1965	Calendar Year 1966	Calendar Year 1967
Scout	6	9	12
Delta	7	9	14
Thor-Agena	2	4	2
Atlas-Agena	4	6	6
Centaur	1	3	5

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

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; and (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 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.

SUMMARY OF RESOURCES REQUIREMENTS:

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

BASIS OF FUND REQUIREMENTS:

Supporting research and technology

Exobiological efforts in the search for extraterrestrial life will be one of the prime objectives of NASA 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.

3. Life-detection experiments are being designed for both unmanned and manned exploration.

The life-detection experiments now being developed will seek to determine if life exists on Mars by trying to detect one or more of the parameters of life as we know it on Earth. The Automated Biological Experiment System will incorporate integrated life-detection experiments of greater flexibility than a limited number of separate highly specialized exobiology experiments, increase the probability of success in detecting planetary life forms, and decrease the likelihood of fallacious interpretations of the resulting data.

The Planetary Quarantine program is essential to exobiological investigations of the planets. The sterilization program includes research to improve present methods and to develop new methods of sterilization compatible with flight and experimental reliability.

Environmental, Behavioral, and Physical Biology Supporting Research and Technology efforts employ basic and applied research in support of the exobiology program, manned space flight, and other aspects of the total Bioscience Program. Examples of research efforts in these areas are: (1) the study of biological organisms to determine their use in space in: (a) bioregenerative life support systems, (b) modifying planetary atmospheres, and (c) determining the effects of radiation, acceleration, and vibration; (2) neurophysiological, biochemical, and behavioral analyses to define brain behavior relationships of importance to the organism in dealing with stress producing environmental factors; (3) investigation of effects of prolonged confinement in small spaces; and, (4) to select living organisms which are uniquely suitable for biological investigations in orbiting vehicles and planetary probes.

Bioscience Investigations for Manned Space Missions includes the research and development necessary to provide scientific experiments and associated equipment for flight on manned spacecraft. The initial emphasis has been placed on Gemini and Apollo missions.

Biosatellite

The Biosatellite program will study the effects of the space environment upon lower forms of life, human tissue, plants, small animals, and primates in order to be able to accumulate basic 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. Seven experiments will be used to explore the combined effects of radiation and weightlessness. These particular experiments 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. The most complex system studied will be that of the primate. The effects of weightlessness on the

primate's cardiovascular, skeletal, and central nervous systems will be studied during orbits of 30 days duration.

SCHEDULE OF LAUNCHES

Schedule of Significant Research and Development Events

Events	Quarter	Calendar Year
Biosatellite first launch	-	1966

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

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 (SR&T) 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).

The contribution of this program through development of techniques and instrumentation for obtaining data to improve the accuracy and timeliness of weather predictions and increasing our knowledge of the upper atmosphere can be extremely beneficial to mankind, nationally and internationally.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1964	1965	1966
Supporting research and technology.....	$7,754	$7,500	$8,200
Meteorological flight experiments.....	---	1,200	4,000

	1964	1965	1966
Tiros	$11,506	$4,100	$4,800
Nimbus	41,673	16,000	22,700
Meteorological soundings	2,244	2,400	3,000
Total	$63,177	$31,200	$42,700

Supporting Research and Technology

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 lifetime of spacecraft instrumentation; and (6) to develop equipment for the observation of Earth phenomena from manned orbital spacecraft. The supporting research and technology effort is applicable to both the research and development portion of the program and the operational system for the Weather Bureau. FY 1966 funds are required to continue efforts previously initiated and for development of advanced cameras; improved power, telemetry, stabilization, and control systems; and to conduct studies leading to experiments on future manned flight and to the development of advanced unmanned systems.

Meteorological Flight Experiments

Meteorological experiments are planned for inclusion aboard the Applications Technology Satellites (ATS) to explore techniques of obtaining continuous cloud data over both the full disc of the Earth and selected areas of the Earth from the vantage point of high altitude and synchronous orbits. FY 1966 funds are required for procurement of high and low resolution cameras, image motion compensation devices, and zoom lenses for the high resolution cameras for the spin-stabilized ATS B and C flights.

Tiros

The Tiros project has demonstrated the engineering and scientific feasibility of the accumulation and dissemination of meteorological data 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 the 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 ninth spacecraft, Tiros I (Eye), the spin-stabilized "wheel" configuration

will be launched in 1965 to obtain interim operational data and to prove this configuration prior to its use in the Weather Bureau funded TOS system. Two additional Tiros spacecraft are programmed for research and development tests leading to advanced meteorological satellite systems development. Additional efforts are underway to develop flight hardware for improvements to the TOS system, to improve reliability and extend subsystem and component life and to meet operational data requirements.

FY 1966 funds are required to complete procurement of the K and L spacecraft and related ground equipment, for ground support for Tiros I (Eye) and K, and for continued effort in the TOS improvement program.

Nimbus

The Nimbus spacecraft is larger than Tiros or TOS and of flexible design, oriented to view to the Earth at all times, providing the essential structure for testing a variety of subsystems and sensors.

The objectives of the Nimbus project are to conduct experimentation leading to obtaining: (1) full picture coverage of daytime cloud cover; (2) daytime cloud cover for local users; (3) infrared measurements of the nighttime cloud cover; and (4) observation of pressure, temperature, wind and water vapor at several altitudes to cover the entire globe.

The successful launch and operation of Nimbus I in 1964 has provided a proven basic spacecraft with three axes stabilization, and power and weight capabilities suitable for testing sensors and subsystems for eventual use in operational meteorological satellites to fulfill the longer range operational data requirements. It also provides capabilities for special atmospheric observations and simultaneous measurements, and provides information for real time use by operational weather data users. FY 1966 funds are required for final preparations, launch, and ground operations for Nimbus "C", incremental funding to continue the Nimbus "B" spacecraft, experiments, ground operations and support; and to initiate development of the Nimbus "D" spacecraft and experiments.

Meteorological Sounding Rockets

Meteorological sounding rocket development programs for large and small sounding rockets are under way, as well as field support for scientific sounding rocket experiments and investigations in cooperation with other countries. Development in the large meteorological sounding rocket is aimed at providing capabilities for exploring the region from 40 to 60 miles in altitude. In the small meteorological sounding rocket program, a reliable, simplified, self-sufficient sounding rocket system is being developed for the routine measurement of meteorological parameters in the 20 to 40 mile region of the atmosphere. FY 1966 funds are required for additional ground equipment and the launch of 45 to 50 large sounding rockets, and for the launch of 100 small sounding rockets and payloads, improvement of rocket systems, and initiation of design and development of an advanced system. Field experiment support

in FY 1966 is planned for the study and observation of the upper atmosphere in Asia, Europe, and South America through the use of small meteorological sounding rockets at several sites in cooperative programs.

SCHEDULE OF LAUNCHES

Schedule of Significant Research and Development Events

Project	Events	Quarter	Calendar Year
Tiros	Launch of Tiros I, the first Tiros wheel configuration.	1	1965
TOS*	OT-1 - Available for launch to fill any data gap which may develop.	-	1965-66
TOS*	Launch of OT-3, a duplicate of Tiros I to obtain operational data.	4	1965
Nimbus	Launch of Nimbus C, the backup for Nimbus I with additional instrumentation.	1	1966
TOS*	Launch of OT-2, the operational APT-equipped Tiros wheel.	1	1966
TOS*	Launch of TOS-A, the operational AVCS-equipped Tiros wheel.	2	1966
TOS*	Launch of TOS-B through H. One APT and one AVCS spacecraft to be kept operating in orbit.	"B" 3 and 1 per Qtr.	1966 1966 & 67
Tiros	Launch of Tiros K into high elliptical orbit.	2	1966
Tiros	Launch of Tiros L into high elliptical orbit.	-	1966
Nimbus	Launch of Nimbus B, an improved version of Nimbus carrying atmospheric structure experiments and other pre-operational experiments.	-	1967
Nimbus	Launch of Nimbus D.	-	1968

*Weather Bureau funded.

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RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS COMMUNICATION SATELLITES PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objectives of the Communications 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 with five other Government Agencies will determine jointly the requirements, existing and estimated, the cost effectiveness, and the potential capability of a satellite system to meet these future needs.

SUMMARY OF RESOURCES REQUIREMENTS:

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

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

The Communications and Navigation activity in Supporting Research and Technology will identify and solve critical technical problems, advance the state-of-art, and provide a foundation for future advanced Communications/ Navigation satellites. Supporting Research and Technology on overall Communication/Navigation system problems has been concentrated in three areas, namely advanced passive and active communications satellite concepts; navigation-traffic coordination system feasibility; and experimentation on fundamental problems of electromagnetic propagation on communications and measurements.

Echo II

The Echo project consisted of design, development, launch, and evaluation of a large inflatable passive communication satellite. Other than a low level effort in experiments on Echo II, the project has been completed. No FY 1966 funds will be required.

Relay

Project Relay consisted of the design, development, launch, and evaluation of two intermediate altitude active communications satellites. This project demonstrated the capability to economically and reliably perform narrowband and wideband communication between widely separated ground stations for long periods of time. Relay I was successfully launched in December 1962 and Relay II in January 1964. FY 1966 funds will be used for continued communications and radiation experiments data reduction and analysis.

Syncom

Project Syncom consisted of the design, development, launch, and evaluation of synchronous altitude active communication satellites. This project demonstrated the capability of performing communications experiments including telegraph, digital data, and TV demonstrations reliably, economically, and for long periods of time. The project was completed following the launch of Syncom III in August 1964 and subsequent successful demonstrations. FY 1966 funds will be used for continued communications experiments data reduction and analysis. Fiscal Year 1965 and 1966 fund requirements are based on planned transfer of Syncom II and III to the Department of Defense (DOD) in 1965.

Early Gravity Gradient Experiment

The Early Gravity Gradient project consisted of the design, development, and flight testing of a gravity gradient stabilization system in support of the Defense Communication Satellite program. The NASA and the 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.

The 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 costs of the spacecraft. No FY 1966 funds are requested by NASA.

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS

APPLICATIONS TECHNOLOGY SATELLITES PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

This program was formerly entitled Advanced Technological Satellites. The objectives of the program 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 the 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, station keeping in the synchronous orbit, and for basic information to validate theoretical concepts of 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:

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

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

The objective of the Supporting research and technology is to provide a continuing effort in spacecraft component and materials investigations and development, advanced instrumentation, stabilization and control systems development, technology experiment feasibility and design, and advanced system studies.

Applications Technology Satellites

This project consists in the design, development, launch, and evaluation of a basic spacecraft capable of performing communications, meteorological, gravity gradient stabilization, scientific and other technological experiments. The project includes five launches, one of a gravity gradient stabilized satellite in a 6,500 mile circular orbit, and two launches of spin stabilized satellites and two launches of gravity gradient stabilized satellites into synchronous orbit. All five satellites will carry meteorological, communications, scientific and other technological experiments, and in addition, the 6,500 mile orbit, and two synchronous satellites will carry gravity gradient experiments. FY 1966 funds are required for continuation of spacecraft development, gravity gradient system development, communication test equipment, and scientific and technological experiments. The funding for the ground station systems development and modifications are included in the Tracking and Data Acquisition Program.

SCHEDULE OF LAUNCHES

Schedule of Significant Research and Development Events

Project	Events	Quarter	Calendar Year
ATS-A	Launch of 6,500 mile gravity gradient stabilized satellite	-	1966
ATS-B,C	Launch of two spin stabilized satellites into synchronous orbit	-	1967
ATS-D,E	Launch of two gravity gradient stabilized satellites into synchronous orbit	-	1968

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — BASIC RESEARCH PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The purpose of the Basic Research Program is to initiate and administer fundamental research in the physical and mathematical sciences which will provide an understanding of phenomena which are important to the development of current and future aircraft and spacecraft. This basic research is carried out in NASA's Research Centers with some contract assistance by universities, industrial and other Government laboratories. Fundamental knowledge in many fields is essential for NASA's programs to advance in an orderly manner and on a scientific basis. Basic research in NASA has, therefore, to cover a wide range of disciplines, and varies from very fundamental studies into the nature of the atomic nucleus and its internal energies to more applied research in materials for application to supersonic transports or entry vehicles. Much of the Basic Research Program cannot be specifically identified with current NASA projects. Its broad objective is to increase man's knowledge and understanding of the physical laws of nature and of their mathematical expression, definition, and interpretation.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1964	1965	1966
Supporting research and technology.....	$22,653	$21,231	$22,000
Total.....	$22,653	$21,231	$22,000

BASIS OF FUND REQUIREMENTS:

The Basic Research Program concentrates on four major disciplines directly related to NASA's current and future missions. These disciplines are Fluid Physics, Electrophysics, Materials, and Applied Mathematics. The following examples show some of the projected accomplishments of our FY 1966 program. Refinements in magnetohydrodynamic accelerators should permit more realistic simulation of reentry conditions in the laboratory. Improved superconductors at less extreme temperatures should make possible extremely small and lightweight magnets with very powerful magnetic fields which could be used as a spacecraft shield against particle radiation. Research in Materials will enable designers to select specific materials for many demanding requirements now being met with existing materials far less suited to the tasks. Improved mathematical techniques will enable complex physical phenomena to be represented more easily and more accurately and to be solved with greater accuracy and speed on electronic computers.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — SPACE VEHICLE SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objectives of the Space Vehicle Systems Program are to identify and solve the critical design problems associated with space vehicle launch and ascent through the atmosphere, flight through space, entry into the atmosphere of Earth or other planets, and landing. The program seeks to advance the state-of-the-art on a broad front to permit the conception and development of advanced vehicles and at the same time to solve critical technical problems that may arise during the course of development of present generation space vehicles.

Major progress was made during the past year both in ground based research and in flight research projects which included the successful conduct of the first experiment in Project Fire to measure entry heating at lunar return speeds and the successful launching of the Explorer XXIII meteoroid satellite. During FY 1966 emphasis will be placed on advancing the technology through coordinated laboratory and flight research in lifting entry flight with special reference to the M-2 and HL-10 lifting body configurations, in hypervelocity aerothermodynamics and ablative heat shield performance, and in the meteoroid hazard area. A major milestone in the meteoroid hazard program is expected during the coming year with the Saturn launchings of the very large Pegasus spacecraft. Augmented effort will also be given to research on the effects of high energy radiation in space vehicle materials and components in the Langley Research Center's new Space Radiation Effects Laboratory, with its 600-million-electron-volt cyclotron, which will begin operation during FY 1966.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1964	1965	1966
Supporting research and technology.....	$24,951	$24,559	$24,000
Project FIRE.....	7,037	2,811	500
Scout reentry project.....	305	750	5,000
Lifting body flight and landing tests.....	1,200	1,500	1,000
Project Pegasus (Saturn-launched meteoroid experiment).....	9,900	13,690	2,500
Small space vehicle flight experiments.....	1,959	1,010	2,000
Scout-launched meteoroid experiments.....	362	175	---
Total.....	$45,714	$44,495	$35,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

The funds requested are needed for the conduct of an aggressive broad base program of research in spacecraft aerothermodynamics, spacecraft structures, launch vehicle aerothermodynamics, launch vehicle structures, space environmental factors, advanced space vehicle concepts, and vehicle design criteria. The research is carried out primarily at Langley, Ames, Lewis and Flight Research Centers, with a complementary effort in specialized areas at Marshall and Goddard Space Flight Centers, Manned Spacecraft Center, and the Jet Propulsion Laboratory. The research is conducted in-house at these NASA Installations and by contract with industry and educational institutions.

Project FIRE

The second (and last) FIRE launch will take place at the end of FY 1965. Fiscal year 1966 funds are required to complete operations on the project and to analyze and publish the results.

Scout Reentry Project

Scout experiment Reentry E will be flown early in FY 1966 to measure the performance of a phenolic-nylon heat shield material. Next, two reentry experiments will measure the performance of two elastomeric materials showing promise for heat shields exposed to long duration reentry heat pulses. Two other experiments will establish the Reynolds Number for transition from laminar to turbulent flow and the heat transfer rate for turbulent flow on a slender cone at 20,000 feet per second, factors which profoundly influence the design of lifting reentry configurations. The FY 1966 funds are needed for design and construction of the instrumented payloads for the four experiments to follow Reentry E.

Project Pegasus

Each of the three Pegasus spacecraft, to be launched on Saturn I development vehicles, will expose to meteoroid penetration an area of more than 2000 square feet, permitting measurement of penetration rates in materials as thick as .016 inches. Design studies will be undertaken to exploit the technology of the capacitor type, meteoroid penetration detector, developed in Project Pegasus, to define the penetration hazard in the region between the Earth and the Moon. During FY 1966 project definition studies will be carried out with the objective of establishing in detail the experimental techniques to be used and the probable schedule of events.

The FY 1966 funds are required for launch of the third Pegasus spacecraft and for analysis of the results of the experiments. Funds are also required for project definition and design studies for the next phase of experiments.

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Small Space Vehicle Flight Experiments

This project consists of a series of carefully selected flight experiments using small rocket launch vehicles to verify results obtained in ground based facilities and to investigate problems which can only be studied under the conditions which exist in actual flight. Current work includes experiments to establish the behavior of cryogenic propellants and other fluids in the weightless condition, measurements of the statistical distribution of wind velocities at various altitudes above major rocket launching bases in the United States (Eastern Test Range and Wallops Island), and experiments with artificially created meteors. The reentry phase of this program is designed to test promising spacecraft materials for correlation with the test results obtained in ground based facilities and for further correlation with the test results obtained in the higher velocity Scout Reentry flights.

The funds requested in FY 1966 are required to procure spacecraft, instrumentation and small rocket motors used in performing these experiments.

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — ELECTRONIC SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of this program is to provide the necessary advances in technology to assure the availability of reliable and efficient electronic components for future aeronautical and spaceflight missions. Research is conducted in the laboratory on the problems of guidance, control, communications, tracking, instrumentation, and data processing systems. Small flight experiments are used to confirm results of laboratory research and, in some cases, to obtain solutions to problems which cannot be studied adequately in the laboratory.

In guidance systems research the objective is reliable and lightweight sensors, reference elements, and associated components which will make up future guidance systems. The program emphasizes technique and component research in inertial, optical, and electromagnetic phenomena for use in the sensing and reference functions. The companion program in control systems research establishes the technology and design requirements for manual and automatic flight control systems and spacecraft attitude stabilization systems. It deals with the problems of displays for manned vehicles, adaptive automatic controls, economical attitude stabilization for long life satellites, and accurate pointing techniques for optical communication devices.

Research in communications is concerned with increasing the data transfer capability of spacecraft by providing advanced techniques and components for space-to-ground communication. Satellites and deep space probes require smaller, lighter equipment with more power and greater reliability than is presently available in order to transmit information without unduly consuming payload weight. Particularly critical are the requirements imposed on a communications system by space probes to Venus, Mars and beyond. Related research in data acquisition is providing the basis for further improvements in the ground based systems designed to track spacecraft and receive transmitted data. Improved accuracy in the determination of trajectory parameters will, among other things, increase understanding of geophysical phenomena and variations in the Earth's gravitational field.

The rapidly expanding requirements for automatic data processing systems, to be used both on the ground and on board spacecraft are stimulating many new developments in this field. The research in this program is providing a basis for improvements in direct, rapid communication between computers and users; for higher capacity, fast data storage units, and for greater use of data processing systems in logical decision making.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1964	1965	1966
Supporting research and technology....	$26,380	$23,322	$30,000
Small flight projects.....	2,320	2,100	4,400
Total.....	$28,700	$25,422	$34,400

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

Funds are required to continue research on promising guidance devices such as cryogenic and electrostatically suspended gyroscopes, optical radars, star mappers, and star trackers. Research in control systems and techniques such as gravity gradient stabilizers, displays, and aircraft landing equipment will be continued. Considerably more emphasis in FY 1966 will be placed on communications research; specifically on transmitter tubes designed for optimum efficiency, on practical laser communications devices, and on improved understanding of propagation phenomena at both radio and optical frequencies. The program will include research on electronic circuits to increase reliability. It will continue work in progress on promising new computer memories, magnetic logic devices and on concepts which improve the accessibility and utility of computers in spacecraft or ground based applications. Research in instrumentation will emphasize remote upper atmosphere density sensors, improved vacuum analyzers, solid state image converters and low power or wireless bioelectronic devices.

Small Flight Projects

Small flight projects support both the radio attenuation measurements and the horizon definition research programs. Ground based simulation techniques are inadequate to verify research theories in these areas. The radio attenuation measurements (Project RAM) has to date established that materials addition tends to alleviate the radio blackout problem for entry velocities below 18,000 feet per second. Future flights are planned using the Scout vehicle to evaluate this and other techniques for reentry velocities of 28,000 feet per second and beyond. Flights in support of the horizon definition research program (Project SCANNER) are planned to develop a better knowledge of the Earth's horizon so that better vertical sensors based on horizon scanners can be designed. These flights, utilizing Trailblazer II vehicles, will be sub-orbital and will carry high-resolution radiometers and a star mapper reference system.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — HUMAN FACTOR SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

This program has four major objectives: (1) to determine man's reactions to the novel environments of space and aeronautical flight, (2) to define the essential requirements for sustaining and protecting man in these environments, (3) to provide the technology necessary to develop suitable life-support and protective systems, and (4) to discover means of integrating man's capabilities with those of machines to obtain composite systems of superior performance.

The first and second objectives will help establish the limits of man's usefulness in space or on the moon: To what extent will his ability to explore, observe, and experiment be encumbered by the mechanical devices and restraints necessary to sustain his life? How will his judgment and powers of perception be affected by his environment? What limitations must be placed on his exposure time to extra-terrestrial environments to avoid both immediate and long-term damage? The second and third objectives together will determine the costs in weight, and therefore in dollars, of sustaining human life in space: How much food, water, and artificial atmosphere must be provided? To what extent, and at what cost in weight, can these be manufactured on board the spacecraft from human waste products? How much natural radiation can man endure and how can the required shielding be provided at least weight? The fourth objective will determine the extent to which the presence of man, with his unique capabilities, can compensate for the costs of sustaining him: How can the machine systems required to take him to the moon be made simpler, more reliable, and lighter in weight by substituting human functions for certain mechanical functions? How can man's capabilities as an observer and recorder of information be augmented by machine systems?

Answers to all of these and many other related questions are being sought in this research program. The work is done by researchers in electronics, physics, engineering, psychology, biology, and nearly every field of medicine. Many of these are NASA scientists and engineers; many more are located in university and industrial laboratories and in other Government agencies.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1964	1965	1966
Supporting research and technology..	$13,200	$11,850	$13,000
Small biotechnology flight projects..	---	1,470	1,900
Total.....	$13,200	$13,320	$14,900

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

This program has four major objectives: (1) to determine man's reactions to the novel environments of space and aeronautical flight, (2) to define the essential requirements for sustaining and protecting man in these environments, (3) to provide the technology necessary to develop suitable life support and protective systems, and (4) to discover means of integrating man's capabilities with those of machines to obtain composite systems of superior performance. The research is conducted in NASA Installations, in university and industrial laboratories, and in other Government-agency laboratories.

Small Biotechnology Flight Projects

This project represents a continuing series of small flight experiments each designed either to validate results of laboratory research or to obtain essential information not obtainable from research in the laboratory. Experiments to be performed in FY 1966 include the measurement of physiological processes in humans under conditions of stress encountered in flight, and measurements of the adaptability of animals to prolonged orbital flight.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY NUCLEAR-ELECTRIC SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

Nuclear-electric power generating systems and electric propulsion systems have been considered as two complementary parts of this single overall program. For future manned deep space or interplanetary missions in which the high specific impulse attainable from electric propulsion would be uniquely advantageous, nuclear-electric power is the only feasible source of the megawatt power levels required for large electric thrustors. Research has also indicated potential applications of electric propulsion for attitude control and station keeping where power levels of only watts would be required, and for satellite orbit raising and unmanned space probes where power requirements would be in the kilowatt range. The lower power requirements for these applications of electric propulsion can again be provided by nuclear power generation systems, although the power systems described under Chemical and Solar Power may also be applicable.

Concepts for utilization of large nuclear reactor power systems include potential for stationary power plants on the moon and planets, and for advanced communication and other on board power requirements as well as for electric propulsion. Isotope power represents the nuclear energy contribution at low power, in the watt to kilowatt range.

The Atomic Energy Commission (AEC) is developing isotope powered systems, and it is proceeding with efforts in the range up to 250 watts. NASA is responsible for integrating such power supplies into spacecraft. Close coordination between the agencies is maintained to insure that the AEC work is directed to meet NASA's requirements and that the results will be suitable for effective integration into the spacecraft systems.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1964	1965	1966
Supporting research and technology....	$26,749	$23,192	$24,000
SNAP-8 development.....	15,465	17,000	---
Space electric rocket test (SERT).....	3,467	2,300	3,000
Small nuclear electric propulsion and power flight projects.....	282	---	---
Total.....	$45,963	$42,492	$27,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

In nuclear power generation, technology is provided for conversion of nuclear energy to electric power by power conversion systems such as the liquid metal Rankine cycle, the gaseous Brayton cycle, thermionic direct conversion and magnetoplasmadynamic systems. Component research, liquid-metal and liquid-metal vapor properties, space environment effects, advanced concepts and mission analysis represent typical areas of research. In Electric Propulsion research, major emphasis is on the technology of electrostatic thrustor systems (ion engines) that have now been both scaled up and clustered from three kilowatts to 30 kilowatt units, with the next immediate objective of scaling to a 100 kilowatt size. Small electrothermal thrustors such as arc jets and resistance heated jets are also receiving emphasis because of early potential application for satellite attitude control and station keeping.

Space Electric Rocket Test (SERT)

The broad objectives of the SERT program have been to obtain data on electric thrustor systems that cannot be obtained in ground test facilities, and to flight qualify electric propulsion systems for mission application. On July 20, 1964, the SERT I flight conclusively demonstrated that electric thrustor ion beams can be successfully neutralized in space and also validated ground based facility practice. In the current phase of the SERT project, electric thrustors are being evaluated in ground based facilities for satellite attitude control and station keeping applications. If proven advantageous, the ground test results will be verified by flight test.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — NUCLEAR ROCKETS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The emphasis in the nuclear rockets program is on laying a technological foundation for proceeding with confidence on the development of nuclear rocket systems that will be required to accomplish heavy payload, high energy missions in space.

Nuclear rocket propulsion provides significant performance advantages for potential missions beyond Apollo such as lunar base logistics operations, very heavy deep space instrumented probes, and manned exploration of the planets. Manned planetary expeditions are considered among the major applications for nuclear rockets; a nuclear rocket-propelled Mars spacecraft could be one third to one fifth the weight of a chemically propelled spacecraft.

A major part of the nuclear rocket program is the research and engineering on the nuclear reactor itself since this entire field is relatively new. In addition, emphasis is placed on the solution of problems associated with non-reactor components whose operating requirements tax the available technology and on the study of the fundamental heat transfer, fluid flow, structural design, and nuclear phenomena involved. An essential part of this program is investigation of experimental ground test engine systems required to develop a full understanding of the interaction of components in nuclear rocket engines and of the system performance characteristics. These data form a basis for eventual flight system development and provide information required by mission planners to incorporate nuclear rocket capabilities in advanced missions.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1964	1965	1966
Supporting research and technology....	$21,261	$21,731	$22,000
Kiwi.....	1,700	---	---
NERVA.....	48,820	34,261	35,000
RIFT.....	6,645	---	---
NRDS.....	750	739	1,000
Total.....	$79,176	$56,731	$58,000

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BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

The supporting research and technology program satisfies four basic needs:

1. supporting data for current projects (NERVA).

2. technology for the development of future generations of nuclear rocket engines and vehicles.

3. feasibility investigations of advanced nuclear propulsion concepts, and

4. studies of special flight safety consideration of nuclear rockets.

The program includes research on the components and systems required for both the reactor and engine of future nuclear rocket propulsion systems. The major problems studied are those associated with developing systems that will operate reliably under the adverse conditions of reactor radiation and temperature extremes inherent in a nuclear rocket engine.

NERVA

The objective of the NERVA (Nuclear Engine for Rocket Vehicle Application) project is to develop nuclear rocket engine systems that can be tested in ground based facilities to provide a complete understanding of the performance and operation of these systems and their major components under operating conditions corresponding to those of future space missions. The work is being carried out at a nominal power level of 1,000 megawatts, corresponding to a thrust of approximately 50,000 pounds with a specific impulse over 700 seconds. The emphasis is on developing for this purpose components and systems which can lead directly to the later development of operational flight engine systems with a high assurance of success. Specific technical objectives for the NERVA project are to provide the reactor, engine systems, facilities and component technologies. The project is conducted principally under a joint AEC-NASA contract by the Aerojet-General Corporation and Westinghouse Electric Corporation.

NRDS Operations

The mission of the Nuclear Rocket Development Station in Nevada is to provide a site for ground static testing of reactors, engines, and eventually, vehicle stages for the Nuclear Rockets Program. The funds under this project provide for NASA's share of the base support services necessary in the maintenance and operation of the facilities at the site.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — CHEMICAL PROPULSION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The chemical rocket research program explores the engineering science of propulsion for the spectrum of anticipated vehicle applications including launch vehicles, upper stages and spacecraft. The work covers basic studies and experiments such as measurements of chemical and physical properties of propellants, ignition and combustion phenomena, classical and non-equilibrium thermodynamic processes, studies of fluid mechanics; gas dynamics; heat transfer and solid mechanics. This area also includes the examination of new materials, propellants or processes. Analyses are made of the functions a piece of propulsion equipment must do, the performance levels that can be met and, in the broad cycle efficiency sense, the conditions under which it might best perform. Future requirements and new problem areas are identified for further work.

An experimental engineering program has been undertaken to bridge the technological gap between propulsion research and the initiation of mission oriented propulsion system development. This work involves the design, fabrication and test of model experimental propulsion systems and sub-components to demonstrate their engineering practicality. These experimental system demonstrations will significantly reduce the engineering costs and development times required to bring advanced propulsion systems to operational status when future programs require. They will also provide mission planners with clearly defined operational envelopes for future propulsion systems. A direct result of this work will be preliminary engineering specifications for advanced systems with design criteria and fabrication process detail. A by product will be realistic assessments of potential development costs and schedules, and facility and equipment requirements.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1964	1965	1966
Supporting research and technology.....	$21,970	$24,762	$30,000
M-1 engine project.....	24,000	24,000	---
Large-solid-motor project.....	---	15,000	---
Small chemical propulsion flight projects..	30	30	---
Total.....	$46,000	$63,792	$30,000

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

Advanced engine design concepts for improving vehicle performance with chemical propellants are being investigated for launch vehicle and upper stage application; the more exotic high energy propellants are being examined for use in spacecraft where high specific impulse offers significant weight savings. A liquid propellant experimental program is concentrating initially on spacecraft propulsion related to immediate future applications; it includes an advanced propulsion system designed for earth storable propellants and an extension of work on high performance propellant systems intended for use in upper stages.

The solid propellant motor program includes research on nondestructive testing techniques for inspection and qualification of loaded motors, ignition and instability problems, thrust vector control systems, methods of combustion termination, and improved processing techniques. New requirements under investigation are stop-restart capability, more accurate thrust alignment, and improved predictability of propellant burning rate. An experimental engineering program will support the technology related to solid motor development.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY SOLAR AND CHEMICAL POWER PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Solar and Chemical Power program provides research and technology necessary for the development of new and improved methods of solar and chemical power generation for space applications. The program includes research on all elements of complete systems: (a) the energy collection equipment such as a solar collector or a reactant supply; (b) the energy conversion devices including solar cells, thermionic generators, turbomachinery, fuel cells, etc.; (c) the energy storage unit such as a battery or thermal energy storage device; and (d) power conditioning and power management equipment.

All active space vehicles require electrical power for the operation of equipment, such as instruments, communication and data processing. For manned space missions, electric power is also required for additional functions such as life support and guidance for controlled reentry. Thus, this multi-disciplined program makes a direct and significant contribution to a broad cross-section of the national space program.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1964	1965	1966
Supporting research and technology...	$14,000	$13,745	$14,200
Total.....	$14,000	$13,745	$14,200

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

Funds are required to support continuing research on improvement of solar-cell radiation resistance and calibration standards, lightweight solar-cell arrays, direct conversion of solar-to-electrical energy by new and improved thermionic and thermoelectric conversion techniques, lightweight and accurate solar collectors, thermal heat storage materials and containment, gaseous dynamic system components, battery life extension and charge rate control, advanced high efficiency fuel cells and power distribution reliability. Research in NASA Installations, other government agencies, universities, and industrial contractors all contribute to the Solar and Chemical Power program.

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — AERONAUTICS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The primary role of the Aeronautics program is that of conducting scientific research to improve the efficiency, utility, and safety of aircraft. Continuing overall objectives of the NASA aeronautical effort in the Office of Advanced Research and Technology are:

1. To exercise unbiased technical leadership in the generation of advanced aircraft concepts.

2. To seek technological advances which will permit the development of improved aircraft.

3. To provide research information to industry for the design of new aircraft.

The continuing scope of the NASA aeronautical research program includes work in aerodynamics, structures, materials, and air breathing propulsion, the operational and safety aspects associated with these disciplines and, to some extent, electronics and human factors. It is the evolutionary research in these technical disciplines that provides the fundamental knowledge needed to understand the complex problems involved in the design and construction of advanced aircraft. Understanding of these problems, in turn, aids in the determination of the likely direction of technological advances in the future. For example, the XV-5A fan-in-wing aircraft, the tilt wing XC-142A V/STOL transport, and the variable sweep concept for the F-111 originated several years ago as promising concepts as a result of NASA research. In the years between the first indication of the value of the concept and the first flights of the vehicles NASA aided in the detailed formulation of the concepts and in substantiating the overall capabilities of practical vehicles based on these concepts. In addition, NASA has conducted and will continue extensive wind tunnel tests, simulator programs, and flight investigations using appropriate test-bed aircraft to substantiate predicted performance and operational characteristics of such vehicles and to aid in the solution of problems of a developmental nature. In this regard, advanced technical development in support of military and civil aircraft procurement will continue to be conducted. This work is performed in cooperation with government sponsored contractors at the request of the cognizant government agencies.

Experimental research and development aircraft and engineering-test-pilot-proficiency aircraft considered necessary to carry out and support the aeronautics effort are included under this program.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars)		
	1964	1965	1966
Supporting research and technology....	$9,195	$7,887	$8,300
X-15A research aircraft.....	900	1,425	900
Supersonic transport.....	8,821	19,953	16,000
V/STOL aircraft.....	2,879	2,850	2,000
Hypersonic ramjet experiment.....	---	3,125	5,000
XB-70/SST flight research project.....	---	---	10,000
Total.....	$21,795	$35,240	$42,200

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

The Supporting Research and Technology program in Aeronautics in FY 1966 will include studies directed toward improvement of subsonic, supersonic, and hypersonic aircraft, for example aerodynamic studies of means of improving the efficiency of subsonic transport aircraft by delaying the drag rise due to compressibility effects at transonic speeds; studies of new structural design concepts required to fabricate reliable lightweight structures suitable for long lifetimes under high temperature conditions, for supersonic and hypersonic aircraft; studies of air-breathing propulsion cycles and engine components to increase efficiency and permit the design of efficient lightweight engines for V/STOL aircraft, supersonic transport, and hypersonic aircraft; studies of manned hypersonic air-breathing vehicles which have the potential of providing hypersonic reconnaissance capabilities, hypersonic transport, and recoverable hypersonic air-breathing launch vehicles; and studies directed toward improving flight safety and increasing operational flexibility of present and proposed aircraft, especially under adverse or "all-weather" flight conditions.

X-15 Research Aircraft

The NASA-Air Force-Navy Research Airplane Committee early in 1964 decided that the X-15 aircraft should be used to obtain additional basic research information (especially in the areas of air-breathing propulsion, aerodynamics, and structures) for the next logical step in our flight research program--manned, maneuverable hypersonic cruise flight. This decision was based on the fact that the X-15 aircraft are the only vehicles available to obtain this information. It is anticipated that addition of these tasks to the program will require X-15 flight tests at least through calendar year 1968.

One of the three X-15 airplanes to be used in this program has been modified, following an accident in 1962, to increase its speed potential from its original capability of Mach number 6 to Mach number 8. The higher speeds will be required for the Hypersonic Ramjet Experiment and for studies of hypersonic aircraft structures. The increased speed capability can also be exchanged for increased flight duration at Mach numbers of 6 and below, when this is necessary, for certain tests such as those required for aerodynamic heat transfer studies.

Supersonic Transport

The NASA role in the national supersonic-transport project is to provide the research information required for the project on a timely basis. During FY 1966, NASA will expand its programs in the areas of propulsion, aerodynamic efficiency, dynamic stability, noise, sonic boom, and structural materials. In the area of operating problems, joint NASA-FAA studies of simulated air traffic control problems for supersonic transports will be continued to determine the effects of present and proposed air traffic control systems on design requirements and operating techniques for the airplanes.

Flight tests will also be conducted utilizing specially modified jet transports now owned by the NASA or to be leased, to define the desired handling qualities under normal and emergency conditions, to define the height control requirements in flare and landing, and to review the requirements for airworthiness test procedures.

V/STOL Aircraft

In FY 1966, greater attention will be given to the potential of V/STOL aircraft for civil applications. Special emphasis will be placed on providing design and operational information required in the development of V/STOL short-haul aircraft to satisfy increasing transportation needs in congested, highly developed areas. Research will continue on high speed V/STOL aircraft considering such problems as engine hot gas reingestion, of particular concern for jet V/STOL designs. Flight research utilizing variable stability V/STOL research aircraft will continue with the objective of defining minimum and optimum requirements for V/STOL handling qualities and control, under visual flight regulation as well as instrument flight regulation conditions. These programs will be supplemented with ground based research utilizing a six-degree-of-freedom simulator and with results from flight evaluations of specific military aircraft (e.g., the XC-142A tilt-wing, X-19A tilt-prop, and XV-5A lift-fan vehicles).

Hypersonic Ramjet Experiment

This project seeks the eventual construction of a research test engine, and flight on the X-15 airplane to provide information on ramjets operating in a speed range from Mach number 3 to Mach number 8, as a means of advancing the technology of air-breathing propulsion. The ramjet power-plant, with which great advantages in reduced weight and improved flight efficiency are

foreseen, is expected to be useful for hypersonic transport aircraft, launch vehicles, and spacecraft flying within the atmosphere. During the first phase of the program, which was started in FY 1965 and will continue during FY 1966, selected contractors are performing independent studies to establish technical concepts and accomplish preliminary designs. These studies consist primarily of analyses such as engine cycle, inlet aerodynamics, and combustor and nozzle aerodynamics, with some substantiating laboratory effort. Evaluation of the proposals resulting from these studies will provide the basis for a decision on the continuation of the project into a later phase in which the construction of the engine would be funded.

XB-70/SST Flight Research Program

This program is designed to obtain advanced research information in the basic problem areas related to large supersonic aircraft and to provide research information and advanced technology for the design, development, construction, and flight test of the American supersonic transport. The first phase of the program, which began in FY 1963, consisted of installation of instrumentation in the two XB-70A aircraft during manufacture and the acquisition, reduction, and analysis of certain data obtained during the USAF flight test program. The second phase, beginning in FY 1966, will consist of continuation and expansion of the initial NASA program and the initiation of several additional tasks, such as aerothermoelasticity research, which could not be accommodated during the USAF program. NASA will fund all of the costs associated with the NASA XB-70/SST Flight Research Program, including the cost of operating one XB-70 aircraft. This program is obtaining results which are useful to the Federal Aviation Agency in its role as manager of the United States Supersonic Transport program; the FAA is kept informed on the progress of the program on a continuing basis.

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SUMMARY

OFFICE OF TRACKING AND DATA ACQUISITION TRACKING AND DATA ACQUISITION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The purpose of this Program is to provide tracking and data acquisition support to meet the requirements of flight projects. Responsive and efficient support is provided for all NASA projects, and as mutually agreed, for projects of the Department of Defense, other government agencies, universities, private corporations, international organizations, and other countries engaged in mutual research endeavors.

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

Types of support provided include tracking to determine the position and trajectory of vehicles in space, acquisition of data from scientific experiments and on the engineering performance of spacecraft and launch vehicle systems, transmission of commands from ground stations to spacecraft, communication of information between various ground facilities and mission control centers, and processing of the data acquired from the space vehicles. Without this vital support, the NASA space research program would not be possible.

Tracking and data acquisition support is provided by a world-wide network of ground stations (including Department of Defense stations and instrumented ships), and by general purpose facilities in launch areas. These stations are linked together by a network of ground communications which provides the real-time information necessary for critical decisions. Facilities also are provided to process into meaningful form the large amounts of data which are collected from flight projects.

Tracking and data acquisition facilities are used for support of current missions. At the same time, they must be augmented to meet the requirements of missions in the immediate future. Concurrently, planning must proceed for projects which are even further in the future, and equipment and techniques must be developed to assure a sound technological approach for the support of the more complex mission requirements of the next generation.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Thousands of Dollars) 1964	1965	1966
Operations	$78,131	$102,819	$129,300
Equipment	103,326	157,248	102,400
Supporting research and technology	12,890	14,683	14,500
Total	$194,347	$274,750	$246,200

BASIS OF FUND REQUIREMENTS:

Operations

Funds are required for the operation and maintenance of the world-wide tracking and data acquisition facilities. The operations program for FY 1966 reflects the increased activity required to support the more complex flight missions which will occur during the period. New facilities, funded in prior years, are becoming operational and existing facilities are being augmented with equipment to meet the requirements of upcoming projects. Additional personnel and logistics must be provided to operate and maintain the new facilities and equipment.

Equipment

Equipment must be procured and facilities must be modified to meet the tracking and data acquisition support requirements of forthcoming flight projects. Funds required for this purpose will decrease in FY 1966 primarily because the large procurements necessary to meet the stringent support requirements of the Apollo Program were initiated with FY 1964 and FY 1965 funds. FY 1966 funds will be required to continue these procurements, and also to provide the many and varied equipments which are necessary for support of the complex unmanned missions scheduled to occur in the 1967-1968 time period.

Supporting Research and Technology

Supporting Research and Technology is the activity whereby the Office of Tracking and Data Acquisition develops a technology of advanced systems, components and techniques which are then used to implement the various networks to meet the requirements of new flight projects. The program for FY 1966 will emphasize system integration of the new equipment developed in recent years, direct increased attention toward data handling and processing techniques, and expand the effort in the area of complementary spacecraft equipment.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1966 ESTIMATES

SUMMARY

OFFICE OF TECHNOLOGY UTILIZATION — TECHNOLOGY UTILIZATION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The primary objective of the Technology Utilization Program is to provide for the widest 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:

	(Thousands of Dollars) 1964	1965	1966
Technology utilization.....	$3,500	$4,750	$5,000

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. Included in this effort is a continuing state-of-the-art survey organized around broad scientific areas and disciplines. Commercially oriented reports of reported innovations possessing industrial potential are prepared by a number of industrial research institutes and disseminated for consideration and possible adaption by industry.

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. The Midwest Research Institute (MRI) pilot project, initiated in early FY 1962, is now serving

more than 1000 firms. The Aerospace Research Applications Center (ARAC) project is now nearing the end of its second year of operation. This center charges companies a membership fee for the services the center offers. All but two of the original 29 member companies have renewed their memberships with ARAC 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. 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. Studies underway include research in the process of scientific inquiry, complex problem solving, contracting systems and procedures, project management, cost estimation and budgeting.

Studies of 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; on national economic growth: and upon the allocation of scientific and engineering manpower have been sponsored by this program. A study recently started at the University of California, Los Angeles, is attempting to analyze the shifting geographic patterns of primary, first and second tier contracting. Another study funded at Washington University (St. Louis) attempts to analyze the national impact of governmental spending with particular emphasis being laid upon variations of the level and composition of these expenditures.

The impact of expenditures is being studied in both an empirical and a qualitative sense to learn of the types of magnitude of the community problems created by the space center build-up in the Cape Kennedy area. In another case, 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.

It is to be emphasized that the Technology Utilization Program at its present stage is still very much an experimental program. Future plans, therefore, will be based upon review and assessment of every phase of the present Technology Utilization Program. 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

PROPOSED APPROPRIATION BILL

CONSTRUCTION OF FACILITIES

For advance planning, design, and construction of facilities for the National Aeronautics and Space Administration and for the acquisition or condemnation of real property, as authorized by law, [$262,880,500] *$74,700,000*, to remain available until expended. *(42 U.S.C. 2451, et seq., 50 U.S.C. 151–160, 511–515; Independent Offices Appropriation Act, 1965; additional authorizing legislation to be proposed.)*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

CONSTRUCTION OF FACILITIES

Program and Financing (in thousands of dollars)

	Budget Plan			Obligations		
	1964	1965	1966	1964	1965	1966
Program by activities:						
Direct program:						
1. Manned space flight.....	496,842	213,481	27,825	384,120	431,400	127,700
2. Scientific investigations in space.....	16,698	5,765	8,377	32,831	34,500	8,300
3. Space applications.....	3,933	.....	.....	3,697	100	300
4. Space technology.....	60,950	23,812	20,435	68,174	76,400	21,500
5. Aircraft technology.....	2,585	4,452	762	100	7,000	800
6. Supporting activities.....	134,442	15,370	17,301	57,637	110,200	13,000
Total direct.....	715,450	262,880	74,700	546,559	659,600	171,600
Reimbursable program:						
3. Space applications.....	.....	.....	.....	.....	2,597	.....
Total.....	715,450	262,880	74,700	546,559	662,197	171,600
Financing:						
Receipts and reimbursements from Administrative budget accounts.....	.....	.....	.....	2,490	.....	.....
Recovery of prior year obligations...	.....	.....	.....	-158	.....	.....
Unobligated balance available, start of year:						
For completion of prior year budget plans.....	.....	.....	.....	-380,011	-544,791	-147,253

CONSTRUCTION OF FACILITIES

Program and Financing (in thousands of dollars) - Continued

	Budget Plan			Obligations		
	1964	1965	1966	1964	1965	1966
Available to finance new budget plans	-15,797	.....	.....	-15,797	.....	.....
Unobligated balance transferred from "Research and development" (77 Stat. 439)	-1,779	.....	.....	.....	-1,779	.....
Unobligated balance transferred to "Research and development" (76 Stat. 731) and (75 Stat. 355).	15,472	.....	.....	15,472	.....	.....
Unobligated balance available, end of year, for completion of prior year budget plans	.....	.....	.....	544,791	147,253	50,353
New obligational authority	713,346	262,880	74,700	713,346	262,880	74,700
New obligational authority:						
Appropriation	680,000	262,880	74,700	680,000	262,880	74,700
Transferred from:						
"Research and development" (77 Stat. 439)	20,046	.....	.....	20,046	.....	.....
"Administrative operations" (77 Stat. 439)	13,300	.....	.....	13,300	.....	.....
Appropriation (adjusted)	713,346	262,880	74,700	713,346	262,880	74,700

Program and Financing (in thousands of dollars) - Continued

	1964 actual	1965 estimate	1966 estimate
Note.—Reconciliation of budget plan to obligations:			
Total budget plan	715,450	262,880	74,700
Deduct portion of budget plan to be obligated in subsequent years	430,323	58,010	33,700
Add obligations of prior year budget plans	261,432	457,327	130,600
Total obligations	546,559	662,197	171,600

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

SUMMARY OF CONSTRUCTION OF FACILITIES BUDGET PLAN BY LOCATION

(In thousands of dollars)

Location	Fiscal Year 1964	Fiscal Year 1965	Fiscal Year 1966
Ames Research Center	$11,580	$5,730	$2,749
Electronics Research Center	4,820	10,050	10,000
Flight Research Center	2,495		
Goddard Space Flight Center	17,182	1,791	2,400
Jet Propulsion Laboratory	3,243	3,620	
John F. Kennedy Space Center, NASA	284,690	89,073	8,595
Langley Research Center	9,943	4,575	8,250
Lewis Research Center	20,468	2,055	867
Manned Spacecraft Center	36,142	24,443	4,400
Marshall Space Flight Center	30,081	15,000	4,776
Michoud Plant	9,058	6,313	300
Mississippi Test Facility	96,163	54,182	2,121
Nuclear Rocket Development Station	4,190		
Various Locations	184,820	44,299	21,694
Wallops Station	575	1,749	1,048
Facility Planning and Design 1/			7,500
Total Plan	$715,450	$262,880	$74,700

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.

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 spaceflight 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, 1964)*	$ 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		

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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
Electronics Research Center	Advanced Res. & Tech.	Cambridge, Mass.	Middlesex	----------

INSTALLATION MISSION

The mission of the Electronics Research Center is to increase the agency's capability in space electronics by providing the knowledge and advanced technology needed to overcome deficiencies in electronic systems and components. The Center organizes, manages, and conducts a comprehensive program of basic and applied space electronics research. It also provides a focal point for national space electronics research, coordinating nationwide research efforts and sponsoring electronics research conducted by industry, universities, and private institutions.

PERSONNEL STRENGTH	FY 1964	FY 1965	FY 1966
NASA PERSONNEL *(End of Year)*	25	250	550
CONTRACTOR AND OTHER PERSONNEL	-	-	-
TOTAL ALL PERSONNEL	25	250	550

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, 1964)*	$ -

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YEAR	FY 1966 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Space Guidance Laboratory	OART	110.0	3,900.0	-0-	4,010.0
Optical Communications Laboratory	OART	98.0	2,100.0	-0-	2,198.0
Microwave Radiation Laboratory	OART	100.0	3,000.0	-0-	3,100.0
Center Support Facilities (Second Phase)	OART	85.0	1,000.0	-0-	1,085.0
ALL OTHER PROJECTS	OART	14,875.0			
TOTALS		$15,268.0	10,000.0		

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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
Flight Research Center	Advanced Res. & Tech.	Air Force Base, Edwards, California	Kern	Lancaster, California

INSTALLATION MISSION

This Center conducts research in and evaluates problems of manned space flight, both within and outside the atmosphere. The work includes effort on problems of takeoff and landing, low-speed flight, supersonic and hypersonic flight, and re-entry to verify predicted characteristics and to identify unexpected problems in actual flight.

PERSONNEL STRENGTH	FY 1964	FY 1965	FY 1966
NASA PERSONNEL *(End of Year)*	619	619	619
CONTRACTOR AND OTHER PERSONNEL	188	188	220
TOTAL ALL PERSONNEL	807	807	839

LAND	NO. ACRES
NASA-OWNED	---
OTHER GOVERNMENT AGENCY-OWNED	171
NON-FEDERAL *(Leases, easements)*	---
TOTAL LAND	171

TOTAL CAPITAL INVESTMENT *(Including NASA-Owned Land) (as of June 30, 1964)*	$ 27,116.0

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YEAR	FY 1966 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
ALL OTHER PROJECTS		6,137.0			
TOTALS		6,137.0			

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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
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		

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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
Jet Propulsion Laboratory	Space Science & Applications	Pasadena, California	Los Angeles	Pasadena

INSTALLATION MISSION

The Jet Propulsion Laboratory (JPL) is a government-owned research and development facility, operated for NASA by the California Institute of Technology. The Laboratory carries out research programs and unmanned lunar and planetary space projects for NASA, and conceives and executes advanced development and experimental engineering investigations to further the technology required for the nation's space program. Present flight programs include Ranger, Mariner, Surveyor, and Voyager.

PERSONNEL STRENGTH	FY 19 64	FY 19 65	FY 19 66
JPL PERSONNEL *(End of Year)*	4,222	4,100	4,000
CONTRACTOR AND OTHER PERSONNEL	983	947	884
TOTAL ALL PERSONNEL	5,205	5,047	4,884

LAND	NO. ACRES
NASA-OWNED	145.9
OTHER GOVERNMENT AGENCY-OWNED	41,215.2
NON-FEDERAL *(Leases, easements)*	
TOTAL LAND	41,361.1

TOTAL CAPITAL INVESTMENT *(Including NASA-Owned Land) (as of June 30, 1964)*	$ 101,100

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 19 59 THRU CURRENT YEAR	FY 1964 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
ALL OTHER PROJECTS		38,846.0			
TOTALS		38,846.0			

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

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		

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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
Langley Research Center	Office of Adv. Research & Tech.	Langley AFB Hampton, Virginia		Hampton, Virginia

INSTALLATION MISSION

LRC Mission - Undertake research to provide a technical base for such missions as: (1) Manned and unmanned exploration of space; (2) Improvement of performance and utility of airborne flight; plan, develop and operate necessary facilities; generate new and advanced concepts; provide research advice and assistance to other branches of the Government; disseminate scientific and technical information; search for and identify potential industrial applications involved in the course of research.

PERSONNEL STRENGTH	FY 1964	FY 1965	FY 19 66
NASA PERSONNEL *(End of Year)*	4330	4308	4308
CONTRACTOR AND OTHER PERSONNEL	482	502	566
TOTAL ALL PERSONNEL	4812	4810	4874

LAND	NO. ACRES
NASA-OWNED	540
OTHER GOVERNMENT AGENCY-OWNED	3618
NON-FEDERAL *(Leases, easements)*	72
TOTAL LAND	4230
TOTAL CAPITAL INVESTMENT *(Including NASA-Owned Land) (as of June 30, 1964)*	$ 249,776.0

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YEAR	FY 19 66 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Flight Control Research Facility	OART	201.0	3,576.0	-0-	3,777.0
Life Support Technology Laboratory	OART	164.0	2,492.0	-0-	2,656.0
Increase Research Capabilities of M-6 and 8.5 Tunnels	OART	50.0	682.0	-0-	732.0
Magazine and Test Area for Highly Reactive Chemical Mats.	OART	90.0	1,500.0	-0-	1,590.0
ALL OTHER PROJECTS		58,488.0			
TOTALS		58,993.0	8,250.0		

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CONSTRUCTION OF FACILITIES

FISCAL YEAR 1966 BUDGET ESTIMATES

(Dollars in thousands)

NASA INSTALLATION 1/	COGNIZANT PROGRAM OFFICE FOR INSTALLATION	LOCATION OF INSTALLATION	COUNTY	NEAREST CITY
Lewis Research Center	Advanced Research & Technology	Cleveland, Ohio	Cuyahoga	Cleveland, Ohio

INSTALLATION MISSION

Research and development in the areas of advanced propulsion and space power generation. In-house projects include: materials and metallurgy; bearings, seals and heat transfer problems at cryogenic and liquid-metal temperatures; combustion and direct-energy conversion processes; chemical, nuclear and electric rockets and their accessories; system control dynamics; plasmas and magnetohydrodynamics; and zero-gravity effects. The Center maintains technical management of many NASA contracts, including the Centaur, Agena, M-1 and large solid propellant rockets.

PERSONNEL STRENGTH	FY 1964	FY 1965	FY 1966
NASA PERSONNEL *(End of Year)*	4859	4847	4847
CONTRACTOR AND OTHER PERSONNEL	300	340	365
TOTAL ALL PERSONNEL	5159	5187	5212

LAND	NO. ACRES
NASA-OWNED	6,380
OTHER GOVERNMENT AGENCY-OWNED	-
NON FEDERAL *(Leases, easements)*	15
TOTAL LAND	6,395
TOTAL CAPITAL INVESTMENT *(Including NASA-Owned Land) (as of June 30, 1964)*	$ 239,998.0

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1959 THRU CURRENT YEAR	FY 1966 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Building Addition to 10 x 10-foot Supersonic Wind Tunnel for Data Processing	OART	23.0	407.0	-0-	430.0
Space Power Research Laboratory	OART	27.0	460.0	-0-	487.0
ALL OTHER PROJECTS		93,663.0			
TOTALS		93,713.0	867.0		

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

1/ Includes Plum Brook Station

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
Manned Spacecraft Center	Manned Space Flight	Clear Lake, Texas	Harris	Houston, Texas

INSTALLATION MISSION

The mission of the Manned Spacecraft Center is the development of spacecraft for Manned Space Flight programs. The Center is also responsible for Manned Space Flight operations and conduct of astronaut training.

PERSONNEL STRENGTH	FY 19 64	FY 19 65	FY 19 66
NASA PERSONNEL *(End of Year)*	4,277	4,811	4,811
CONTRACTOR AND OTHER PERSONNEL	1,519	2,907	3,720
TOTAL ALL PERSONNEL	5,796	7,718	8,531

LAND	NO. ACRES
NASA-OWNED	1,600
OTHER GOVERNMENT AGENCY-OWNED	-
NON-FEDERAL *(Leases, easements)*	477
TOTAL LAND	2,077

TOTAL CAPITAL INVESTMENT *(Including NASA-Owned Land) (as of June 30, 19 64)*	$ 131,045.0

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 19 62 THRU CURRENT YEAR	FY 19 66 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Modifications to the Environmental Testing Laboratory	MSF	41,830.0	3,600.0	-0-	45,430.0
Center Support Facilities	MSF	56.0	800.0	-0-	856.0
ALL OTHER PROJECTS		133,658.0			
TOTALS		175,544.0	4,400.0		

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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
Marshall Space Flight Center	Manned Space Flight	Huntsville, Alabama	Madison	Huntsville, Alabama

INSTALLATION MISSION

The mission of the Marshall Space Flight Center is the development of launch vehicles, engines and vehicle systems for Manned Space Flight programs. The Center also performs advanced studies and research in the general field of astronautics.

PERSONNEL STRENGTH	FY 1964	FY 1965	FY 1966
NASA PERSONNEL *(End of Year)*	7,355	7,220	7,195
CONTRACTOR AND OTHER PERSONNEL	5,454	5,986	6,088
TOTAL ALL PERSONNEL	12,809	13,206	13,283

LAND	NO. ACRES
NASA-OWNED	1,786
OTHER GOVERNMENT AGENCY-OWNED	-
NON-FEDERAL *(Leases, easements)*	64
TOTAL LAND	1,850

TOTAL CAPITAL INVESTMENT *(Including NASA-Owned Land) (as of June 30, 1964)*	$ 223,843.0

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1961 THRU CURRENT YEAR	FY 1966 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Non-Destructive Testing Laboratory	MSF	59.0	708.0	-0-	767.0
Additions to Materials Laboratory	MSF	72.0	1,107.0	-0-	1,179.0
Test Engineering Building Extension	MSF	1,478.0	616.0	-0-	2,094.0
Extension to High Pressure Gas Systems	MSF	117.0	1,415.0	-0-	1,532.0
LOX Storage Facilities for West Test Area	MSF	76.0	930.0	-0-	1,006.0
ALL OTHER PROJECTS		147,033.0			
TOTALS		148,835.0	4,776.0		

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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
Michoud Plant	Manned Space Flight	New Orleans, La.	Orleans Parish	New Orleans

INSTALLATION MISSION

The mission of the Michoud Plant is the manufacturing of the booster stage for the Saturn family of launch vehicles.

PERSONNEL STRENGTH	FY 19 64	FY 19 65	FY 19 66
NASA PERSONNEL *(End of Year)*	281	312	320
CONTRACTOR AND OTHER PERSONNEL	10,985	12,050	11,450
TOTAL ALL PERSONNEL	11,266	12,362	11,770

LAND	NO. ACRES
NASA-OWNED	839
OTHER GOVERNMENT AGENCY-OWNED	72
NON-FEDERAL *(Leases, easements)*	
TOTAL LAND	911
TOTAL CAPITAL INVESTMENT *(Including NASA-Owned Land) (as of June 30, 1964)*	$ 100,651.0

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1962 THRU CURRENT YEAR	FY 1966 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Improvements to the Storm Drainage System	MSF	24.0	300.0	-0-	324.0
ALL OTHER PROJECTS		55,494.0			
TOTALS		55,518.0	300.0		

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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
Mississippi Test Facility	Manned Space Flight	Pearl River, Miss.	Hancock	Bay St. Louis, Miss.

INSTALLATION MISSION

The mission of Mississippi Test Facility is the static test firing of large vehicle stages and propulsion systems.

PERSONNEL STRENGTH	FY 1964	FY 1965	FY 1966
NASA PERSONNEL *(End of Year)*	43	126	143
CONTRACTOR AND OTHER PERSONNEL	248	1,113	2,349
TOTAL ALL PERSONNEL	291	1,239	2,492

LAND	NO. ACRES
NASA-OWNED	21,391
OTHER GOVERNMENT AGENCY-OWNED	-
NON-FEDERAL *(Leases, easements)*	117,704
TOTAL LAND	139,095

TOTAL CAPITAL INVESTMENT *(Including NASA-Owned Land) (as of June 30, 1964)*	$ 57,103.0

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1962 THRU CURRENT YEAR	FY 1966 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Addition to S-II Stage Checkout & Storage Facility	MSF	4,748.7	1,177.0	-0-	5,925.7
General Support Facilities	MSF	60.0	944.0	-0-	1,004.0
ALL OTHER PROJECTS		246,209.3			
TOTALS		251,018.0	2,121.0		

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
Pacific Launch Operations Office	Space Science & Applications	Vandenberg AFB (Point Arguello) California	Santa Barbara	Lompoc, California

INSTALLATION MISSION

The mission of the Pacific Launch Operations Office covers two broad areas: (1) Representing NASA, in its relationships with the Western Test Range, including negotiating for and coordinating the use of range services and facilities to support requirements developed by NASA Centers or by local project representatives; and (2) Providing or arranging for administrative, logistic, and technical support for NASA programs and projects at the Western Test Range.

PERSONNEL STRENGTH	FY 19 64	FY 19 65	FY 19 66
NASA PERSONNEL *(End of Year)*	22	22	22
CONTRACTOR AND OTHER PERSONNEL	106	110	78
TOTAL ALL PERSONNEL	128	132	100

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

TOTAL CAPITAL INVESTMENT *(Including NASA-Owned Land) (as of June 30, 19 64)*	$ 1,865.0

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 19 59 THRU CURRENT YEAR	FY 19 66 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
ALL OTHER PROJECTS		2,274.0			
TOTALS		2,274.0			

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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
Space Nuclear Propulsion Office (NRDS)	OART	Jackass Flats, Nevada	Nye	Las Vegas

INSTALLATION MISSION

The mission of the Nuclear Rocket Development Station (NRDS) is to provide a site for ground static testing of the reactors, engines, and eventually, vehicles associated with nuclear rocket development.

PERSONNEL STRENGTH	FY 19 64	FY 19 65	FY 19 66
NASA PERSONNEL *(End of Year)* 1/	34	31	31
CONTRACTOR AND OTHER PERSONNEL 2/	1,242	1,362	1,521
TOTAL ALL PERSONNEL	1,276	1,393	1,552

LAND	NO. ACRES
NASA-OWNED	-0-
OTHER GOVERNMENT AGENCY-OWNED	90,000
NON-FEDERAL *(Leases, easements)*	-0-
TOTAL LAND	90,000

TOTAL CAPITAL INVESTMENT 3/ *(Including NASA-Owned Land) (as of June 30, 19 64)* $ 8,069.0

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 19 59 THRU CURRENT YEAR	FY 19 66 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
ALL OTHER PROJECTS		30,366.0			
TOTALS		30,366.0			

1/ SNPO-N NASA employees only
2/ Excludes lump-sum construction contractors
3/ NASA funded facilities only. Estimated plant value of AEC funded facilities at 6/30/64 was $50,192.6

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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
Various Locations	Manned Space Flight	Not applicable	Not applicable	Not applicable

INSTALLATION MISSION

PERSONNEL STRENGTH	FY 1964	FY 1965	FY 1966
NASA PERSONNEL *(End of Year)*			
CONTRACTOR AND OTHER PERSONNEL			
TOTAL ALL PERSONNEL			

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, 1964)*	$ ---

PROJECT LINE ITEM	COGNIZANT OFFICE	FY 1962 THRU CURRENT YEAR	FY 1966 *(Estimated)*	FUTURE YEARS *(Estimated)*	TOTAL ALL YEARS *(Estimated)*
Facilities for F-1 Engine Program	MSF	62,196.0	2,007.0	-0-	64,203.0
Facilities for J-2 Engine Program	MSF	29,502.8	2,436.0	-0-	31,938.8
Facilities for S-II Stage Program	MSF	2,863.7	1,690.0	-0-	4,553.7
Deep Space Antenna Facility, Madrid, Spain	TDA	36.0	472.0	-0-	508.0
Deep Space Antenna Facility, Canberra, Australia	TDA	38.0	510.0	-0-	548.0
STADAN Facility, Fairbanks, Alaska	TDA	83.0	1,115.0	-0-	1,198.0
Apollo Network Ground Station - Antigua (Fac. for Unified "S" - Band System)	TDA	162.0	2,700.0	-0-	2,862.0
Apollo Network Ground Station - Antigua (Community Support Facilities)	TDA	210.0	3,090.0	-0-	3,300.0
Apollo Network Ground Station - Canary Islands	TDA	120.0	7,674.0	-0-	7,794.0
ALL OTHER PROJECTS		390,672.5			
TOTALS		485,884.0	21,694.0		

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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
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 1964	FY 1965	FY 1966
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 1959 THRU CURRENT YEAR	FY 1966 *(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		

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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
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 1962 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		($43,937.0) 1/	$7,500.0		

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PROPOSED APPROPRIATION BILL

ADMINISTRATIVE OPERATIONS

For necessary expenses, not otherwise provided for, of the operations of the National Aeronautics and Space Administration, including uniforms or allowances therefor, as authorized by the Act of September 1, 1954, as amended (5 U.S.C. 2131); minor construction; supplies, materials, services, and equipment; awards; [purchase or hire of not to exceed two aircraft for administrative use;] *hire*, maintenance and operation of administrative aircraft; purchase and hire of motor vehicles (including purchase of not to exceed [eighty-five] *thirty* passenger motor vehicles, of which [forty] *twenty-four* shall be for replacement only); and maintenance, repair, and alteration of real and personal property; [$623,525,500.] *$609,400,000: Provided, That contracts may be entered into under this appropriation for maintenance and operation of facilities, and for other services, to be provided during the next fiscal year. (42 U.S.C. 2451, et seq., 50 U.S.C. 151-160, 511-515; Independent Offices Appropriation Act, 1965; additional authorizing legislation to be proposed.)*

Note.—Includes $24,800 thousand for activities previously carried under "Research and development." The amounts obligated in 1964 and 1965 are shown in the schedule as comparative transfers.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

ADMINISTRATIVE OPERATIONS

Program and Financing (in thousands of dollars)

	Budget Plan/Obligations		
	1964	1965	1966
Program by activities:			
Direct program:			
1. Manned space flight	246,800	321,816	310,200
2. Scientific investigations in space	66,414	86,130	65,000
3. Space applications	13,686	20,050	19,500
4. Space technology	126,999	143,800	143,800
5. Aircraft technology	28,996	30,500	35,400
6. Supporting activities	28,715	43,425	35,500
Total direct obligations	511,610	645,721	609,400
Reimbursable program:			
1. Manned space flight	205	180	31
3. Space applications	1,006	1,847	2,592
4. Space technology	419	420	420
6. Supporting activities	915	1,653	1,857
Total reimbursable obligations	2,545	4,100	4,900
Total obligations	514,155	649,821	614,300

ADMINISTRATIVE OPERATIONS

Program and Financing (in thousands of dollars) (Continued)

	Budget Plan/Obligations		
	1964	1965	1966
Financing:			
Receipts and reimbursements from:			
Administrative budget accounts	-2,381	-3,936	-4,673
Non-Federal sources [1]	-164	-164	-227
Comparative transfers from other accounts	-17,757	-22,468	.....
Unobligated balance lapsing	2,246	.....	.....
New obligational authority	496,099	623,253	609,400
New obligational authority:			
Appropriation	494,000	623,526	609,400
Transferred to:			
"Construction of facilities" (77 Stat. 439)	-13,300	.....	.....
"Operating expenses, Public Buildings Service," General Services Administration (77 Stat. 436 and 78 Stat. 655).	-286	-273	.....
Transferred from "Research and development" (77 Stat. 439)	15,685	.....	.....
Appropriation (adjusted)	496,099	623,253	609,400

[1] Reimbursements from non-Federal sources are payments for services performed on Telstar and Comsat communications satellite projects (42 U.S.C. 2473) and for personal property sold for replacement purposes (40 U.S.C. 481).

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

ADMINISTRATIVE OPERATIONS

SUMMARY OF OBLIGATIONS BY INSTALLATION
(Thousands of dollars)

	Fiscal Year 1964	Fiscal Year 1965	Fiscal Year 1966
MANNED SPACE FLIGHT			
John F. Kennedy Space Center, NASA	$34,959	$61,616	$62,697
Manned Spacecraft Center	68,634	91,201	89,658
Marshall Space Flight Center	124,443	140,458	137,387
SPACE SCIENCE AND APPLICATIONS			
Goddard Space Flight Center	62,466	85,923	69,591
Pacific Launch Operations Office	1,037	835	804
Wallops Station	9,715	11,442	9,800
ADVANCED RESEARCH AND TECHNOLOGY			
Ames Research Center	29,886	31,698	32,300
Electronics Research Center	730	3,600	7,622
Flight Research Center	9,514	9,750	9,600
Langley Research Center	52,642	57,258	61,783
Lewis Research Center	61,694	70,971	63,880
Space Nuclear Propulsion Office	1,472	1,725	1,838
SUPPORTING ACTIVITIES			
Northeastern Office	379	-	-
Western Operations Office	4,924	5,989	6,337
NASA Headquarters	49,115	73,255	56,103
TOTAL	$511,610	$645,721	$609,400

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

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	-0-	-0-
Western Operations Office	376	406	406
NASA Headquarters	2,133	2,221	2,221
TOTAL	32,499	33,800	34,100

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

JOHN F. KENNEDY SPACE CENTER, NASA

SUMMARY

MISSION:

The John F. Kennedy Space Center is responsible for the overall planning and supervision of the preparation and launch of NASA space vehicle systems at Cape Kennedy and the Merritt Island Launch Area, and providing administrative and technical support to all NASA elements at this location. The Installation has developed unique launch capabilities through the accomplishment of numerous launches, beginning with the Redstone program in 1952, under the Department of the Army. These capabilities include design of launch and related facilities and design of ground support equipment.

Launch activities have increased steadily over the past years. As the Apollo Saturn I launches are completed, Kennedy Space Center will begin Apollo Saturn IB launches, and activation and checkout of facilities for the Apollo Saturn V program. Facilities in the Merritt Island Launch Area, located north of the Air Force Eastern Test Range, have been under construction for approximately three years. The major construction activity will be substantially complete by the end of FY 1966.

DESCRIPTION:

The total land area occupied by the Installation is approximately 88,743 acres acquired by purchase anddesignated the Merritt Island Launch Area (MILA). The real property includes launch and related support facilities, an industrial-administrative complex at the Merritt Island Launch Area, in addition to launch complexes (for which NASA is designated launch agency) and supporting facilities within the Air Force Eastern Test Range. The total capital investment as of June 30, 1964 was $298,069,000.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1964	1965	1966
Number of Positions, end of year..	1,625	2,082	2,082
Average Number of All Employees...	1,322	1,914	2,056
Administrative Operations.....	$34,959	$61,616	$62,697

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ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

MANNED SPACECRAFT CENTER

SUMMARY

MISSION:

The Manned Spacecraft Center develops spacecraft and related equipment for manned space flight programs, selects and trains flight crews, and conducts manned flight operations. The Center is currently engaged in two major space research and development efforts.

1. Gemini The objectives of the Gemini program are to develop an operational capability in manned space flight, and through this capability, to conduct specific experiments and tests which support Apollo, Department of Defense programs and scientific investigations. This program is time-phased between the short duration earth-orbital Mercury missions and the long duration mission of Apollo. The major objectives are:

a. To determine man's capability during long duration space flight,

b. To develop techniques and provide crew experience in rendezvous and docking,

c. To experiment with orbital flight maneuvering and extravehicular crew activity, and

d. To conduct scientific experiments.

2. Apollo Spacecraft This phase of the presently planned lunar landing program involves utilization of a three-man spacecraft of modular design, capable of extended flights in earth and lunar orbit. The flights will lead to a landing on, and return from, the lunar surface.

The Center's mission embraces an engineering, development, test and evaluation, and operations capability to support these programs, and to develop the knowledge required to advance the technology of space and manned spacecraft development. Technology efforts focus on the conception and implementation of a program of applied research and development in the areas of space research, space physics, and life support systems.

DESCRIPTION:

The Manned Spacecraft Center is located two miles east of Webster, Texas. The site, bordering Clear Lake, is approximately 20 miles southeast of downtown Houston, 25 miles northwest of Galveston, and 20 miles

southwest of Baytown, Texas. The total NASA-owned land consists of 1,500 acres. This land was acquired by two conveyances, 20 acres of which are reserved for mineral rights by the Humble Oil Company. The property is subject to easements to the Houston Natural Gas Company, Harris County, and the State of Texas. In addition, the Manned Spacecraft Center holds 55,952 acres at White Sands Missile Range in New Mexico under use agreement with the Department of Defense. The total capital investment of the Manned Spacecraft Center as of June 30, 1964 was $131,045,000.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1964	1965	1966
Number of Positions, end of year..	4,277	4,811	4,811
Average Number of All Employees...	3,509	4,524	4,725
Administrative Operations.....	$68,634	$91,201	$89,658

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

MARSHALL SPACE FLIGHT CENTER

SUMMARY

MISSION:

The Marshall Space Flight Center develops launch vehicles and space transportation systems necessary to meet National space program requirements. To accomplish this mission, Marshall possesses the necessary resources in terms of highly skilled Government scientific and engineering personnel, unique laboratory facilities, and industrial contractor capability.

Flight testing of the Saturn I launch vehicle is scheduled for completion in FY 1966. During FY 1966, development effort will continue on the Saturn IB and Saturn V launch vehicles, as well as the engine programs.

DESCRIPTION:

The Marshall Space Flight Center at Huntsville, Alabama, occupies 1,786 acres acquired on a non-revocable use permit from the Department of the Army and 64 leased acres. The Center's capital investment as of June 30, 1964 was $223,843,000. Marshall is responsible for management of the Michoud Plant, New Orleans, Louisiana, including the computer facility at Slidell, Louisiana, with a combined capital investment of $100,651,000 on 911 acres; and the Mississippi Test Facility, Pearl River, Mississippi, with a capital investment of $57,103,000 on 139,095 acres.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1964	1965	1966
Number of Positions, end of year..	7,679	7,658	7,658
Average Number of All Employees...	7,332	7,546	7,576
Administrative Operations.....	$124,443	$140,458	$137,337

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

GODDARD SPACE FLIGHT CENTER

SUMMARY

MISSION:

The Goddard Space Flight Center is responsible for developing sounding rockets for scientific investigations, management of application satellite projects (e.g., NIMBUS, TIROS, ECHO, SYNCOM, RELAY, and the Applications Technology Satellite), scientific satellite projects (e.g., OAO, OGO, OSO, AOSO, and Explorers), and world-wide NASA tracking and data acquisition operations. It also provides for pre-flight testing and evaluation of spacecraft under simulated flight conditions and the launching of Centaur and Atlas-Agena vehicles in support of other NASA Centers. Goddard has both project management and launch responsibility for NASA's Delta launch vehicles.

DESCRIPTION:

The Goddard Space Flight Center occupies a main site of 530 acres located 15 miles northeast of Washington, D. C., near Greenbelt, Maryland. Four separate areas totaling 652 acres located within two miles of the Installation 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.

SUMMARY OF RESOURCES REQUIREMENTS:

(Dollars in Thousands)

	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	$85,923	$69,591

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

PACIFIC LAUNCH OPERATIONS OFFICE

SUMMARY

MISSION:

The Pacific Launch Operations Office represents NASA in its west coast relationships with the Department of Defense (DOD) range management agencies; negotiates for and coordinates the use of range services and facilities; provides administrative, logistic and technical support for agency programs and projects at the DOD west coast ranges; and provides central coordination of matters pertaining to support requirements developed by field installation groups located at the Pacific launch site.

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 Vandenberg Air Force Base on or about March 1, 1965. The physical plant comprises various facilities, all located on land owned by other government agencies. The total NASA capital investment at Vandenberg Air Force Base as of June 30, 1964, was $1,865,000.

SUMMARY OF RESOURCES REQUIREMENTS:

(Dollars in Thousands)

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

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

WALLOPS STATION

SUMMARY

MISSION:

Wallops Station functions primarily as a support center for the launching of scientific satellites, meteorological probes and sounding rockets. The Installation has responsibility for providing all necessary support to insure success for approximately 300 launches which take place there annually. This includes providing launch facilities and launch support, the design and development of special instrumentation, and tracking and data acquisition support as necessary. Wallops conducts recovery operations for suborbital shots and trains foreign nationals in launch techniques and other space flight operations. Wallops Station will shortly undertake project management for several scientific satellites in the University Explorer class. This responsibility will give Wallops the unique capability of managing a flight project from the initial design stage to the actual launch and tracking and data acquisition phases.

DESCRIPTION:

Wallops Station is located in Virginia on the Atlantic coast and consists of three separate areas: the Main Base, Wallops Island and Wallops Mainland. The Main Base, formerly the Chincoteague Naval Air Station, houses administrative and shop support units, the Range Control Center and the main telemetry building. Wallops Island, seven miles southeast of the main base, is the location for the assembly shops, blockhouses and the launch sites. The Wallops Mainland, a one-half mile strip of land west of the island, is the site of the radar and optical tracking complexes. The area of 6,561 acres is government owned and the total capital investment as of June 30, 1964 was $42,978,000.

SUMMARY OF RESOURCES REQUIREMENTS:

(Dollars in Thousands)

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

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

AMES RESEARCH CENTER

SUMMARY

MISSION:

The primary mission of Ames Research Center is to conduct supporting research and technology in the physical sciences, the space sciences, and the life sciences. The Installation is also assigned project management responsibility for the Pioneer and the Biosatellite projects.

Many unique facilities for simulating atmospheric and space flights ranging from low speeds to escape velocity are located at this Installation. Research tools consist of wind tunnels, flight simulators, free-flight ballistic test facilities, and specialized laboratory equipment.

Ames is the principle NASA installation in the field of human factors and the bioscience programs. The requirements of present and future space missions underscore the need for basic research in the physiological and behavior sciences concerned with the effects of space travel. The Pioneer and the Biosatellite projects are examples of this endeavor.

Other work includes the stability and control performance of a wide range of spacecraft configurations, spacecraft materials and structures, and electronic navigation and control systems. In the aeronautics field, problems associated with the supersonic transport, the V/STOL aircraft, and the hypersonic research aircraft are being emphasized. Research in the area of space sciences includes studies of solar physics, planetary environments, and geophysics.

DESCRIPTION:

The Ames Research Center is situated on 235 acres contiguous to the Naval Air Station at Moffett Field, California, of which 115 acres are owned by the NASA and 120 acres are occupied under permit from the Department of the Navy. The Installation is located approximately 35 miles southeast of San Francisco and 15 miles northwest of San Jose, California. The total capital investment as of June 30, 1964, was $155,427,000.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1964	1965	1966
Number of Positions, end of year..	2,204	2,205	2,205
Average Number of All Employees...	2,173	2,195	2,195
Administrative Operations.....	$29,886	$31,698	$32,300

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

ELECTRONICS RESEARCH CENTER

SUMMARY

MISSION:

The Electronics Research Center will serve as a national focal point for advanced research and technology in space electronics. The Installation will organize, manage, and conduct comprehensive programs in basic and applied research aimed at providing the information required as a prerequisite to more reliable and efficient space electronic equipment.

The facilities to be constructed in the near future will provide the initial research tools necessary to implement the mission of the center. The technical staff will include experts in the fields of electronics, physics, and flight mechanics.

The programs to be undertaken will include effort in the fundamental disciplines of electrostatics, microwave radiation, inertial sensing, optics, and solid state physics. Technique and component advances will be refined to demonstrate instrumentation applications and system utility or feasibility for communications, data processing, control and guidance systems.

The North Eastern Office formerly located in Cambridge, Massachusetts, was merged with the Electronics Research Center effective September 1, 1964. The FY 1965 and 1966 fund requirements are included in the estimates for the Electronics Research Center.

DESCRIPTION:

The Electronics Research Center will be situated on a 29 acre tract of land located in Cambridge, Massachusetts. The master planning for the Installation contemplates an auxiliary site, as yet unselected, for the construction of additional research facilities and development of field test areas.

SUMMARY OF RESOURCES REQUIREMENTS:

(Dollars in Thousands)

	1964	1965	1966
Number of Positions, end of year..	25	250	550
Average Number of All Employees...	12	119	405
Administrative Operations.....	$730	$3,600	$7,622

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ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

FLIGHT RESEARCH CENTER

SUMMARY

MISSION:

The primary mission of the Flight Research Center is to conduct flight research, and study the problems of manned flight both within and outside the atmosphere. Research includes supporting research and technology effort on take-off and landing, low-speed flight, supersonic and hypersonic flight, and reentry.

The Installation facilities consist of research and fighter aircraft, special purpose vehicles such as paragliders, lifting bodies, lunar landing research vehicles, airborne simulators, and specialized ground support equipment. Other facilities include an office-laboratory building, flight maintenance hanger and a calibration hanger. The technical staff of the Installation includes leading experts in the fields of flight research, aerodynamics, loads and structures, thermodynamics, biotechnology, and electronics.

A substantial part of the total Installation staff is involved in direct support of the agency's aeronautical program including the X-15 aircraft program and related projects. Support of the manned space flight program is provided to the Gemini and Apollo projects through efforts on parachute and paraglider development. Other effort is directed in support of space vehicle systems, electronics, and the man-machine integration problems associated with the operation of manned vehicles.

DESCRIPTION:

Flight Research Center is situated on 171 acres of land under permit from the Air Force. The Installation is located northeast of Edwards Air Force Base, California, adjacent to Rogers Dry Lake, approximately 65 air miles north of Los Angeles. The total capital investment as of June 30,1964 was $27,116,000.

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1964	1965	1966
Number of Positions, end of year..	619	619	619
Average Number of All Employees...	621	622	619
Administrative Operations.....	$9,514	$9,750	$9,600

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

LANGLEY RESEARCH CENTER

SUMMARY

MISSION:

The primary mission of Langley Research Center is to conduct basic and applied research in the areas of advanced aeronautics and space flight. Along with providing technical support for the development of advanced types of manned vehicles, the Installation is assigned project management responsibility for the Scout vehicle development and procurement, flight projects associated with reentry problems, and the lunar orbiter satellite.

Research facilities at the Installation include conventional wind tunnels ranging from subsonic to hypersonic speeds, flight simulators and extensive aerospace facilities utilized for the advancement of knowledge in rendezvous, lunar landings, and other space flight operations. These facilities are supplemented by free flight studies of models and full-scale research aircraft.

The Langley Research Center conducts supporting research and technology in the areas of space vehicle systems, electronic systems, life and space sciences, space power, and chemical propulsion systems. Studies include structural and operational problems associated with the supersonic transport, problems associated with the development and operation of a manned orbital research laboratory, and technical support for the Gemini and Apollo projects, involving problems in connection with lunar landings, rendezvous techniques and reentry flights.

Research effort is being utilized in the areas of passive communications satellites and meteorological satellites. The Installation also supports other government agencies, including the Department of Defense and the Federal Aviation Agency. In addition to assuming project responsibility for the Scout vehicle development and procurement, Project Fire, and the Lunar Orbiter satellite, the Installation is also exercising management responsibility for the Joint Italian-United States international satellite program.

DESCRIPTION:

Langley Research Center is situated on 772 acres of land at Hampton, Virginia, of which 430 acres are owned by NASA and 342 acres are occupied under permit from the Air Force. The Installation, divided into two separate areas by facilities of the Langley Air Force Base, is approximately

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10 miles north of Hampton, Virginia. A plot of 110 acres at Newport News, Virginia, was acquired for construction of the Space Radiation Effects Laboratory. The total capital investment as of June 30, 1964, including the acreage located at Newport News, Virginia, was $249,776,000.

SUMMARY OF RESOURCES REQUIREMENTS:

(Dollars in thousands)

	1964	1965	1966
Number of Positions, end of year..	4,330	4,308	4,308
Average Number of All Employees...	4,260	4,292	4,281
Administrative Operations.....	$52,642	$57,258	$61,783

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

LEWIS RESEARCH CENTER

SUMMARY

MISSION:

The primary mission of the Lewis Research Center is basic and applied research, and development in advanced propulsion and space power generation. The Lewis Research Center is also assigned project management responsibility for the Centaur launch vehicle, and Agena procurement.

In addition to the development of the Centaur launch vehicle, considerable in-house effort will be utilized in support of experimental and developmental projects associated with nuclear electric and nuclear rocket propulsion systems; space vehicle technology, including propellant handling under environmental conditions; advanced concepts and basic research studies on liquid and solid propulsion systems and components; and investigations of solar and chemical power generating systems.

Other major areas of research are materials research in support of propulsion systems, electronics systems and fluid physics.

Aeronautical research includes propulsion systems for the supersonic transport.

Research facilities at Lewis (including Plum Brook Station) include a nuclear reactor for components testing; a space radiator and condenser facility for study of heat transfer; space environmental vacuum chambers; atmospheric wind tunnels; and numerous test stands for engine and subsystem studies.

DESCRIPTION:

Lewis Research Center is situated on 364 acres of land immediately west of the Cleveland-Hopkins Airport, 12 miles southwest of Cleveland, Ohio, and consists of 349 acres of government-owned land and 15 acres of leased property. The Plum Brook Station, which is a part of the Lewis Research Center, occupies a 6,031 acre NASA-owned tract near Sandusky, Ohio. The Plum Brook Station is approximately 45 miles west of the Cleveland site. The total capital investment as of June 30, 1964 for both Lewis and Plum Brook was $239,998,000.

SUMMARY OF RESOURCES REQUIREMENTS:

(Dollars in Thousands)

	1964	1965	1966
Number of Positions, end of year..	4,859	4,847	4,847
Average Number of All Employees...	4,799	4,866	4,827
Administrative Operations.....	$61,694	$70,971	$63,880

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

SPACE NUCLEAR PROPULSION OFFICE

SUMMARY

MISSION:

The mission of the Space Nuclear Propulsion Office (a joint office of the National Aeronautics and Space Administration and the Atomic Energy Commission) is to establish the basic technology, and develop and provide qualified nuclear rocket engines to accomplish operational missions in advanced launch vehicles.

The Installation was established to assure the formulation and execution of a well integrated program for nuclear rockets which fulfills the responsibilities of both the NASA and AEC. Implementation of the assigned programs will encompass basic research on reactors, engine systems, and nuclear vehicle technology; development of practical heat-exchanger type rocket reactors and engine systems; and ground testing of reactors and engines.

DESCRIPTION:

The organization consists of a headquarters office located at Germantown, Maryland, and three field extensions located in Ohio, New Mexico, and Nevada. The total capital investment of these facilities amounted to $8,069,000 as of June 30, 1964.

SUMMARY OF RESOURCES REQUIREMENTS:

(Dollars in Thousands)

	1964	1965	1966
Number of Positions, end of year..	112	116	116
Average Number of All Employees...	103	114	116
Administrative Operations.....	$1,472	$1,725	$1,838

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

NASA HEADQUARTERS

SUMMARY

MISSION:

The NASA Headquarters is responsible for the planning, coordination, and executive direction of programs established to implement the national objectives stated in the National Aeronautics and Space Act of 1958, as amended. To assist NASA general management in carrying out the technical activities the Headquarters is organized into broad program areas: Manned Space Flight, Space Science and Applications, Advanced Research and Technology, and a support function for Tracking and Data Acquisition. In addition to the responsibility for program direction, the program offices are responsible for management of the field Installations which carry out these programs. The Office of Manned Space Flight is responsible for the management of the Marshall Space Flight Center, Manned Spacecraft Center and the John F. Kennedy Space Center; the Office of Space Science and Applications for the Goddard Space Flight Center, Wallops Station, Pacific Launch Operations Office and the administration of the contract for the operation of the Jet Propulsion Laboratory; the Office of Advanced Research and Technology for the Ames Research Center, Electronics Research Center, Flight Research Center, Langley Research Center, Lewis Research Center, and the Space Nuclear Propulsion Office.

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.

SUMMARY OF RESOURCES REQUIREMENTS:

(Dollars in Thousands)

	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.....	$49,115	$73,255	$56,103

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

NORTH EASTERN OFFICE

SUMMARY

MISSION:

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

SUMMARY OF RESOURCES REQUIREMENTS:

	(Dollars in Thousands)		
	1964	1965	1966
Number of Positions, end of year..	33	---	---
Average Number of All Employees...	30	---	---
Administrative Operations.....	$379	---	---

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

WESTERN OPERATIONS OFFICE

SUMMARY

MISSION:

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

The mission of the Western Operations Office also includes administrative support and services for the NASA residence 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.

DESCRIPTION:

The Western Operations Office is located at 150 Pico Boulevard, Santa Monica, California. The Office occupies a group of leased buildings and there is no government investment in buildings or land 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.

SUMMARY OF RESOURCES REQUIREMENTS:

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

SUMMARY OF APPROPRIATION BUDGET PLANS BY INSTALLATION

(In millions of dollars)

	Research and Development			Construction of Facilities			Administrative Operations			Total		
	1964	1965	1966	1964	1965	1966	1964	1965	1966	1964	1965	1966
John F. Kennedy Space Center, NASA	51.7	53.4	73.5	284.7	89.1	8.6	35.0	61.6	62.7	371.4	204.1	144.8
Manned Spacecraft Center	1363.0	1406.1	1486.1	36.1	24.4	4.4	68.6	91.2	89.7	1467.7	1521.7	1580.2
Marshall Space Flight Center	1301.9	1468.5	1689.6	30.1	15.0	4.8	124.5	140.5	137.4	1456.5	1624.0	1831.8
Michoud Plant	-	-	-	9.1	6.3	.3	-	-	-	9.1	6.3	.3
Mississippi Test Facility	-	-	-	96.2	54.2	2.1	-	-	-	96.2	54.2	2.1
Goddard Space Flight Center	376.4	387.0	410.9	17.2	1.8	2.4	62.5	85.9	69.6	456.1	474.7	482.9
Pacific Launch Operations Office	-	.1	-	-	-	-	1.0	.8	.8	1.0	.9	.8
Wallops Station	5.1	6.8	10.4	.6	1.7	1.0	9.7	11.5	9.8	15.4	20.0	21.2
Jet Propulsion Laboratory	224.7	214.0	222.0	3.2	3.6	-	-	-	-	227.9	217.6	222.0
Ames Research Center	40.3	52.9	45.5	11.6	5.7	2.7	29.9	31.7	32.3	81.8	90.3	80.5
Electronics Research Center	-	1.9	5.2	4.8	10.1	10.0	.7	3.6	7.6	5.5	15.6	22.8
Flight Research Center	10.3	11.5	18.6	2.5	-	-	9.5	9.7	9.6	22.3	21.2	28.2
Langley Research Center	78.4	97.4	100.8	9.9	4.6	8.3	52.6	57.3	61.8	140.9	159.3	170.9
Lewis Research Center	300.3	313.7	258.6	20.5	2.1	.9	61.7	71.0	63.9	382.5	386.8	323.4
Space Nuclear Propulsion Office	60.4	45.0	48.9	4.2	-	-	1.5	1.7	1.8	66.1	46.7	50.7
Northeastern Office	-	-	-	-	-	-	.4	-	-	.4	-	-
Western Operations Office	4.5	.2	.3	-	-	-	4.9	6.0	6.3	9.4	6.2	6.6
NASA Headquarters	158.0	210.1	205.5	-	-	-	49.1	73.2	56.1	207.1	283.3	261.6
Various Locations	-	-	-	184.8	44.3	21.7	-	-	-	184.8	44.3	21.7
Facility Planning and Design	-	-	-	-	-	7.5	-	-	-	-	-	7.5
Total Budget Plan	3975.0	4268.6	4575.9	715.5	262.9	74.7	511.6	645.7	609.4	5202.1	5177.2	5260.0

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

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

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)

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1966 ESTIMATES

JET PROPULSION LABORATORY

SUMMARY

MISSION:

The Jet Propulsion Laboratory (JPL), a government-owned facility, is operated by the California Institute of Technology under contractual arrangement with the National Aeronautics and Space Administration. JPL has primary responsibility for the development and/or project management of complete spacecraft systems (e.g., Ranger, Surveyor, and Mariner), lunar and deep space unmanned scientific missions, and world-wide tracking, data acquisition, data reduction and analysis capability as required by lunar and deep space flights. Other areas of importance in the JPL program include advanced spacecraft guidance and control systems, advanced solid propellant and liquid propellant spacecraft engines, and integration of advanced propulsion systems into spacecraft.

DESCRIPTION:

The Jet Propulsion Laboratory occupies a main site of 145.9 acres in Pasadena, California, approximately twenty miles from Los Angeles. Subsidiary facilities are located at Goldstone, California; Edwards Air Force Base in Muroc, California; and at Table Mountain, California. The capital investment as of June 30, 1964 was $101,100,000.

SUMMARY OF RESOURCES REQUIREMENTS:

(Dollars in Thousands)

	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 Costs*.....	$61,626	$62,646	$58,735

*As a contractor operation, personnel and operation of installation costs at the Jet Propulsion Laboratory are research and development funded. Therefore, the administrative operations type estimates for JPL are shown for comparability purposes and are not separate requests in the NASA Administrative Operations Appropriation.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

CONSOLIDATED STATEMENT

ON THE AERONAUTICS PROGRAM

The funding shown in the NASA Research and Development budget (Volume II) for the Aeronautics program does not totally reflect the level of effort being conducted. NASA has, in its own research centers, a very great capability to accomplish aeronautics research. This capability, exemplified by major wind tunnel complexes, operational research aircraft, and extensive flight simulation facilities, is operated by Government personnel. In order to assess the magnitude of the NASA aeronautical research effort performed, the portion of the "Administrative Operations" appropriation which supports aeronautics projects must be added to the Research and Development funds. In addition, the cost of related Construction of Facilities projects is also to be considered, since, the increased capability to conduct aeronautics research is directly related to keeping the NASA physical plant up to date.

In addition to the funding described above, there is a considerable amount of work performed in other NASA Research and Technology activities that has potential benefit to Aeronautics. This may be categorized as "other OART, Supporting Research and Technology applicable to Aeronautics" and shown, as an estimate, in the table below.

	(Dollars in Millions)		
	1964	1965	1966
Research and development.....	$21.8	$35.2	$42.2
Construction of facilities	2.6	4.5	0.8
Administrative operations.....	28.9	30.4	33.2
Sub-Total.....	$53.3	$70.1	$76.2
Other OART supporting research and technology applicable to aeronautics.....	$30.0	$30.0	$30.0
Total.....	$83.3	$100.1	$106.2
Number of direct personnel engaged in aeronautics research and development effort.....	1,394	1,467	1,600

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1966 ESTIMATES

SUPPORTING RESEARCH AND TECHNOLOGY
(Thousands of dollars)

	Fiscal Year 1964	Fiscal Year 1965	Fiscal Year 1966
OFFICE OF MANNED SPACE FLIGHT.....	$30,272	$39,900	$22,600
Apollo.....	30,272	39,900	22,600
Spacecraft supporting development	(6,024)	(20,300)	(10,600)
Launch vehicle supporting development.....	(14,208)	(12,500)	(7,000)
Propulsion supporting development	(7,605)	(4,100)	(2,000)
Launch operations supporting development.....	(2,435)	(3,000)	(3,000)
OFFICE OF SPACE SCIENCE AND APPLICATIONS.....	$67,998	$79,949	$94,200
Physics and astronomy.....	17,666	20,100	25,200
Lunar and planetary exploration....	22,000	28,749	36,800
Launch vehicle development.....	3,800	7,100	4,000
Bioscience.....	12,979	12,700	15,500
Meteorological satellites.....	7,754	7,500	8,200
Communications satellites.....	1,637	2,100	2,500
Applications technology satellites.	2,162	1,700	2,000
OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY.....	$180,359	$172,279	$187,500
Basic research.....	22,653	21,231	22,000
Space vehicle systems.....	24,951	24,559	24,000
Electronic systems.....	26,380	23,322	30,000
Human factors systems.....	13,200	11,850	13,000
Nuclear-electric systems.....	26,749	23,192	24,000
Nuclear rockets.....	21,261	21,731	22,000
Chemical propulsion.....	21,970	24,762	30,000
Solar and chemical power.....	14,000	13,745	14,200
Aeronautics.....	9,195	7,887	8,300
OFFICE OF TRACKING AND DATA ACQUISITION.....	$12,890	$14,683	$14,500
GRAND TOTAL.....	$291,519	$306,811	$318,800

U. S. GOVERNMENT PRINTING OFFICE : 1965 O - 761-256