# *National Aeronautics and Space Administration*

# BUDGET ESTIMATES

## FISCAL YEAR 1968

**Volume I**

SUMMARY DATA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

SUMMARY DATA

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

## GENERAL STATEMENT

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

A total program of $5,110,000,000 is requested,to be financed by $5,050,000,000 new obligational authority and $60,000,000 of prior year funds, to maintain effort in current programs at a level deemed important to the maintenance of the United States world position in space and aeronautics.

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

MANNED SPACE FLIGHT: A program for the development of a capability for peaceful manned space operations and the utilization of that capability for earth orbit and lunar missions.

SPACE SCIENCE AND APPLICATIONS: An unmanned space flight program directed toward scientific investigations of the earth, moon, sun, planets, stars and interplanetary space; and the development of technology and spacecraft systems which can be utilized for meteorology, communications and geodetic observations.

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

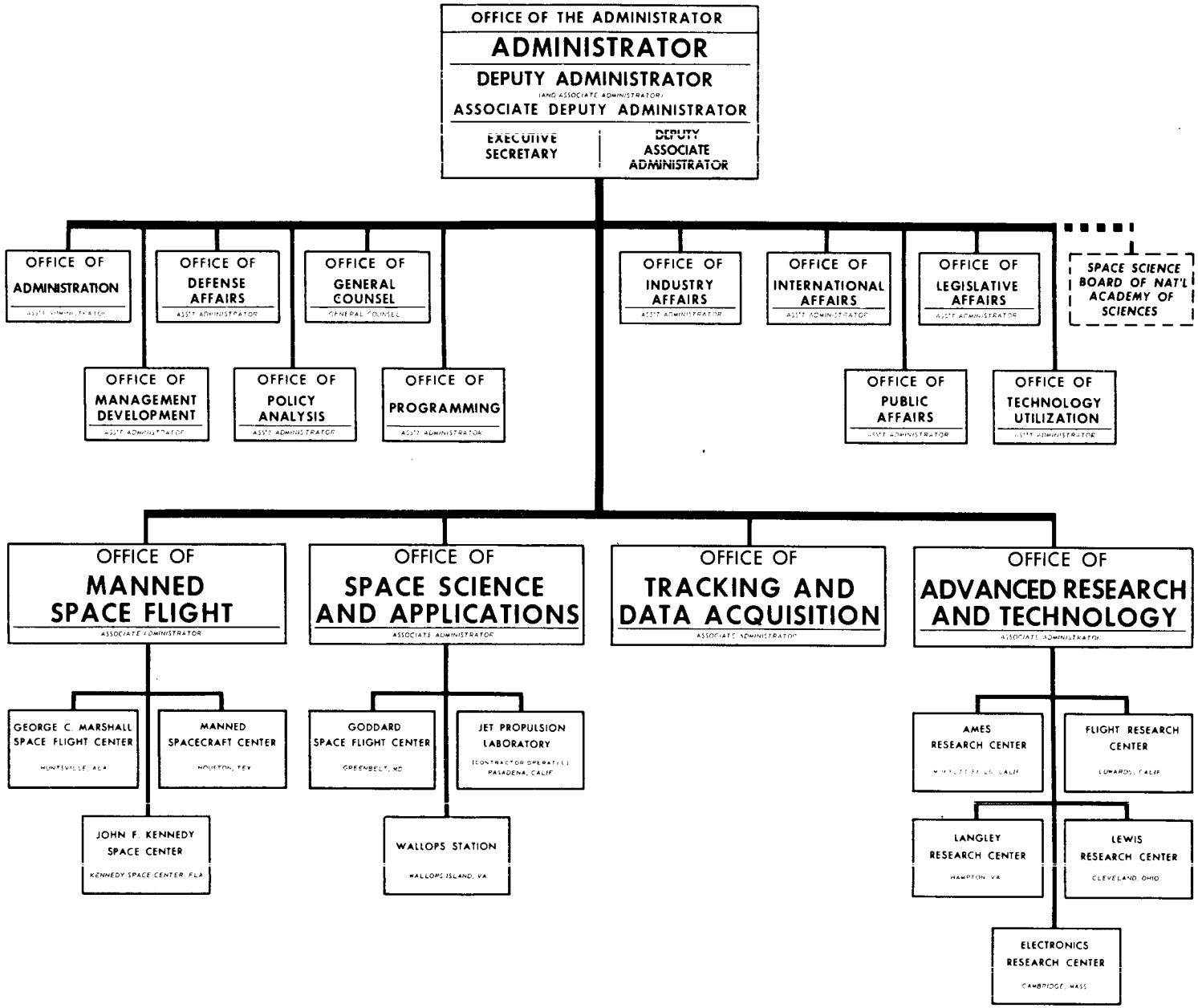
TRACKING AND DATA ACQUISITION: The world wide activity required to support the NASA manned and unmanned flight programs.

Detailed justification of the FY 1968 budget estimate for the total program of $5,110,000,000 is provided in the following three volumes:

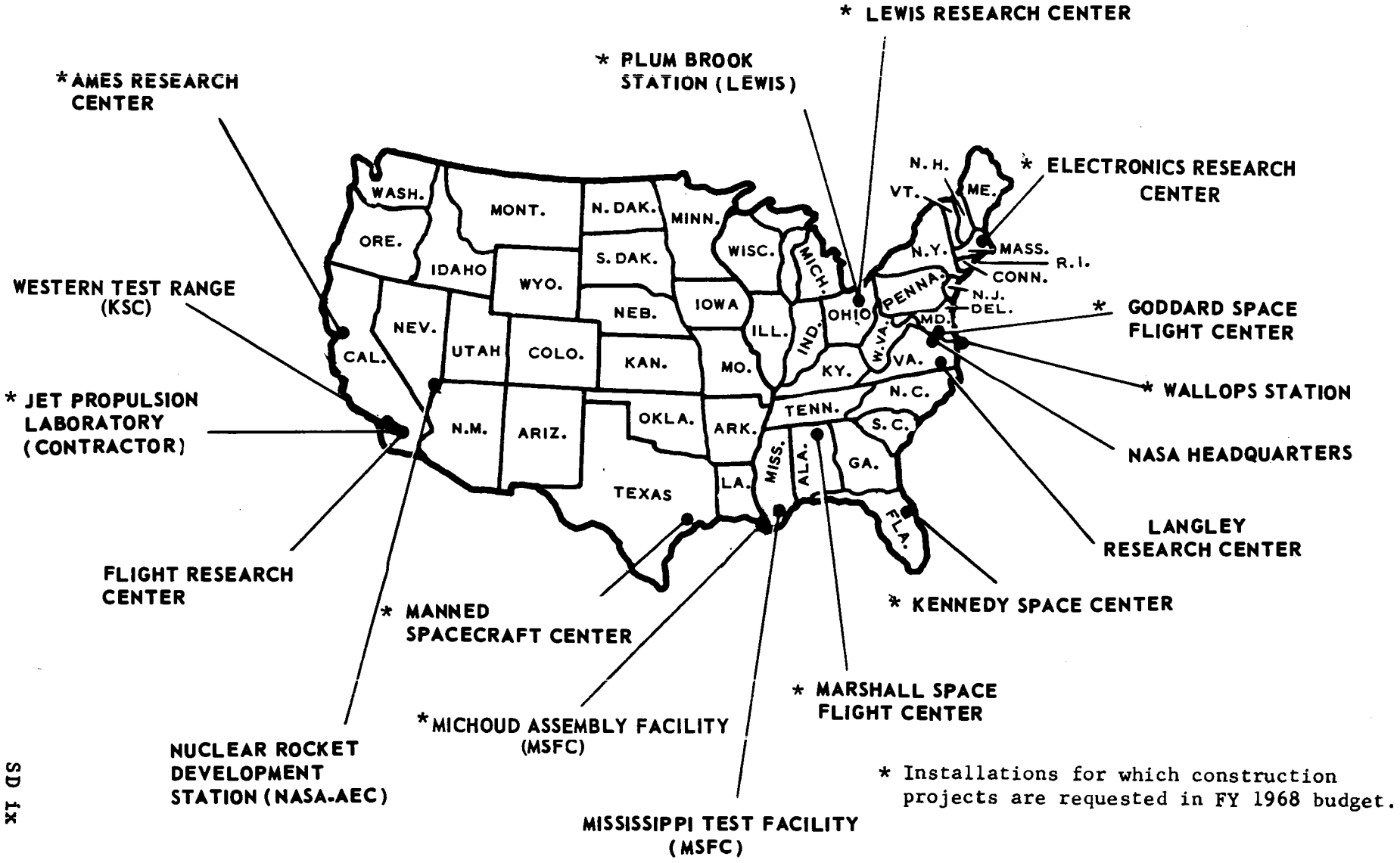
| Volume | | Amount |
|---|---|---|
| II | Research and Development | $4,384,500,000 |
| III | Construction of Facilities | 54,200,000 |
| IV | Administrative Operations | 671,300,000 |
| | TOTAL | $5,110,000,000* |

* Includes $60,000,000 of prior year funds applied to FY 1968 program.

## NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



# NASA INSTALLATIONS




* Installations for which construction projects are requested in FY 1968 budget.

A 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.

1 Be it enacted by the Senate and House of Representatives
2 of the United States of America in Congress assembled, That
3 there is hereby authorized to be appropriated to the National
4 Aeronautics and Space Administration the sum of $5,050,000,000,
5 as follows:
6 (a) For "Research and development," for the following
7 programs:
8 (1) Apollo, $2,546,500,000;
9 (2) Apollo applications, $454,700,000;
10 (3) Advanced missions, $8,000,000;
11 (4) Physics and Astronomy, $147,500,000;
12 (5) Lunar and planetary exploration, $142,000,000;
13 (6) Voyager, $71,500,000;
14 (7) Bioscience, $44,300,000;
15 (8) Space applications, $104,200,000;
16 (9) Launch vehicle procurement, $165,100,000;
17 (10) Space vehicle systems, $37,000,000;
18 (11) Electronics systems, $40,200,000;

(12) Human factor systems, $21,000,000;

(13) Basic research, $23,500,000;

(14) Space power and electric propulsion systems, $45,000,000;

(15) Nuclear rockets, $46,500,000;

(16) Chemical propulsion, $38,000,000;

(17) Aeronautics, $66,800,000;

(18) Tracking and data acquisition, $297,700,000;

(19) Sustaining university program, $20,000,000;

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

(b) For "Construction of facilities," including land acquisitions, as follows:

(1) Ames Research Center, Moffett Field, California, $5,365,000;

(2) Electronics Research Center, Cambridge, Massachusetts, $6,220,000;

(3) Goddard Space Flight Center, Greenbelt, Maryland, $565,000;

(4) Jet Propulsion Laboratory, Pasadena, California, $3,125,000;

(5) John F. Kennedy Space Center, NASA, Kennedy Space Center, Florida, $24,885,000;

(6) Lewis Research Center, Cleveland and Sandusky, Ohio, $2,115,000;

(7) Manned Spacecraft Center, Houston, Texas, $2,425,000;

(8) George C. Marshall Space Flight Center, Huntsville, Alabama, $870,000;

(9) Michoud Assembly Facility, New Orleans and Slidell, Louisiana, $2,010,000;

(10) Wallops Station, Wallops Island, Virginia, $740,000;

(11) Various locations, $2,880,000;

(12) Facility planning and design not otherwise provided for, $3,000,000.

(c) For "Administrative operations," $671,300,000.

(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"

1 pursuant to this Act may be used for construction of any major
2 facility, the estimated cost of which, including collateral
3 equipment, exceeds $250,000, unless the Administrator or his
4 designee has notified the Speaker of the House of Representa-
5 tives and the President of the Senate and the Committee on
6 Science and Astronautics of the House of Representatives and
7 the Committee on Aeronautical and Space Sciences of the Senate
8 of the nature, location, and estimated cost of such facility.
9 (e) When so specified in an appropriation Act, (1) any
10 amount appropriated for "Research and development" or for
11 "Construction of facilities" may remain available without
12 fiscal year limitation, and (2) maintenance and operation
13 of facilities, and support services contracts may be
14 entered into under the "Administrative operations" appro-
15 priation for periods not in excess of twelve months
16 beginning at any time during the fiscal year.
17 (f) Appropriations made pursuant to subsection 1(c)
18 may be used, but not to exceed $35,000, for scientific
19 consultations or extraordinary expenses upon the approval
20 or authority of the Administrator and his determination
21 shall be final and conclusive upon the accounting officers
22 of the Government.
23 (g) No part of the funds appropriated pursuant to
24 subsection 1(c) for maintenance, repairs, alterations, and

1 minor construction shall be used for the construction of any
2 new facility the estimated cost of which, including col-
3 lateral equipment, exceeds $100,000.
4 Sec. 2. Authorization is hereby granted whereby any of
5 the amounts prescribed in paragraphs (1), (2), (3), (4),
6 (5), (6), (7), (8), (9), (10), and (11) of subsection 1(b)
7 may, in the discretion of the Administrator of the National
8 Aeronautics and Space Administration, be varied upward 5 per
9 centum to meet unusual cost variations, but the total cost of
10 all work authorized under such paragraphs shall not exceed the
11 total of the amounts specified in such paragraphs.
12 Sec. 3. Not to exceed one-half of 1 per centum of the
13 funds appropriated pursuant to subsection 1(a) hereof may
14 be transferred to the "Construction of facilities" appropria-
15 tion, and, when so transferred, together with $10,000,000 of
16 the funds appropriated pursuant to subsection 1(b) hereof
17 (other than funds appropriated pursuant to paragraph (12) of
18 such subsection) shall be available for expenditure to con-
19 struct, expand, or modify laboratories and other installations
20 at any location (including locations specified in subsection
21 1(b)), if (1) the Administrator determines such action to be
22 necessary because of changes in the national program of aero-
23 nautical and space activities or new scientific or engineering
24 developments, and (2) he determines that deferral of such



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1 action until the enactment of the next authorization Act would
2 be inconsistent with the interest of the Nation in aeronautical
3 and space activities. The funds so made available may be
4 expended to acquire, construct, convert, rehabilitate, or
5 install permanent or temporary public works, including land
6 acquisition, site preparation, appurtenances, utilities, and
7 equipment. No portion of such sums may be obligated for
8 expenditure or expended to construct, expand, or modify
9 laboratories and other installations unless (A) a period of
10 thirty days has passed after the Administrator or his designee
11 has transmitted to the Speaker of the House of Representatives
12 and to the President of the Senate and to the Committee on
13 Science and Astronautics of the House of Representatives and
14 to the Committee on Aeronautical and Space Sciences of the
15 Senate a written report containing a full and complete state-
16 ment concerning (1) the nature of such construction, expansion,
17 or modification, (2) the cost thereof including the cost of
18 any real estate action pertaining thereto, and (3) the reason
19 why such construction, expansion, or modification is necessary
20 in the national interest, or (B) each such committee before
21 the expiration of such period has transmitted to the Adminis-
22 trator written notice to the effect that such committee has
23 no objection to the proposed action.

1 Sec. 4. Notwithstanding any other provision of this
2 Act--
3 (1) no amount appropriated pursuant to this Act
4 may be used for any program deleted by the Congress
5 from requests as originally made to either the House
6 Committee on Science and Astronautics or the Senate
7 Committee on Aeronautical and Space Sciences,
8 (2) no amount appropriated pursuant to this Act may
9 be used for any program in excess of the amount
10 actually authorized for that particular program by
11 sections 1(a) and 1(c), and
12 (3) no amount appropriated pursuant to this Act
13 may be used for any program which has not been pre-
14 sented to or requested of either such committee,
15 unless (A) a period of thirty days has passed after the
16 receipt by the Speaker of the House of Representatives and
17 the President of the Senate and each such committee of notice
18 given by the Administrator or his designee containing a full
19 and complete statement of the action proposed to be taken and
20 the facts and circumstances relied upon in support of such
21 proposed action, or (B) each such committee before the expira-
22 tion of such period has transmitted to the Administrator
23 written notice to the effect that such committee has no objec-
24 tion to the proposed action.

1 Sec. 5. It is the sense of Congress that it is in the
2 national interest that consideration be given to geographical
3 distribution of Federal research funds whenever feasible, and
4 that the National Aeronautics and Space Administration should
5 explore ways and means of distributing its research and devel-
6 opment funds whenever feasible.
7 Sec. 6. This Act may be cited as the "National Aeronautics
8 and Space Administration Authorization Act, 1968."

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

SUMMARY OF APPROPRIATIONS

(In thousands of dollars)

| Appropriation | P.L. 89-128 Fiscal Year 1966 | P.L. 89-555 Fiscal Year 1967 | Fiscal Year 1968 |
|---|---|---|---|
| Research and Development..... | $4,531,000 | $4,245,000 | $4,324,500 |
| Construction of Facilities.... | 60,000 | 83,000 | 54,200 |
| Administrative Operations..... | 584,000 | 640,000 | 671,300 |
| TOTAL..... | $5,175,000 | $4,968,000 | $5,050,000 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

SUMMARY OF APPROPRIATIONS (ADJUSTED)

(Thousands of dollars)

| | Total | Research and Development | Construction of Facilities | Administrative Operations |
|---|---|---|---|---|
| FISCAL YEAR 1966 | | | | |
| Independent Offices Appropriation Act, 1966 (79 Stat. 533-4)..... | $5,175,000 | $4,531,000 | $60,000 | $584,000 |
| NASA Appropriation Transfers (79 Stat. 534)..... | --- | -28,836 | 940 | 27,896 |
| Transfer to "Operating expenses, Public Buildings Service," General Services Administration (79 Stat. 531)..... | -76 | --- | --- | -76 |
| Appropriation (adjusted)..... | $5,174,924 | $4,502,164 | $60,940 | $611,820 |
| FISCAL YEAR 1967 | | | | |
| Independent Offices Appropriation Act, 1967 (80 Stat. 675)..... | $4,968,000 | $4,245,000 | $83,000 | $640,000 |
| NASA Appropriation Transfers (80 Stat. 676)..... | --- | -9,900 | 2,000 | 7,900 |
| Transfer to "Operating expenses, Public Buildings Service," General Services Administration (80 Stat. 674)..... | -417 | --- | --- | -417 |
| Appropriation (adjusted)..... | $4,967,583 | $4,235,100 | $85,000 | $647,483 |
| FISCAL YEAR 1968 | | | | |
| Appropriation request..... | $5,050,000 | $4,324,500 | $54,200 | $671,300 |

## NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

## FISCAL YEAR 1968 ESTIMATES

### SUMMARY OF BUDGET PLAN 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 1966** | **$5,152,405** | **$3,530,253** | **$689,043** | **$115,261** | **$403,692** | **$80,351** | **$333,805** |
| Research and development | 4,483,011 | 3,199,507 | 608,840 | 102,853 | 248,500 | 41,496 | 281,815 |
| Construction of facilities | 58,208 | 17,478 | 8,024 | --- | 13,435 | 682 | 18,589 |
| Administrative operations | 611,186 | 313,268 | 72,179 | 12,408 | 141,757 | 38,173 | 33,401 |
| **Fiscal Year 1967** | **$4,907,583** | **$3,398,226** | **$559,493** | **$112,185** | **$384,745** | **$103,396** | **$349,538** |
| Research and development | 4,175,100 | 3,024,000 | 475,500 | 99,000 | 233,850 | 35,900 | 306,850 |
| Construction of facilities | 85,000 | 43,821 | 4,879 | --- | 8,589 | 21,011 | 6,700 |
| Administrative operations | 647,483 | 330,405 | 79,114 | 13,185 | 142,306 | 46,485 | 35,988 |
| **Fiscal Year 1968** | **$5,110,000*** | **$3,435,780*** | **$602,540** | **$161,025** | **$424,317** | **$119,567** | **$366,771** |
| Research and development | 4,384,500* | 3,069,200* | 516,316 | 147,284 | 262,200 | 66,800 | 322,700 |
| Construction of facilities | 54,200 | 27,900 | 6,985 | --- | 8,335 | 3,170 | 7,810 |
| Administrative operations | 671,300 | 338,680 | 79,239 | 13,741 | 153,782 | 49,597 | 36,261 |

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

NUMBER OF PERSONNEL POSITIONS

| | Fiscal Year 1966 | Fiscal Year 1967 | Fiscal Year 1968 |
|---|---|---|---|
| MANNED SPACE FLIGHT | | | |
| John F. Kennedy Space Center, NASA | 2,589 | 2,720 | 2,720 |
| Manned Spacecraft Center | 4,737 | 4,634 | 4,634 |
| Marshall Space Flight Center | 7,271 | 7,030 | 7,030 |
| SPACE SCIENCE AND APPLICATIONS | | | |
| Goddard Space Flight Center | 3,712 | 3,782 | 3,782 |
| Wallops Station | 518 | 518 | 518 |
| ADVANCED RESEARCH AND TECHNOLOGY | | | |
| Ames Research Center | 2,223 | 2,171 | 2,171 |
| Electronics Research Center | 510 | 741 | 1,041 |
| Flight Research Center | 603 | 590 | 590 |
| Langley Research Center | 4,233 | 4,136 | 4,236 |
| Lewis Research Center | 4,819 | 4,676 | 4,676 |
| Space Nuclear Propulsion Office | 117 | 117 | 117 |
| SUPPORTING OPERATIONS | | | |
| NASA Headquarters | 2,592 | 2,611 | 2,611 |
| TOTAL PERMANENT POSITIONS | 33,924 | 33,726 | 34,126 |
| POSITIONS OTHER THAN PERMANENT | 2,182 | 2,182 | 2,182 |
| TOTAL POSITIONS | 36,106 | 35,908 | 36,308 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 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 | JET PROPULSION LABORATORY | WALLOPS STATION | AMES RESEARCH CENTER | ELECTRONICS RESEARCH CENTER | FLIGHT RESEARCH CENTER | LANGLEY RESEARCH CENTER | LEWIS RESEARCH CENTER | SPACE NUCLEAR PROPULSION OFFICE | NASA HEADQUARTERS | WESTERN SUPPORT OFFICE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OFFICE OF MANNED SPACE FLIGHT, TOTAL | 1966 | 3,199,507 | 128,859 | 1,506,278 | 1,517,982 | 1,986 | - | 200 | 1,721 | - | - | 2,140 | - | - | 36,631 | 3,710 |
| | 1967 | 3,024,000 | 224,050 | 1,407,527 | 1,354,141 | 93 | - | - | 125 | - | - | 1,070 | - | - | 36,794 | 200 |
| | 1968 | 3,069,200 | 232,200 | 1,392,000 | 1,390,800 | 100 | - | - | - | - | - | - | - | | 54,100 | - |
| Gemini | 1966 | 197,275 | - | 196,875 | - | - | - | - | - | - | - | - | - | - | 400 | - |
| | 1967 | 21,600 | - | 21,600 | - | - | - | - | - | - | - | - | - | - | - | - |
| | 1968 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Apollo | 1966 | 2,940,985 | 128,109 | 1,279,394 | 1,506,935 | 425 | - | - | 230 | - | - | - | - | - | 23,022 | 2,870 |
| | 1967 | 2,916,200 | 223,450 | 1,350,073 | 1,314,096 | 93 | - | - | - | - | - | 170 | - | - | 28,118 | 200 |
| | 1968 | 2,606,500 | 228,500 | 1,160,400 | 1,188,100 | 100 | - | - | - | - | - | - | - | - | 29,400 | - |
| Apollo applications | 1966 | 51,247 | 250 | 28,109 | 5,352 | 1,561 | - | 200 | 1,491 | - | - | 1,590 | - | - | 11,954 | 740 |
| | 1967 | 80,000 | 250 | 32,604 | 37,445 | - | - | - | 125 | - | - | 900 | - | - | 8,676 | - |
| | 1968 | 454,700 | 3,300 | 228,200 | 199,600 | - | - | - | - | - | - | - | - | - | 23,600 | - |
| Advanced missions | 1966 | 10,000 | 500 | 1,900 | 5,695 | - | - | - | - | - | - | 550 | - | - | 1,255 | 100 |
| | 1967 | 6,200 | 350 | 3,250 | 2,600 | - | - | - | - | - | - | - | - | - | - | - |
| | 1968 | 8,000 | 400 | 3,400 | 3,100 | - | - | - | - | - | - | - | - | - | 1,100 | - |
| OFFICE OF SPACE SCIENCE AND APPLICATIONS, TOTAL | 1966 | 759,093 | 4,647 | 18 | 8,500 | 184,181 | 149,767 | 2,050 | 40,414 | 1,335 | 5 | 75,436 | 183,755 | - | 100,201 | 8,784 |
| | 1967 | 607,100 | 3,987 | - | 2,295 | 173,373 | 139,675 | 1,148 | 41,493 | 1,715 | 10 | 42,607 | 118,213 | - | 74,659 | 7,925 |
| | 1968 | 694,600 | 3,332 | 5,000 | 23,820 | 215,171 | 154,400 | 2,173 | 42,200 | 1,995 | 25 | 49,469 | 110,233 | - | 72,417 | 14,365 |
| Physics and astronomy | 1966 | 142,753 | - | - | 25 | 100,753 | 759 | 1,610 | 15,219 | - | 5 | 1,869 | - | - | 22,513 | - |
| | 1967 | 129,800 | - | - | 125 | 95,061 | 338 | 996 | 10,502 | 60 | 10 | 1,230 | - | - | 21,478 | - |
| | 1968 | 147,500 | - | - | 100 | 108,911 | 300 | 1,800 | 10,100 | 75 | 25 | 3,139 | - | - | 23,050 | - |
| Lunar and planetary exploration | 1966 | 204,300 | - | - | 630 | 1,119 | 131,668 | - | 668 | - | - | 58,842 | - | - | 11,373 | - |
| | 1967 | 169,400 | - | - | 635 | 800 | 129,184 | - | 480 | 40 | - | 29,425 | - | - | 8,836 | - |
| | 1968 | 142,000 | - | - | 400 | 1,000 | 120,500 | - | 500 | 50 | - | 10,500 | - | - | 9,050 | - |
| Voyager | 1966 | 17,097 | - | - | 210 | - | 15,502 | - | 200 | - | - | 585 | - | - | 600 | - |
| | 1967 | 10,450 | - | - | 1,000 | - | 8,200 | - | 250 | - | - | 1,000 | - | - | - | - |
| | 1968 | 71,500 | - | - | 21,300 | - | 31,000 | - | 500 | - | - | 18,000 | - | - | 700 | - |
| Sustaining university program | 1966 | 46,000 | - | - | - | - | - | - | - | - | - | - | - | - | 46,000 | - |
| | 1967 | 31,000 | - | - | - | - | - | - | - | - | - | - | - | - | 31,000 | - |
| | 1968 | 20,000 | - | - | - | - | - | - | - | - | - | - | - | - | 20,000 | - |
| Launch vehicle development | 1966 | 57,790 | 470 | - | 7,205 | - | 140 | - | - | 600 | - | 890 | 48,125 | - | 360 | - |
| | 1967 | 31,200 | 200 | - | - | - | - | - | - | 1,025 | - | 487 | 28,988 | - | 500 | - |
| | 1968 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Launch vehicle procurement | 1966 | 178,700 | 4,177 | - | - | 11,879 | - | - | - | - | - | 12,090 | 135,430 | - | 6,340 | 8,784 |
| | 1967 | 122,400 | 3,787 | - | - | 12,563 | - | - | - | - | - | 9,400 | 88,725 | - | - | 7,925 |
| | 1968 | 165,100 | 3,332 | - | 1,100 | 18,400 | - | - | - | 1,270 | - | 16,900 | 109,233 | - | 500 | 14,365 |
| Bioscience | 1966 | 34,400 | - | - | 60 | 420 | 1,151 | 100 | 24,127 | - | - | 30 | - | - | 8,512 | - |
| | 1967 | 41,550 | - | - | 100 | 369 | 1,784 | 25 | 30,161 | - | - | 160 | - | - | 8,951 | - |
| | 1968 | 44,300 | - | - | 120 | 350 | 2,300 | 153 | 31,000 | - | - | 200 | - | - | 10,177 | - |
| Space applications | 1966 | 78,053 | - | 18 | 370 | 70,010 | 547 | 340 | 200 | 735 | - | 1,130 | 200 | - | 4,503 | - |
| | 1967 | 71,300 | - | - | 435 | 64,580 | 169 | 127 | 100 | 590 | - | 905 | 500 | - | 3,894 | - |
| | 1968 | 104,200 | - | 5,000 | 800 | 86,510 | 300 | 220 | 100 | 600 | - | 730 | 1,000 | - | 8,940 | - |

214-304 O - 67 (Face blank p. 20) No. 1

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 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 | JET PROPULSION LABORATORY | WALLOPS STATION | AMES RESEARCH CENTER | ELECTRONICS RESEARCH CENTER | FLIGHT RESEARCH CENTER | LANGLEY RESEARCH CENTER | LEWIS RESEARCH CENTER | SPACE NUCLEAR PROPULSION OFFICE | NASA HEADQUARTERS | WESTERN SUPPORT OFFICE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY, TOTAL | 1966 | 288,596 | 193 | 3,011 | 20,010 | 9,676 | 20,788 | - | 19,454 | 7,325 | 15,828 | 43,431 | 68,023 | 50,431 | 22,432 | 7,994 |
| | 1967 | 268,150 | - | 4,040 | 15,910 | 10,166 | 18,344 | - | 20,531 | 12,694 | 8,011 | 46,460 | 51,946 | 47,985 | 24,324 | 7,739 |
| | 1968 | 318,000 | 100 | 4,925 | 21,942 | 10,115 | 21,840 | - | 25,788 | 20,375 | 23,590 | 56,095 | 59,770 | 39,350 | 29,410 | 4,700 |
| Basic research | 1966 | 22,000 | - | - | 815 | 117 | 5,056 | - | 2,070 | 1,035 | 30 | 2,144 | 2,731 | - | 7,351 | 651 |
| | 1967 | 21,465 | - | - | 888 | 145 | 4,757 | - | 2,106 | 1,126 | - | 2,360 | 2,775 | - | 6,698 | 610 |
| | 1968 | 23,500 | - | - | 992 | 175 | 5,125 | - | 2,313 | 1,695 | - | 2,420 | 2,960 | - | 7,170 | 650 |
| Space vehicle systems | 1966 | 35,000 | - | 456 | 4,617 | 1,624 | 3,718 | - | 3,126 | 250 | 1,010 | 13,442 | 3,199 | - | 3,062 | 496 |
| | 1967 | 33,935 | - | 560 | 3,682 | 1,905 | 2,426 | - | 2,825 | 320 | 1,010 | 15,963 | 2,288 | - | 2,665 | 291 |
| | 1968 | 37,000 | - | 485 | 4,260 | 2,100 | 1,575 | - | 3,015 | 470 | 1,200 | 18,535 | 2,425 | - | 2,935 | - |
| Electronics systems | 1966 | 32,300 | - | 500 | 4,408 | 3,090 | 3,591 | - | 3,893 | 5,407 | 683 | 7,442 | 539 | - | 2,747 | - |
| | 1967 | 33,597 | - | 340 | 4,019 | 2,990 | 2,182 | - | 3,635 | 9,651 | 810 | 7,024 | 450 | - | 2,496 | - |
| | 1968 | 40,200 | - | 340 | 4,090 | 2,990 | 3,040 | - | 3,710 | 15,710 | 890 | 5,915 | 460 | - | 3,055 | - |
| Human factor systems | 1966 | 14,900 | - | 795 | 310 | 25 | 100 | - | 5,260 | 359 | 1,500 | 4,286 | 14 | - | 2,171 | 80 |
| | 1967 | 16,175 | - | 1,160 | 300 | - | - | - | 5,690 | 650 | 1,000 | 4,354 | 100 | - | 2,921 | - |
| | 1968 | 21,000 | - | 2,300 | 300 | - | - | - | 5,500 | 850 | 1,000 | 6,850 | 150 | - | 4,050 | - |
| Space power and electric propulsion systems | 1966 | 45,200 | - | 635 | 1,685 | 4,270 | 4,812 | - | 110 | 84 | - | 1,322 | 28,194 | - | 2,586 | 1,502 |
| | 1967 | 40,440 | - | 1,430 | 1,731 | 4,676 | 5,641 | - | 295 | 853 | - | 1,370 | 20,569 | - | 2,862 | 1,013 |
| | 1968 | 45,000 | - | 800 | 1,400 | 4,400 | 7,500 | - | 250 | 1,500 | - | 700 | 25,650 | - | 2,500 | 300 |
| Nuclear rockets | 1966 | 58,000 | - | - | 1,125 | - | - | - | - | - | - | - | 6,444 | 50,431 | - | - |
| | 1967 | 53,000 | - | - | 1,500 | - | - | - | - | - | - | - | 3,515 | 47,985 | - | - |
| | 1968 | 46,500 | - | - | 2,950 | - | - | - | - | - | - | - | 4,200 | 39,350 | - | - |
| Chemical propulsion | 1966 | 39,700 | 193 | 625 | 7,050 | 550 | 3,511 | - | - | - | - | 2,869 | 17,186 | - | 2,451 | 5,265 |
| | 1967 | 33,638 | - | 550 | 3,790 | 450 | 3,338 | - | - | - | - | 2,516 | 11,890 | - | 5,279 | 5,825 |
| | 1968 | 38,000 | 100 | 1,000 | 7,950 | 450 | 4,600 | - | - | - | - | 2,775 | 9,725 | - | 7,650 | 3,750 |
| Aeronautics | 1966 | 41,496 | - | - | - | - | - | - | 4,995 | 190 | 12,605 | 11,926 | 9,716 | - | 2,064 | - |
| | 1967 | 35,900 | - | - | - | - | - | - | 5,980 | 94 | 5,191 | 12,873 | 10,359 | - | 1,403 | - |
| | 1968 | 66,800 | - | - | - | - | - | - | 11,000 | 150 | 20,500 | 18,900 | 14,200 | - | 2,050 | - |
| OFFICE OF TRACKING AND DATA ACQUISITION | 1966 | 231,065 | - | 1,271 | 1,627 | 155,425 | 52,629 | 5,300 | - | - | 1,900 | 1,800 | - | - | 11,113 | - |
| | 1967 | 270,850 | - | - | 800 | 191,400 | 55,800 | 6,600 | - | - | 1,900 | 2,450 | - | - | 11,900 | - |
| | 1968 | 297,700 | - | - | 800 | 213,100 | 60,400 | 7,100 | - | - | 2,000 | 2,000 | - | - | 12,300 | - |
| Tracking and data acquisition | 1966 | 231,065 | - | 1,271 | 1,627 | 155,425 | 52,629 | 5,300 | - | - | 1,900 | 1,800 | - | - | 11,113 | - |
| | 1967 | 270,850 | - | - | 800 | 191,400 | 55,800 | 6,600 | - | - | 1,900 | 2,450 | - | - | 11,900 | - |
| | 1968 | 297,700 | - | - | 800 | 213,100 | 60,400 | 7,100 | - | - | 2,000 | 2,000 | - | - | 12,300 | - |
| OFFICE OF TECHNOLOGY UTILIZATION AND POLICY PLANNING | 1966 | 4,750 | - | - | - | - | - | - | - | - | - | - | - | - | 4,750 | - |
| | 1967 | 5,000 | - | - | - | - | - | - | - | - | - | - | - | - | 5,000 | - |
| | 1968 | 5,000 | - | - | - | - | - | - | - | - | - | - | - | - | 5,000 | - |
| Technology utilization | 1966 | 4,750 | - | - | - | - | - | - | - | - | - | - | - | - | 4,750 | - |
| | 1967 | 5,000 | - | - | - | - | - | - | - | - | - | - | - | - | 5,000 | - |
| | 1968 | 5,000 | - | - | - | - | - | - | - | - | - | - | - | - | 5,000 | - |
| TOTAL BUDGET PLAN | 1966 | 4,483,011 | 133,699 | 1,510,578 | 1,548,119 | 351,268 | 223,184 | 7,550 | 61,589 | 8,660 | 17,733 | 122,807 | 251,778 | 50,431 | 175,127 | 20,488 |
| | 1967 | 4,175,100 | 228,037 | 1,411,567 | 1,373,146 | 375,032 | 213,819 | 7,748 | 62,149 | 14,409 | 9,921 | 92,587 | 170,159 | 47,985 | 152,677 | 15,864 |
| | 1968 | 4,384,500 1/ | 235,632 | 1,401,925 | 1,437,362 | 438,486 | 236,640 | 9,273 | 67,988 | 22,370 | 25,615 | 107,564 | 170,003 | 39,350 | 173,227 | 19,065 |

1/ Includes $60 million unobligated balance available to finance new program plan.

244-304 O - 67 (Face blank p. 20 No. 3

## 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, [$4,245,000,000] *$4,324,500,000*, to remain available until expended. *(42 U.S.C. 2451, et seq., 50 U.S.C. 151–160, 511–515; Independent Offices Appropriation Act, 1967; additional authorizing legislation to be proposed.)*

244-879 O - 67 (Face blank p. 26) Insert No. 1

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

RESEARCH AND DEVELOPMENT

Program and Financing (in thousands of dollars)

| | Budget Plan | | | Costs to this appropriation | | |
|---|---|---|---|---|---|---|
| | 1966 | 1967 | 1968 | 1966 | 1967 | 1968 |
| Program by activities: | | | | | | |
| Direct program: | | | | | | |
| 1. Manned space flight: | | | | | | |
| (a) Gemini..... | 197,275 | 21,600 | ..... | 218,728 | 113,000 | ..... |
| (b) Apollo..... | 2,940,985 | 2,916,200 | 2,606,500 | 3,245,757 | 3,101,300 | 2,675,800 |
| (c) Apollo applications..... | 51,247 | 80,000 | 454,700 | 19,364 | 99,500 | 440,000 |
| (d) Advanced mission studies | 10,000 | 6,200 | 8,000 | 18,887 | 16,300 | 8,000 |
| 2. Scientific investigations in space: | | | | | | |
| (a) Physics and astronomy... | 176,553 | 171,400 | 199,958 | 162,890 | 179,300 | 194,300 |
| (b) Lunar and planetary exploration..... | 294,597 | 207,350 | 235,158 | 255,236 | 252,700 | 244,900 |
| (c) Bioscience..... | 43,900 | 41,550 | 48,800 | 41,197 | 46,800 | 51,200 |
| (d) Launch vehicle development..... | 93,790 | 55,200 | 32,400 | 106,820 | 70,400 | 39,600 |
| 3. Space applications..... | 102,853 | 99,000 | 147,284 | 102,248 | 97,000 | 133,200 |
| 4. Space technology..... | 248,500 | 233,850 | 262,200 | 254,922 | 260,700 | 258,000 |
| 5. Aircraft technology..... | 41,496 | 35,900 | 66,800 | 36,297 | 45,800 | 49,600 |
| 6. Supporting activities: | | | | | | |
| (a) Tracking and data acquisition..... | 231,065 | 270,850 | 297,700 | 271,899 | 320,800 | 332,300 |
| (b) Sustaining university program..... | 46,000 | 31,000 | 20,000 | 33,263 | 38,500 | 35,500 |
| (c) Technology utilization.. | 4,750 | 5,000 | 5,000 | 3,453 | 7,100 | 5,400 |
| Total direct program costs, funded..... | 4,483,011 | 4,175,100 | 4,384,500 | 4,770,961 | 4,649,200 | 4,467,800 |

## RESEARCH AND DEVELOPMENT

Program and Financing (in thousands of dollars) - Continued

| | Budget Plan | | | Costs to this appropriation | | |
|---|---|---|---|---|---|---|
| | 1966 | 1967 | 1968 | 1966 | 1967 | 1968 |
| Reimbursable program: | | | | | | |
| 1. Manned space flight: | | | | | | |
| (a) Gemini..... | 7,020 | ..... | ..... | 8,930 | 2,197 | ..... |
| (b) Apollo..... | 762 | 155 | 2,255 | 419 | 440 | 2,255 |
| 2. Scientific investigations in space: | | | | | | |
| (a) Physics and astronomy..... | ..... | 381 | ..... | 154 | 454 | ..... |
| 3. Space applications..... | 3,027 | 43,270 | 40,100 | 28,604 | 56,666 | 40,100 |
| 4. Space technology..... | 40,158 | 53,429 | 29,000 | 41,219 | 54,134 | 29,000 |
| 5. Aircraft technology..... | 2,585 | 2,100 | 2,800 | 492 | 3,228 | 2,800 |
| 6. Supporting activities: | | | | | | |
| (a) Tracking and data acquisition..... | 1,320 | 575 | 2,245 | 402 | 966 | 2,245 |
| (b) Sustaining university program..... | ..... | ..... | ..... | 10 | ..... | ..... |
| (c) Technology utilization.... | 160 | 90 | ..... | 102 | 148 | ..... |
| Total reimbursable program costs..... | 55,032 | 100,000 | 76,400 | 80,332 | 118,233 | 76,400 |
| Total program costs, funded..... | 4,538,043 | 4,275,100 | 4,460,900 | 4,851,293 | 4,767,433 | 4,544,200 |
| Change in selected resources1/.... | ..... | ..... | ..... | -295,982 | -288,668 | -83,300 |
| 10 Total..... | 4,538,043 | 4,275,100 | 4,460,900 | 4,555,311 | 4,478,765 | 4,460,900 |

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## RESEARCH AND DEVELOPMENT

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

| | Budget Plan | | | Costs to this appropriation | | |
|---|---|---|---|---|---|---|
| | 1966 | 1967 | 1968 | 1966 | 1967 | 1968 |
| 10 Total..... | 4,538,043 | 4,275,100 | 4,460,900 | 4,555,311 | 4,478,765 | 4,460,900 |
| Financing: | | | | | | |
| Receipts and reimbursements from: | | | | | | |
| 11 Administrative budget accounts | -54,697 | -88,637 | -63,000 | -54,697 | -88,637 | -63,000 |
| 14 Non-Federal sources[2] | -335 | -11,363 | -13,400 | -335 | -11,363 | -13,400 |
| 21 Unobligated balance available, start of year: | | | | | | |
| For completion of prior year budget plans..... | ..... | ..... | ..... | -246,266 | -203,665 | ..... |
| Available to finance new budget plans..... | ..... | ..... | -60,000 | ..... | ..... | -60,000 |
| 23 Unobligated balance transferred to "Construction of facilities" (75 Stat. 355, 76 Stat. 731, 77 Stat. 439 and 78 Stat. 658). | ..... | ..... | ..... | 44,486 | ..... | ..... |
| Reprogramming to or from prior year budget plans..... | 19,153 | ..... | ..... | ..... | ..... | ..... |
| 24 Unobligated balance available, end of year: | | | | | | |
| For completion of prior year budget plans..... | ..... | ..... | ..... | 203,665 | ..... | ..... |

RESEARCH AND DEVELOPMENT

Program and Financing (in thousands of dollars) - Continued

| | Budget Plan | | | Costs to this appropriation | | |
|---|---|---|---|---|---|---|
| | 1966 | 1967 | 1968 | 1966 | 1967 | 1968 |
| Available to finance new budget plans..... | ..... | 60,000 | ..... | ..... | 60,000 | ..... |
| New obligational authority | 4,502,164 | 4,235,100 | 4,324,500 | 4,502,164 | 4,235,100 | 4,324,500 |
| New obligational authority: | | | | | | |
| Current authorization: | | | | | | |
| 40 Appropriation..... | 4,531,000 | 4,245,000 | 4,324,500 | 4,531,000 | 4,245,000 | 4,324,500 |
| 41 Transferred to (79 Stat. 534 and 80 Stat. 676) - | | | | | | |
| "Construction of facilities"... | -940 | -2,000 | ..... | -940 | -2,000 | ..... |
| "Administrative operations".... | -27,896 | -7,900 | ..... | -27,896 | -7,900 | ..... |
| 43 Appropriation (adjusted)..... | 4,502,164 | 4,235,100 | 4,324,500 | 4,502,164 | 4,235,100 | 4,324,500 |
| Relation of obligations to expenditures: | | | | | | |
| 10 Total obligations..... | | | | 4,555,311 | 4,478,765 | 4,460,900 |
| 70 Receipts and other offsets (items 11-17)..... | | | | -55,032 | -100,000 | -76,400 |
| 71 Obligations affecting expenditures..... | | | | 4,500,279 | 4,378,765 | 4,384,500 |
| 72 Obligated balance, start of year..... | | | | 2,078,469 | 1,837,620 | 1,535,585 |
| 74 Obligated balance, end of year..... | | | | -1,837,620 | -1,535,585 | -1,450,085 |
| 90 Expenditures..... | | | | 4,741,128 | 4,680,800 | 4,470,000 |

## RESEARCH AND DEVELOPMENT

Program and Financing (in thousands of dollars) - Continued

| | 1965 | 1966 Adjustments | 1966 | 1967 | 1968 |
|---|---|---|---|---|---|
| [1]Selected resources as of June 30 are as follows: | | | | | |
| Stores | 38,862 | ..... | 35,257 | 35,257 | 35,257 |
| Unpaid undelivered orders | 1,433,855 | ..... | 1,147,462 | 858,794 | 775,494 |
| Advances | 13,716 | -1,169 | 6,563 | 6,563 | 6,563 |
| Total selected resources | 1,486,433 | -1,169 | 1,189,282 | 900,614 | 817,314 |

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

| | 1966 actual | 1967 estimate | 1968 estimate |
|---|---|---|---|
| Note.--Reconciliation of budget plan to obligations: | | | |
| Total budget plan | 4,538,043 | 4,275,100 | 4,460,900 |
| Deduct portion of budget plan to be obligated in subsequent years | 194,467 | ..... | ..... |
| Add obligations of prior year budget plans | 211,735 | 203,665 | ..... |
| Total obligations | 4,555,311 | 4,478,765 | 4,460,900 |



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

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

| BUDGET ACTIVITY | OFFICE/PROGRAM | Fiscal Year 1966 | Fiscal Year 1967 | Fiscal Year 1968 |
|---|---|---|---|---|
| | MANNED SPACE FLIGHT..... | $3,199,507 | $3,024,000 | $3,069,200 |
| 1a | Gemini..... | 197,275 | 21,600 | --- |
| 1b | Apollo..... | 2,940,985 | 2,916,200 | 2,606,500** |
| 1c | Apollo applications..... | 51,247 | 80,000 | 454,700 |
| 1d | Advanced mission studies.. | 10,000 | 6,200 | 8,000 |
| | SPACE SCIENCE AND APPLICATIONS..... | 759,093 | 607,100 | 694,600 |
| 2a | Physics and astronomy..... | 142,753 | 129,800 | 147,500 |
| 2b | Lunar and planetary exploration..... | 204,300 | 169,400 | 142,000 |
| 2b | Voyager..... | 17,097 | 10,450 | 71,500 |
| 6b | Sustaining university program..... | 46,000 | 31,000 | 20,000 |
| 2d | Launch vehicle development | 57,790 | 31,200 | --- |
| * | Launch vehicle procurement | 178,700 | 122,400 | 165,100 |
| 2c | Bioscience..... | 34,400 | 41,550 | 44,300 |
| 3 | Space applications..... | 78,053 | 71,300 | 104,200 |
| | ADVANCED RESEARCH AND TECHNOLOGY..... | 288,596 | 268,150 | 318,000 |
| 4 | Basic research..... | 22,000 | 21,465 | 23,500 |
| 4 | Space vehicle systems..... | 35,000 | 33,935 | 37,000 |
| 4 | Electronics systems..... | 32,300 | 33,597 | 40,200 |
| 4 | Human factor systems..... | 14,900 | 16,175 | 21,000 |
| 4 | Space power and electric propulsion systems..... | 45,200 | 40,440 | 45,000 |
| 4 | Nuclear rockets..... | 58,000 | 53,000 | 46,500 |
| 4 | Chemical propulsion..... | 39,700 | 33,638 | 38,000 |
| 5 | Aeronautics..... | 41,496 | 35,900 | 66,800 |
| 6a | TRACKING AND DATA ACQUISITION | 231,065 | 270,850 | 297,700 |
| 6c | TECHNOLOGY UTILIZATION..... | 4,750 | 5,000 | 5,000 |
| | TOTAL BUDGET PLAN..... | $4,483,011 | $4,175,100 | $4,384,500** |

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

NEW RESEARCH AND DEVELOPMENT PROGRAMS AND PROJECTS

The fiscal year 1968 budget contains $35,100,000 for the following new research and development programs and projects:

| | Fiscal Year 1967 | Fiscal Year 1968 |
|---|---|---|
| **Physics and Astronomy Program** | | |
| Sunblazer | --- | $2,000,000 |

The basic objective of the Sunblazer project is to place small, relatively inexpensive scientific spacecraft into heliocentric orbits to study the solar corona. This is to be accomplished by means of a propagation experiment, magnetic field mapping and observations of solar particle fluxes. Of the five initial spacecraft, one, an engineering model, is planned to be launched in FY 1968, two in FY 1969 and two in FY 1970. Fiscal year 1968 funds will initiate the procurement of components, fabrication and assembly, integration, test, and preparation for launch of Sunblazer A. Experiment funding will allow for the pre-launch formating and programming of the propagation experiment.

| | Fiscal Year 1967 | Fiscal Year 1968 |
|---|---|---|
| **Lunar and Planetary Program** | | |
| Mariner Mars 1971 | --- | $10,100,000 |

The Mariner Mars 1971 project will launch two spacecraft which will not only obtain pictures of the surface of that planet with substantially higher resolution than those to be taken by Mariner Mars 1969, but will also secure significant qualitative data on atmospheric constituents and structure by injecting a scaled down Voyager capsule into the Martian atmosphere. Besides yielding results that will represent a substantial increase in our scientific knowledge of Mars, this mission will also make possible a significant increase in the scientific return from the Voyager 1973 mission by permitting instrumentation adjustments, a more intelligent choice of orbits and landing areas and optimum operational procedures. In addition, the efficiency of the Voyager capsule development program will be improved by permitting the development of critical capsule technologies and the sterilization techniques and procedures on a smaller scale. The funds requested for FY 1968 will establish the functional specifications, complete the systems design, and provide for extensive

development and testing of prototypes of critical subsystems.

| | Fiscal Year 1967 | Fiscal Year 1968 |
|---|---|---|
| **Space Applications Program** | | |
| Nimbus (E&F) | --- | $5,000,000 |

The objectives of these missions are to continue the development of improved meteorological satellites to provide data for use by meteorologists, to carry out flight tests to prove the applicability of the instrumentation, to fulfill special data requirements of the atmospheric sciences research community which can be provided uniquely by this instrumentation functioning as a space meteorological observatory, and to provide the basis for further technological advances in meteorological satellites for scientific and operational uses. Two launches are planned to continue the Nimbus series. FY 1968 funds are required for final definition of the spacecraft and to initiate the procurement of long leadtime spacecraft components and experiments.

| | Fiscal Year 1967 | Fiscal Year 1968 |
|---|---|---|
| Applications Technology Satellites (F&G) | --- | $15,700,000 |

The objectives of this project are to develop the technology for erecting and accurately pointing large antennas in space; to investigate the technology of accurate angle measurement in space using an interforometer; to investigate the technology for multi-beam phased array antennas in space; and conduct other applications technology experiments requiring an accurately stabilized platform in geostationary orbit. Two flights are planned in the 1970-1971 period for launch at synchronous orbit as follow-on flights in the ATS series. FY 1968 funds are required for detailed study, analysis and preliminary design of the spacecraft and associated ground system modification, and for initial definition and development of experiments in the communications, meteorological, navigation and geodesy areas for test on these missions.

| | Fiscal Year 1967 | Fiscal Year 1968 |
|---|---|---|
| Voice Broadcast Satellite | --- | $2,300,000 |

The objectives of this project are to develop the capability and demonstrate the feasibility of broadcasting aural program material directly to conventional FM and/or shortwave AM radios. The spacecraft transponder

could be made wideband to make possible an alternative mode permitting transmission of TV program material to specifically designed receivers for experimental purposes. Two flights are planned in the 1971-72 period to flight test the necessary equipment aboard a large spacecraft structure. The FY 1968 funds are required for definition studies and systems analysis.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF MANNED SPACE FLIGHT APOLLO PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The program goal is to create a viable manned space flight capability, which will achieve and maintain a position of leadership in space for the United States. An immediate objective in acquiring this capability is landing men on the moon and returning them safely to earth within this decade. The Apollo program, as part of the overall manned space flight program, will not only meet the near-term objective, but will also build a broad base of operational capability in manned space flight and associated skills and technology; a valuable complex of development, manufacturing, test, and operational facilities; and an experienced Government and industrial team. In a real sense, the operational skills, resources, and technology that have been developed for Apollo bring the Nation to the threshold of a versatile and vigorous space program.

To accomplish the immediate goal of lunar landing and return, the Apollo program has focused on the development of a highly reliable spacecraft, which is capable of supporting three men in space for periods up to two weeks, docking in space, landing on and returning from the lunar surface, and safely re-entering the earth's atmosphere. The program includes three large launch vehicles - the Saturn-I, which completed its flight series in 1965; the Uprated Saturn-I; and the Saturn V.

The Apollo program is divided into unmanned flights, manned earth orbital flights, and manned lunar flights. Unmanned Apollo Uprated Saturn-I flights have demonstrated the structural integrity and the compatibility of the spacecraft and adapter with the launch vehicle; the firing and restarting of the spacecraft engines; the ability of the command module heatshield to withstand high speed re-entry; and the operational readiness of the ground support and recovery crews. The three unmanned flights conducted calendar year 1966 have qualified the Uprated Saturn-I for manned missions.

Fiscal year 1968 funds support a period of intensive flight activity. Manned earth orbital rendezvous operations will be conducted using Uprated Saturn-I launch vehicles. In addition, emphasis will be placed on Apollo Saturn V flight qualification to demonstrate the efficiency of the ground support network and to validate the operational reliability of the spacecraft and launch vehicle systems. These steps lead to the complex lunar mission simulations which precede manned lunar landing and return.



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SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Spacecraft | $1,233,800 | $1,250,300 | $1,036,300 |
| Uprated Saturn I | 274,786 | 236,600 | 156,200 |
| Saturn V | 1,134,871 | 1,135,600 | 1,108,500 |
| Engine development | 133,200 | 49,800 | 24,500 |
| Mission support | 164,328 | 243,900 | 281,000 |
| Total program plan | $2,940,985 | $2,916,200 | 2,606,500 |
| Unobligated balance available to finance new program plan | | | -60,000 |
| Total new authority requested | | | $2,546,500 |

BASIS OF FUND REQUIREMENTS:

## Spacecraft

The Apollo spacecraft is undergoing extensive development and qualification testing on the ground and on unmanned Saturn flights. These ground and flight tests are conducted to detect procedural or technical problems before manned flights are attempted. The initial version of the Apollo spacecraft, launched by an Uprated Saturn-I, was qualified for manned flight on August 25, 1966. Manned missions in earth orbit on Uprated Saturn-I launch vehicles will begin in 1967. The manned missions are designed to demonstrate the effective operation of the spacecraft and the ground crew for periods of up to 14 days, and to develop Apollo earth orbital rendezvous and docking techniques. The first manned command and service module will be flown on an Uprated Saturn-I in early 1967. Current plans call for an unmanned lunar module development flight after the first manned earth orbital mission.

Unmanned spacecraft qualification flights on the Saturn V are also planned for 1967. Manned Apollo Saturn V flights, simulating the lunar mission, are scheduled for 1968.

## Uprated Saturn-I

The Apollo program includes a total of twelve Uprated Saturn-I flight vehicles, (AS-201 through 212). This series is designed to verify the reliability of the systems which will be incorporated into the Saturn V 3rd stage and instrument unit, and to provide a launch capability for manned earth-orbital rendezvous missions with Apollo spacecraft module.

In 1966, the Uprated Saturn-I was qualified for manned flight. The flight series began on February 26, 1966, with the successful launch of Apollo Saturn 201 from Launch Complex 34 at the Kennedy Space Center. An unmanned suborbital flight, this mission demonstrated the structural stability and operational characteristics of the launch vehicle systems and provided partial qualification of the Command and Service Module. The second launch occurred on July 5, 1966. The liquid hydrogen experiment conducted during the mission furnished critical flight test data on the storage and behavioral characteristics of cryogenic fuel under zero-gravity conditions. After the third launch, which took place on August 25, 1966, the launch vehicle and Command and Service Module were qualified for manned flight.

An Uprated Saturn-I is scheduled to launch the first manned Apollo spacecraft in early 1967. Following this flight, Uprated Saturn-I will be used to launch the first unmanned Lunar Module into earth orbit for development testing. The next two vehicles will be used for a dual launch. In the first phase of this mission, a manned Apollo Command and Service Module will be orbited by an Uprated Saturn-I. Approximately one day later, an unmanned Lunar Module will be orbited by another Uprated Saturn-I to support the spacecraft development effort and to provide early experience in Apollo rendezvous and docking maneuvers.

Fiscal year 1968 funds will provide for completion of the five remaining Apollo Uprated Saturn-I launch vehicles and delivery to the Kennedy Space Center. The eighth and ninth flight vehicles will undergo pre-launch checkout at Kennedy in preparation for earth orbital rendezvous missions. The tenth and eleventh flight stages and instrument units are scheduled for completion of acceptance testing, and delivery to Kennedy to support the Uprated Saturn-I flight schedule. The final launch vehicle in this series will also be completed during this time.

## Saturn V

The Saturn V schedule provides for fifteen launch vehicles in support of Apollo unmanned qualification flights, manned lunar mission simulations, and manned lunar missions. Saturn V hardware production and deliveries are rapidly building up to meet the mission requirements. Peak production activity, based on hardware in process, will be reached during FY 1967. Work is already underway on all the fifteen Saturn V launch vehicles. Manufacture of the first five has been completed and long leadtime components for the last launch vehicles are being fabricated. By the end of the year, assembly of the fifteenth launch vehicle will be underway.

The first launch of a Saturn V vehicle from Complex 39 at the Kennedy Space Center is scheduled in 1967. This mission, designated AS-501, will be an unmanned orbital flight to test the vehicle's dynamic characteristics, the reliability of the propulsion systems, and the accuracy

of the guidance and control sequencing system. The second unmanned qualification flight, AS-502, is also scheduled for 1967. Again, the operational reliability and performance characteristics of the vehicle will be validated. The mission will also be designed to demonstrate that the 3rd stage has the capability to provide the propulsion to eject the Apollo spacecraft out of earth orbit and on to the moon. Major emphasis during 1967 will be on flight qualification of the Saturn V. Assuming success with the initial flight tests, manned missions are planned for 1968.

Fiscal year 1968 funds support a period of intensive flight qualification leading to manned Apollo Saturn V flights, as well as high hardware production rate in support of the flight schedule. The third, fourth, fifth, and sixth flight vehicles are scheduled for completion of acceptance testing, post-static checkout, and shipment to Kennedy. The tempo of hardware production for subsequent flights will also be sustained. The seventh through twelfth vehicle units will be undergoing manufacturing, assembly, in-plant checkout, or acceptance firing to support flight requirements, and procurement activity for the remaining three vehicles will be underway.

## Engine Development

Fiscal year 1966 was the last full year of funding for contractor effort on H-1, F-1 and J-2 engine development under the Engine Development project. Upon completion of engine qualification, funding of contractor effort was transferred to the respective engine accounts of the Saturn launch vehicles. This transfer covers all field and engineering support for evaluation and problem solving. Transfer dates for these efforts were July, 1966 for the H-1, October, 1966 for the F-1, and January, 1967 for the J-2. Fiscal year 1967 funding after these dates provides for government-furnished propellants and ancillary chemicals; services and equipment associated with contractor effort; contract, audit and property administration; and quality assurance and inspection services.

During FY 1968 the funds requested will provide for government-furnished propellants, reimbursement to the Department of Defense for contract administration and quality assurance services, and a continuing program of government in-house and independent contractor evaluation and analysis of engine prime contractor-produced hardware. The major activity in this area is the J-2 engine environmental test program conducted at the Air Force Arnold Engineering Development Center, Tullahoma, Tennessee. Necessary improvements, to provide the launch vehicle with greater operational flexibility, reliability, or safety, will be incorporated into the engines.

## Mission Support

In FY 1968, support effort will continue for the over-all launch, flight, crew and recovery operations; program-wide systems engineering; and supporting development required for the successful accomplishment of manned space flights. Intensive emphasis also will be placed on support activities at the Mission Control Center located at the Manned Spacecraft Center and at the Kennedy Space Center.

## SCHEDULE OF LAUNCHES

| Events | Calendar Year |
|---|---|
| Apollo Saturn 201 Launch (Unmanned Sub-orbital Qualification Flight for Spacecraft and Launch Vehicle Development) | February 26, 1966 |
| Apollo Saturn 203 Launch (Unmanned Orbital Flight Test; Liquid Hydrogen Experiment) | July 5, 1966 |
| Apollo Saturn 202 Launch (Unmanned Orbital Qualification Flight) | August 25, 1966 |
| First Manned Uprated Saturn-I Launch | 1967 |
| First Unmanned Saturn V Launch | 1967 |
| First Manned Saturn V Launch | 1968 |
| First Manned Lunar Landing | Before end of the decade |

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF MANNED SPACE FLIGHT — APOLLO APPLICATIONS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

In 1961, the United States undertook the first step toward a major manned space flight capability by selecting the goal of a manned lunar landing within the decade. The Apollo and Saturn systems have been developed to meet that goal, and the successful Gemini program has provided the necessary early experience in maneuver, rendezvous, docking, extravehicular activity, and 14-day flight. The Apollo Applications program is the second significant step toward that capability and represents an effort even more important and far-reaching in its implications than the Apollo effort upon which it is based. The program will carry out a full investigation of man's role in the effective exploitation of the environment of space to meet man's needs on the earth and in the long term exploration of the universe.

The Apollo Applications program proposed for initiation in the FY 1968 budget is based on an average annual launch rate of 4 Uprated Saturn I and 4 Saturn V flights per year following those required for the manned lunar landing. The planned program will avoid any hiatus in the continued development of United States' manned flight capability, will continue the availability of the Nation's two most powerful rocket vehicles, and will not affect the on-going Apollo effort. Maximum economy will be achieved through the full utilization and extension of Apollo and Saturn developments. The experimental payloads included in the Apollo Applications program are designed to provide significant data on the capabilities of man and equipment, and on their potential ability, as promptly and as economically as possible. These plans have the flexibility of employing for new missions any spacecraft and launch vehicles currently on order for the Apollo program that, in the event of early successes, are not required to meet Apollo objectives.

The Apollo Applications missions will build upon the strong base of flight experience, ground facilities, and trained manpower developed in past and current programs. Each mission is designed to take full advantage of the Saturn-Apollo system to make significant contributions to a wide range of objectives. Missions are planned to concurrently gain experience, test theory, perform experiments, and collect data. By establishing multiple objectives for each flight mission, a program limited to a minimum economical launch rate can achieve rapid progress and make great gains at low cost. Key elements of this planning include the decision to use, modify, and expand present Apollo systems capabilities rather than move toward whole new developments, the strategy of re-using basic hardware for many missions by storing

it in orbit and returning later with fresh crews and expendables, and the approach of designing experiments that will gather important data while at the same time testing the experimental concepts themselves.

The program of investigations and development to be carried forward in the Apollo Applications program will meet two basic objectives: to make unique contributions to practical applications, operational capabilities, science, and technology; and, at the same time, to place the nation in a position to assess, on the basis of valid scientific experimentation and actual experience, the value and feasiblity of future space flight and the interrelated roles of manned and unmanned systems.

In support of these objectives, the principal areas toward which the FY 1968 effort will be directed are the development of an extended flight capability, the conduct of manned astronomical and earth observations from space, and the continued exploration of the moon.

The early development of long duration flight capability is clearly one of the most important areas to be pressed forward, in that it is a key requirement for most of the possible significant advances in manned flight. Apollo Applications flights of up to one year or more in duration will represent a significant increase in the nation's operational capabilities in space and opportunities for important scientific and technological experimentation. Extended duration flight experience is also necessary to provide a sound basis for those future decisions on manned programs of the greatest interest and potential, such as permanent manned facilities in space or manned flights to the planets.

Apollo Applications experiments will permit important and unique observations of the sun starting in 1969 and will at the same time provide experience that is essential for the design and operation of future large telescopes in space (manned, man-tended, or unmanned) which will open up a whole new chapter in the exploration and understanding of the universe.

Apollo Applications experiments with a wide variety of sensing devices will test the feasibility and utility of advanced types of meteorological observations and earth resource surveys from space. These experiments will provide the data for decisions on future systems--unmanned or manned--to derive additional practical benefits from space observations.

Saturn V flights in the Apollo Applications program will provide for following up the first Apollo landings with additional lunar exploration missions of up to 14 days on the surface and for observation and mapping from lunar orbit. These missions will yield important additional scientific data about the moon and will also provide the information necessary for deciding whether our manned capabilities for exploration of the moon should be further developed and exploited.

Within this framework, specific program elements have been selected for initiation in FY 1967 and 1968 that, in combination, provide the greatest contribution to the nation's space objectives at the lowest cost. These are:

The spent, orbiting second stage of an Uprated Saturn I will be converted into a habitable, 10,000 cubic foot, orbital workshop. Provided with an airlock, the workshop will provide in 1968 an economical long duration manned shelter for many experimental activities and will be revisited and re-used during the course of the program.

The support systems of the basic Apollo command and service modules will be modified for long duration operations.

The lunar module will be modified to serve as a base for manned lunar investigations of up to two weeks.

The Apollo developed lunar mapping and survey system will be used to complete the cartography of the moon.

The command module will be modified to carry up to 6 men for short duration ferry and resupply missions and will be provided a land landing capability, thereby reducing costs and increasing operating flexibility.

Specialized payloads will be developed for operation in various orbits and on the moon, including multispectral earth and weather sensors, biological and biomedical experiments, mobile lunar vehicles, and communications systems.

A manned solar telescope system, forerunner of long-lived orbital astronomical facilities, will be flown during the peak of solar activity.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Space vehicles..... | $8,500 | $38,600 | $263,700 |
| Experiments..... | 40,347 | 35,600 | 140,700 |
| Mission support..... | 2,400 | 5,800 | 50,300 |
| Total..... | $51,247 | $80,000 | $454,700 |

## Space Vehicles

The FY 1968 request provides for continued incremental funding of follow-on Uprated Saturn I procurements, initiated in FY 1966 and 1967, and the initial funding for follow-on Saturn V vehicles and command and service modules (CSM). The first follow-on Uprated Saturn I will be delivered at the end of 1968. The first follow-on Saturn V will be delivered in mid-1970. The first follow-on CSM is to be delivered late in 1969.

Apollo spacecraft systems, including the electrical power system and the life support and environmental control systems, are currently being subjected to an extensive series of tests to determine their capabilities to operate both in the environments and for the duration contemplated by Apollo Applications missions. The plan is to incorporate the minimum changes needed to accomplish the new missions. Fiscal year 1968 funds will provide for the continuation of these test, design and development efforts, begun in FY 1966 and FY 1967, pertinent to modification of Apollo spacecraft systems to support Apollo Applications missions.

Fiscal year 1968 funds also provide for the initiation of the development of a land landing capability for the command module. Initial flights are planned for 1970. The system will allow elimination of water landing as the primary recovery mode, thereby reducing recovery costs. Studies indicate that it will then be economically advantageous to plan to refurbish and re-use command modules. In conjunction with the incorporation of the land landing capability the interior of the command module will be rearranged to accommodate up to three additional astronauts for short duration resupply and ferry missions.

## Experiments

Apollo Applications experiments cover a wide range of objectives in the fields of science, medicine, applications, technology and engineering. The definition and development of experiment payloads to meet these objectives will include activity by elements of NASA, other government agencies, and the scientific and industrial communities.

One of the more significant scientific experiments involves the Apollo telescope mount (ATM). This is a new development, initiated in fiscal year 1967, that will support a variety of solar and stellar experiments in Apollo Applications flights. The ATM provides a stabilized platform which can accommodate instruments requiring finely controlled pointing. It will be mounted in a structural rack attached to the ascent stage of the lunar module. The great advantage of this capability is that the sun and stars can be clearly observed without being obscured by the earth's atmosphere, and it will be possible for the first time to return photographic film from such observations.

An important technological and operational experiment in its own right is the orbital workshop. In addition to the experience gained from its operation it will permit astronauts to work and perform experiments that could not be accomplished without it. The workshop consists of the empty hydrogen tank of the spent second stage of an Uprated Saturn I and a 65-inch diameter airlock that provides the connection between the Apollo command and service modules, and the spent stage. A hatch in the airlock will permit the astronauts to go into space without depressurization of the spent stage or the spacecraft. In orbital flight, the command and service module will dock with the airlock, and the crew will activate systems to pressurize the

spent stage for habitation. The experiment equipment for use in the spent stage is to be stored elsewhere during launch and carried into the workshop for operation.

An extensive list of experiments is planned for operation with the orbital workshop. Some are directed toward evaluating the habitability of the workshop for long duration flight, the work capability and mobility of astronauts in zero-g flight, and the effect of long duration zero-g on man. Other experiments will serve science, engineering and technology needs.

## Mission Support

The Apollo Applications program requires significant ground-based operations to handle the integration of payloads, and the planning and support of launch and flight operations. The extent and complexity of this activity is a direct function of the size and number of experiments to be carried and the duration of the flights. The FY 1968 effort will provide for the analysis of payloads to determine detailed payload integration requirements, and the implementation of design and development of integration activities for the initial Apollo Applications flights. Fiscal year 1968 funding will also provide for initiation of operations support for missions including the augmentation of the mission control center at Houston, required to support the increased data demands resulting from the enlarged experiment and operational activity associated with the Apollo Applications program.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 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 NASA space program through analysis of present hardware systems for growth potential; development of requirements for future systems; guidance for research and technology activities; provision of technical information and cost data upon which future program decisions can be based, and initiation of the definition, preliminary design and specification of probable future missions.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Advanced missions studies..... | $10,000 | $6,200 | $8,000 |
| Total..... | $10,000 | $6,200 | $8,000 |

BASIS OF FUND REQUIREMENTS:

Advanced studies provide a firm foundation for planning and selecting future manned space flight missions. Specific areas of investigation include manned earth orbital, lunar, and planetary missions and launch vehicles. Fiscal year 1966 and 1967 Studies provided support for the evolving Apollo Applications program, including both the definition of experiments and other mission payloads and the cost-effectiveness examination of alternate flight equipment approaches. The FY 1966 and 1967 studies also examined the feasibility of a long-duration space station module. In addition to the varied potential applications for earth orbital missions, the space station study includes analysis to identify design features common to a manned planetary flight requirement.

Earth Orbital Studies

The FY 1968 effort will refine the most promising space station concepts for an initial one-year capability, as well as a continuous-operation station. The ultimate growth capabilities of such a continuous-operation space station into a planetary mission module will also be examined.

## Planetary Mission Studies

Manned planetary mission studies have examined a number of mission modes and systems concepts for manned Mars and Venus reconnaissance, sample retrieval from Mars, and, ultimately, for Mars landing missions. Studies identified the practicability of using Apollo space vehicle hardware for sample retrieval or reconnaissance missions, and developed spacecraft concepts for an ultimate manned Mars landing mission.

The FY 1968 study program will emphasize further definition of the technology requirements and concepts for a Mars sample retrieval mission. Such a manned mission would have the unique capability of returning to earth samples of the Mars surface and atmosphere for scientific analysis by means of an unmanned sample return probe targeted, launched, and retrieved by the manned spacecraft. Additional orbiting and landing probes could be launched for obtaining more definitive scientific data on the Mars environment. The studies will include preliminary definition of the mission spacecraft, associated propulsion stages and onboard experiments that might be conducted by the crew members during the mission.

## Lunar Mission Studies

In FY 1968 studies will provide for updating the current plan for lunar exploration to develop the accompanying conceptual designs. This exploration plan will review the basis for a continuing series of manned and unmanned missions. Studies will define various alternatives for improving and extending the capabilities of Apollo-type systems for extended mobility. Future direct flight systems which can meet extended lunar exploration requirements will also be studied.

## Launch Vehicle Studies

Launch vehicle studies to support earth orbital, planetary and lunar manned missions will be continued during FY 1968. These studies will stress preliminary definition of improved Saturn vehicles. Efforts will continue on reusable re-entry spacecraft. The related facilities and support requirements will also be studied.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 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; of the sun and the relationship of the sun to the earth and to the interplanetary medium; and of the fundamental physical nature of the universe. In order to achieve this objective, research programs have been developed to study the upper atmosphere, the ionosphere, the earth's magnetosphere, the region beyond the boundaries of the magnetosphere, solar radiation, the solar wind particles and its interactions in space, cosmic rays from beyond the solar system, and radiation from stars and other celestial bodies which cannot be observed from the earth's surface.

While the objective of the program has been divided into three major areas, they are by no means independent of each other. Knowledge gained in one contributes to understanding the others. Many studies contribute to knowledge in all three. Practical applications of the knowledge gained in this program have been made in national programs such as meteorology, communications, manned space flight, and cartography. However, the program is intended primarily to be one of basic research dedicated to the expansion of knowledge. As such, it is integrated with the programs of educational and scientific research institutions in the United States and in many foreign countries. Substantial efforts are being made to insure that the results of the research are made available to facilitate future advancement in technology, scientific research, and education.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Supporting research and technology/Advanced studies..... | $20,594 | $19,900 | $19,900 |
| Solar observatories..... | 19,052 | 9,800 | 11,900 |
| Astronomical observatories..... | 22,300 | 27,700 | 40,600 |
| Geophysical observatories..... | 28,215 | 24,000 | 20,000 |
| Pioneer..... | 12,700 | 7,200 | 7,500 |
| Explorers..... | 18,592 | 19,200 | 21,600 |
| Sounding rockets..... | 19,300 | 20,000 | 22,000 |
| Sunblazer..... | --- | --- | 2,000 |
| Data analysis..... | 2,000 | 2,000 | 2,000 |
| Total..... | $142,753 | $129,800 | $147,500 |

BASIS OF FUND REQUIREMENTS:

## Supporting Research and Technology

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

## Advanced Studies

Advanced Studies establish the concepts, characteristics, and feasibility of future manned and automated earth-orbital and interplanetary missions. Among the missions to be studied are small scientific satellites of the Explorer class, specialized Explorers, galactic - Jupiter probes, and small interplanetary probes.

## Solar Observatories

The objective of the Orbiting Solar Observatory (OSO) project is advancement of solar physics through the use of space techniques which permit expansion of solar research by elimination of the atmospheric absorption which occurs with ground-based observations. The solar observatories are designed to provide an investigation of the sun and of its changing activities. They will systematically study the rapid changes and the long term changes in solar radiation during a solar cycle, and probe into the underlying causes of these changes by examining regions of activity on the solar surface. During the period of decreasing solar activity the flights of OSO-I and II were launched in 1962 and 1965, respectively. Continuous program effort will be pursued with OSO into the period of maximum solar activity.

Fiscal year 1968 funds will provide for completion and launch of the sixth observatory; for continuing work on the two follow-on spacecraft and experimental packages; and for data analysis on the fourth, fifth, and sixth observatories.

## Astronomical Observatories

The primary objective of the Orbiting Astronomical Observatory (OAO) project is to provide a precisely stabilized observatory above the atmosphere to observe the universe. These observatories will be capable of making astronomical observations using electromagnetic radiation in the ultraviolet and X-ray regions of the spectrum which do not penetrate the earth's atmosphere, and of making high resolution observations in the visible regions of the spectrum. The first OAO was flown in 1966, and

carried a variety of ultraviolet, X-ray and gamma ray telescopes. However, an early failure in the spacecraft equipment prevented the operation of the scientific instruments on this flight. Spacecraft and experiment development for three additional OAO's is currently in progress.

Fiscal year 1968 funds will provide for the integration of the experiments and observatory tests for the prototype and the OAO-$A_2$ mission, the initiation of launch preparations for OAO-$A_2$, and acceptance tests for the OAO-B experiment. Funds will also be used for the development, fabrication and test of the OAO-B and OAO-C spacecraft and for the construction of the flight hardware for the Princeton experiment on OAO-C.

## Geophysical Observatories

The objective of the Orbiting Geophysical Observatory (OGO) project is to develop a standard earth-orbiting observatory capable of carrying large numbers of experiments in a wide variety of orbits to investigate simultaneously geophysical phenomena and their interrelationships with solar activity, the interplanetary and galactic medium, the terrestrial magnetosphere, and the atmosphere. The first three spacecraft in this series, OGO-I, II and III, have been launched. All three OGO missions are still operational as spin-stabilized satellites and forty-seven of the total sixty-one experiments on the three missions are still providing useful data. Since September, 1964, over 300,000 hours of experiment data have resulted in seventy-four reports and presentations.

Fiscal year 1968 funds are for completion and launch of OGO-E and integration and test of OGO-F. They will also provide for completion of first run data analyses for OGO-I and II, continuation of data analysis for OGO-II; initiation of data analysis for OGO-D and E; and completion of OGO-F experiment hardware fabrication.

## Pioneer

Pioneers are investigating the interplanetary environment and the propagation of solar and galactic phenomena through this medium. Data from the two Pioneers and similar measurements made near earth provide simultaneous observations at widely separated points in space. Pioneer VI was successfully launched in December, 1965, into solar orbit, and Pioneer VII was successfully launched in August, 1966. Both continue to return useful data from deep space. Three additional Pioneer missions are scheduled for missions approaching as close as 0.8 AU and going out as far as 1.2 AU from the sun (1 AU is equal to the mean earth to sun distance, 92,900,000 miles).

Funds requested for FY 1968 will continue to support the post-launch operations for Pioneer VI and VII, final testing and launch of the third spacecraft, and initial integration and testing for the fourth spacecraft.

## Explorers

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

These spacecraft are developed by NASA installations, industry, universities, and cooperating foreign countries. Many smaller organizations have been able to gain competence and experience by participating in the development of these small Explorer spacecraft. Fiscal year 1968 funds provide for an essentially level-of-effort program, with initiation of follow-on missions emphasizing radio and X-ray astronomy.

## Sounding Rockets

Sounding rockets are the most effective means of making scientific studies of the upper atmosphere at altitudes above 20 miles and below perigee altitudes of earth satellites. These rockets are relatively small, inexpensive vehicles capable of carrying wide varieties of instrumentation for studies related to the atmosphere, the ionosphere, energetic particles, astronomy, and solar physics. Sounding rocket flights have been extremely useful in developing instrumentation for later use on satellites. The usefulness of sounding rockets for astronomical observations of the sun and stars in the X-ray and ultraviolet regions of the spectrum has been greatly increased by the development of attitude control systems.

The small increase in the funding requirements for the Sounding Rocket program in FY 1967 and FY 1968 is largely due to the development and increased use of improved attitude control systems; and to the increased use of larger, more expensive vehicles to carry stabilized heavier payloads.

## Sunblazer

The basic objective of the Sunblazer project is to place small, relatively inexpensive scientific spacecraft into heliocentric orbits to study the solar corona. This is to be accomplished by means of a propagation experiment, magnetic field mapping and observations of solar particle fluxes. Fiscal year 1968 funds will initiate the procurement of components, fabrication and assembly, integration, test, and preparation for launch of Sunblazer A. Experiment funding will allow for the pre-launch formating and programming of the propagation experiment.

## Data Analysis

The primary objective of this project is to carry out NASA's obligation to make the scientific information gained from space projects available to the public. Data accumulated from NASA's earth orbiting spacecraft, sounding rockets, and space probes are being reduced and placed in storage at the National Space Science Data Center located at the Goddard Space Flight Center. Here it is catalogued and distributed to interested researchers. Fiscal year 1967 and FY 1968 funds provide for the operation of the Data Center and for the support of research tasks utilizing the data stored there.

## SCHEDULE OF LAUNCHES

| Project | Mission | Calendar Year |
|---|---|---|
| Solar Observatories | Launch OSO-E and D (subsequent launches at approximately one year intervals) | 1967 |
| Astronomical Observatory | Launch OAO-$A_2$ (subsequent launches at approximately one year intervals) | 1968 |
| Geophysical Observatories | Launch OGO-D (subsequent launches at approximately one year intervals) | 1967 |
| Explorers | Launch Interplanetary Explorers IMP-F and -E (subsequent launches at approximately one year intervals) | 1967 |
| | Launch first Radio Astronomy Explorer, RAE-A | 1967 |
| | Launch NRL Solar Explorer - B | 1967 |
| | Launch United Kingdom satellite UK-E | 1967 |
| | Launch Italian satellite San Marco-B | 1967 |



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| Project | Mission | Calendar Year |
|---|---|---|
| | Launch two European Space Research Organization satellites ESRO-I and II | 1967 |
| | Future Explorers will be launched at the approximate rate of 2-3 per year using Deltas, 2-3 per year using Scouts, and 1-2 per year in international cooperative programs | 1968 on |
| Pioneer | Launch Pioneer C (subsequent launches at approximately one year intervals) | 1967 |
| Sunblazer | Launch Sunblazer A development flight | 1968 |
| Sounding Rockets | Coordinated geophysical and solar measurements to study solar-terrestrial-interplanetary relationships during the period of the active sun | 1967-1972 |
| | Magnetic field of the earth with barium chemical releases | 1967 |
| | Coordinated search of the celestial sphere for X-ray sources | 1967-1968 |
| | Test flights of advanced solar and stellar pointing controls (STRAP, SPARCS, and FACS) with 5-20 arc section spatial resolution. | 1967-1968 |
| | Test flights of instrumentation being developed for OSO, OGO, Air Density/Injun, and Pilgrim satellites and Mariner 1969 | 1967 |
| | Vertical soundings in conjunction with flyby's of OSO, OGO, and Alouette satellites. | 1967 |

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

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

PROGRAM OBJECTIVES AND JUSTIFICATION:

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

The lunar program performs the scientific exploration of the moon with automated spacecraft which precede the more exhaustive investigation to be conducted later by manned systems. Ranger provided initial visual data about the moon which was 1,000 times better than any photographs through earth-based telescopes. Surveyor has measured the bearing strength of the lunar surface, and photographed it in fine detail. The Lunar Orbiter provides broad area photographic coverage both at high and medium resolutions which compliments the detailed in situ Surveyor coverage. The Surveyor-Orbiter team will continue to search for additional Apollo landing sites and contribute further to our knowledge by investigating the chemical composition of the moon, by defining the lunar gravitational field, and by photographing sites of special scientific interest on both the front and hidden side of the moon.

The planets present us with a scientifically attractive opportunity for exploration because they all differ markedly from our earth. In these differences may lie the clues to the nature, origin, and evolution of our solar system and of life itself. Objectives of the Mariner program are to explore the planets, their moons, and interplanetary space with the light weight Mariner systems. Mariner II added significantly to our knowledge of Venus: Mariner IV photographed the surface of Mars and measured fields and charged particle fluxes as it flew by. These missions have demonstrated the value of the Mariner class spacecraft to provide precursor type scientific and engineering data prior to detailed solar system exploration by Voyager class systems which will carry out automated surface

exploration. The Mariner IV spacecraft is serving as a basis for further Mariner missions to Venus in 1967 and to Mars in 1969 and in 1971. It is anticipated that the Mariner program will continue to provide a means for the scientific exploration of Venus, the comets, and other bodies in the solar system, with lightweight automated spacecraft.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Supporting research and technology | $23,000 | $20,900 | $20,900 |
| Surveyor | 104,634 | 84,500 | 42,200 |
| Lunar orbiter | 58,081 | 28,800 | 10,000 |
| Mariner | 17,585 | 35,200 | 68,900 |
| Ranger | 1,000 | --- | --- |
| Total | $204,300 | $169,400 | $142,000 |

BASIS OF FUND REQUIREMENTS:

## Supporting Research and Technology

This program provides the capability to carry out work not specifically a part of currently approved flight missions, but which contributes to lunar and planetary science, advanced technical development, or advanced mission planning. Ground-based observation and measurements of extra-terrestrial bodies provide basic scientific data to be used in comparison with flight measurements. This program also provides early funding for promising experiments which may later be selected for flight missions and provides for work to advance technology as required for future missions, including current work on spacecraft sterilization for the prevention of planetary contamination by terrestrial organisms. Advanced studies funded by this program define future mission possibilities to satisfy various scientific objectives.

## Surveyor

The objectives of the Surveyor project are to develop the technology required to accomplish successful soft landings at predetermined sites on the moon and to conduct scientific measurements on the lunar surface. Surveyor I made the first controlled descent to the surface of the moon, finding a surface which should be safe for Apollo, and transmitted over 11,000 high resolution pictures back to earth. Surveyor II was launched successfully by an Atlas-Centaur launch vehicle but failed due to a malfunction during the midcourse maneuver. The funds requested for FY 1968 will complete assembly, systems environmental and flight acceptance tests, launch and post-launch operations for the last of the seven Surveyor

spacecraft. The five Surveyors yet to be launched will examine potential Apollo landing sites and determine the lunar surface and subsurface physical and chemical properties. This is essential to ensure a high confidence that the topographic and structural characteristics of potential Apollo landing sites are suitable for manned landings before the missions are attempted.

## Lunar Orbiter

The Lunar Orbiter teams with the soft landing Surveyor to provide detailed information about the lunar surface. The five spacecraft in the program serve as orbiting platforms to photograph in detail extended areas of the moon to be used to select suitable Apollo landing sites. Lunar Orbiters I and II have returned high (one meter) resolution pictures of 13 candidate Apollo landing sites covering an area of 4,000 square miles and wide angle (8 meter) resolution pictures of 22 candidate Apollo landing sites covering an area of 30,000 square miles. These two spacecraft also obtained photographs of much of the hidden side of the moon and of certain specific areas of great scientific interest. Tracking of the spacecraft in its orbit further defines the lunar gravitational field which is of strong scientific interest and is useful for refinement of guidance requirements for future manned missions. Lunar Orbiter also secures information on the radiation environment and micrometeoroid flux near the moon. The three remaining Lunar Orbiters will photograph additional potential Apollo landing sites and areas of particular scientific interest. The funds requested for FY 1968 will provide for the acceptance testing of the remaining Lunar Orbiter spacecraft, launch and mission operations, and data analysis.

## Mariner

The Mariner project conducts the early exploration of the planets with automated spacecraft in the 400 to 1,200 pound class, and will provide the scientific and technological basis for detailed exploration by spacecraft of the Voyager class. Mariner II made the first direct measurements of another planet from space when it flew by Venus on December 14, 1962. A modified Mariner IV spacecraft will return for a closer look at that planet in October, 1967, searching for the presence of hydrogen and oxygen and obtaining atmospheric profile data in addition to data on magnetic fields and charged particle and micrometeoroid flux. The Mariner-Mars 1969 fly-by is designed to improve on the results of Mariner IV, which first photographed the cratered surface of Mars, by examining the spectrum of the planet in the infrared and ultraviolet in addition to providing better television pictures than the 1,500 meter resolution obtained by Mariner IV. The mission planned for the 1971 Mars opportunity will use the same basic design as the 1969 spacecraft, with the modifications required to obtain higher resolution pictures of the surface and to probe the Martian atmosphere with a scaled down Voyager capsule, which would telemeter qualitative data on atmospheric constituents and structure as it descends through the atmosphere. These data will aid in optimizing the 1973 Voyager mission profile. The FY 1968 funds requested will provide for the Mariner-Venus 1967 post-launch operations as the spacecraft is enroute to the planet, the encounter

operations, and data analysis; provide for Mariner-Mars 1969 flight hardware, initiate assembly of the flight spacecraft and finish type approval tests of prototype subsystems and environmental systems test of the prototype spacecraft; and fund the Mariner-Mars 1971 effort through the establishment of functional specifications and completion of systems design, including testing of prototypes of critical subsystems.

SCHEDULE OF LAUNCHES

| Project | Mission | Calendar Year |
|---|---|---|
| Surveyor | C through F | 1967 |
| | G | 1968 |
| Lunar Orbiter | C and D | 1967 |
| | E | 1968 |
| Mariner | Venus 1967 (1) | 1967 |
| | Mars 1969 (2) | 1969 |
| | Mars 1971 (2) | 1971 |

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS — VOYAGER PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Voyager is a major new program for which full-scale design and development will start in FY 1968. The Voyager will provide the first opportunity for man to obtain sufficiently detailed data to permit a significant step in the understanding of the planets and the application of this information to the earth itself.

Three primary objectives will shape the Voyager missions: To gain knowledge about the origin of the solar system, to gain knowledge about the origin of life, and to apply both to a better understanding of terrestrial life. Not only do these objectives directly bear on man's place in the universe, but they are closely related to the origin of the universe itself.

The objectives noted above are being used to define the Voyager mission requirements. The Voyager capability will far exceed that of the Mariners and represents a major forward step in this country's planetary exploration program. The Saturn V, developed for Apollo, will be used as the Voyager launch vehicle.

In pursuit of these goals, beginning with the 1973 Mars opportunity, Voyager will orbit, and soft land on the planet and search for evidence of forms of life. The first Voyager mission will provide data on the physical, thermal, and chemical properties of the planet, transmit to earth high resolution photographs of Mars' surface. It is planned to design the Voyager spacecraft so that many of its basic systems, such as the spacecraft, can be used with a minimum of modification for exploration to planets other than Mars. This would minimize development costs for possible future planetary missions, such as landing on Venus, which are currently being studied.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Voyager..... | $17,097 | $10,450 | $71,500 |
| Total..... | $17,097 | $10,450 | $71,500 |

BASIS OF FUND REQUIREMENTS:

Initially, Voyager will investigate the closest planets, beginning with Mars. The first flight missions are planned for Mars during the 1973 and 1975 opportunities. In pursuit of its objectives, the Voyager will place an automated spacecraft in orbit and soft land an automated laboratory on the surface of Mars. One Saturn V launch vehicle will carry two Voyager planetary vehicles mounted in tandem at each of the two launch opportunities. Each planetary vehicle consists of a spacecraft and a landing capsule. The spacecraft will accomplish the transit to Mars, deliver the capsule into orbit, and conduct scientific observations of Mars from orbit over a period of several months. The landing package includes a capsule bus system and a surface laboratory system. The landed surface laboratory system will include instruments to study the chemistry of the atmosphere and surface; measure radiation, temperature, and seismic activity; and search for evidence of extraterrestrial life to the maximum extent possible on the early Voyager missions.

It is anticipated that changes will be made to the surface laboratory from mission to mission as the scientific understanding of Mars is increased. As this progression occurs, it is expected that adaptive and reprogrammable experiments will be conducted and the surface laboratory will evolve into the Voyager Biological Laboratory (VBL). The VBL concept is based upon the conviction that a flexible scientific laboratory type spacecraft will be required to provide results capable of unambiguous interpretation. The VBL will contain a reprogrammable computer capable of controlling and commanding its own operations based on data feedback from previous experiments, or by command from earth.

During FY 1968, system design and development will be initiated for the spacecraft, capsule bus, and surface laboratory systems. A single prime contractor will be chosen for each of the three systems to initiate final system design and to begin the development of long leadtime subsystems. In addition, it is expected that advanced development of scientific instruments which are candidates for the 1973 mission will be conducted in FY 1968. These will include visual imaging devices, mass spectrometer/gas chromatograph, various types of spectrometers, and life detection instruments.

During FY 1968, the VBL and its objectives will be defined in detail. The scientific community will be actively involved in this definition. In addition, subsystem design of the VBL will be initiated including breadboarding of critical subsystems.

During FY 1968 development of the launch vehicle nose fairing and shroud required for the Voyager missions will be continued. In addition, studies of Voyager launch criteria and planning of mission operations will be continued.

## SCHEDULE OF LAUNCHES

| Project | Mission | Calendar Year |
|---|---|---|
| Voyager | Mars (A&B) | 1973 |
| Voyager | Mars (C&D) | 1975 |

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS — SUSTAINING UNIVERSITY PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

NASA depends upon universities to conduct portions of the basic research in support of the space program. To improve this support, the universities are strengthened by the Sustaining University Program. The Sustaining University Program encourages the universities by supporting graduate students in space-related disciplines. It also assists universities in the acquisition of facilities suitable for the effective conduct of space research. Its accomplishments contribute to the replenishment of the national supply of highly trained manpower, to an increase in the scope of research leading to advances in fundamental knowledge, and to improvement of the physical facilities for the conduct of both training and graduate research at universities.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Training | $25,290 | $16,000 | $7,000 |
| Research | 12,860 | 11,000 | 10,000 |
| Research facilities | 7,850 | 4,000 | 3,000 |
| Total | $46,000 | $31,000 | $20,000 |

BASIS OF FUND REQUIREMENTS:

Training

As the national space effort proceeds towards attainment of its program goals, training activities conducted under NASA's Sustaining University Program have been reviewed and reassessed to ensure consonance with the new conditions and tasks the Agency will encounter in the years ahead. In fields with the characteristically long lead times associated with doctoral and postdoctoral training, a timely review of the training requirements for future space activities is especially necessary.

The FY 1967 budget for training is $16 million. With this amount of money about 800 NASA trainees will enter the program in September 1967. In FY 1968, the program will be $7 million and the number of new predoctoral students will be about 350.

NASA provides a series of special training opportunities to upgrade or further develop the competence of certain unique technical or scientific groups whose work is crucial to the mission of the Agency. The Summer Faculty Fellowship Program is designed to help young members keep up with the latest technical developments in engineering and science. A faculty program in systems engineering design was started in 1966 under which faculty members from different engineering disciplines are brought together to work on a space-related problem requiring a team approach. Other activities of a specialized nature include: Summer institutes for upper division undergraduates to acquaint and orient them with some of the substantive problems of space science and engineering; and post Medical Doctors' training in aerospace medicine, to help supply a few very select medical doctors with specialized training which will prepare them for direct or supporting roles in the manned space flight effort. Plans are to continue these special activities at the same level in FY 1968.

## Research

Multidisciplinary research grants under the Sustaining University Program augment NASA's project research by giving universities increased encouragement to extend and enhance their space-related research capabilities. Through the use of broadly based research grants with long-term funding stability, NASA has been able to increase the response from those universities already participating in space research and offer new opportunities to many universities which wish to participate for the first time.

Through this program, groups are evolving which should become increasingly able to bring the sum of the institutions' talent and knowledge closer to national needs. Effective channels of communication have been opened between NASA researchers and their university counterparts. The universities have made significant contributions to NASA's current research progress and some are beginning to look into the more difficult long-range problems. Each institution has increased its research capabilities in areas of interest to NASA and has involved both faculty and students. Some have begun to establish themselves as regional and even national centers of aeronautical and space research. Finally, significant growth and changes have occurred in the development of forward-looking curricula and training activities.

For the continuation of this special purpose research program, with emphasis on newly developing institutions, approximately 50 universities will be supported during FY 1968 at a cost of $10 million. Work at approximately 45 universities will be continued and five institutions will participate for the first time.

## Research Facilities

The conduct of research and training in space-related science and technology in direct support of NASA's mission is being impeded by lack of suitable laboratory space at many educational institutions. The provision of adequate space is essential if the universities are to contribute their

knowledge and experience to the solution of problems being encountered in the exploration of space. In a fundamental sense, these contributions of university activity may be regarded as a means for maintaining or augmenting a major intellectual and creative resource upon which the whole superstructure of the space program may ultimately rely. Therefore, where additional research facilities are urgently needed to support the national space program, NASA intends to provide a limited amount of funds for their acquisition.

Some of these facilities may be expected to become focal points for centers of excellence around which universities may mobilize their total capabilities for the benefit of the nation. All are intended to put universities in a position to undertake the work for which they have competence and which is required if this competence is to support the space program properly.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS — LAUNCH VEHICLE DEVELOPMENT PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of the Launch Vehicle Development program is to provide for the availability of a launch vehicle capability for automated mission requirements in a timely and economical manner. During FY 1966 and FY 1967, the program consisted of Advanced Studies, Supporting Research and Technology, and Centaur Development. With the completion of the Centaur Development Program during FY 1967, support for the on-going Advanced Studies and Supporting Research and Technology efforts is being requested under Launch Vehicle Procurement.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Supporting research and technology/advanced studies | $4,000 | $4,000 | --- |
| Centaur development..... | 53,790 | 27,200 | --- |
| Total..... | $57,790 | $31,200 | --- |

BASIS OF FUND REQUIREMENTS:

No funds are being requested in FY 1968 for Launch Vehicle Development.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS LAUNCH VEHICLE PROCUREMENT PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of the Launch Vehicle Procurement program is to provide launch vehicles together with their related equipment and services in a timely and economical manner for the support of automated space flight missions and to provide minor development effort required in support of future mission requirements. In pursuit of this objective, the program includes a broad spectrum of development and procurement activity, including studies of future mission requirements and the technical developments required to successfully accomplish them, procurement of operational vehicle hardware, and the necessary supporting equipment and services. The Launch Vehicle Procurement program is presented as a separate program, but vehicle funding requirements related to specific flight projects are also shown as a parenthetical notation with the applicable project in order to provide a total estimate of project requirements. The operational vehicles currently procured are: Scout, Delta, Thor Agena, Atlas Agena, and Centaur.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Supporting Research and Technology/ Advanced Studies | --- | --- | $4,000 |
| Scout | $11,700 | $9,400 | 16,800 |
| Delta | 27,729 | 20,900 | 32,600 |
| Agena | 70,669 | 37,100 | 24,700 |
| Centaur | 65,000 | 55,000 | 87,000 |
| Atlas | 3,602 | --- | --- |
| Total | $178,700 | $122,400 | $165,100 |

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology/Advanced Studies

This project, previously funded under the Launch Vehicle Development program, has as its purpose to define vehicle requirements for future missions, to establish the methods by which performance in excess of current capabilities can be developed, and to develop and demonstrate new technology and techniques for meeting future requirements.

FY 1966 and FY 1967 Advanced Studies efforts have been directed toward very high velocity launch vehicles including a high energy upper (kick) stage. FY 1968 efforts will be directed at mission analyses, investigation of vehicle and stage alternatives, and program planning. FY 1967 Supporting Research and Technology funds are being utilized for a variety of vehicle requirements including improvements in propulsion and guidance systems. The FY 1968 funds will also be utilized for various investigations including an examination of the capabilities and limitations of strapdown guidance systems.

## Scout Procurement

The purpose of Scout Procurement is to provide a reliable, relatively inexpensive vehicle for general space research. It is the smallest of the basic family of launch vehicles and meets the requirements of a variety of small sized payloads for orbital, probe, and re-entry missions. The FY 1968 funds for Scout procurement will be utilized to continue the current Scout vehicle and systems management contracts. Funds will also be required for sustaining engineering and maintenance, launch services, logistics requirements, and vehicle adaptation to meet individual mission specifications.

## Delta Procurement

The purpose of Delta Procurement is to provide an economical, reliable launch vehicle for a wide variety of medium-size earth satellites and small space probes. FY 1968 funds will be utilized to incrementally fund the procurement of Delta second stages, the procurement of THORAD boosters, and the procurement of third stage motors. In addition, funds will also be needed for launch services at the Eastern and Western Test Ranges. FY 1967 Sustaining Engineering and Maintenance funds were used to adapt the TE-364 (Surveyor retro-motor) as a third stage for Delta and to adapt the Delta to the long tank Thor (THORAD). FY 1968 Sustaining Engineering and Maintenance funds will also be required for the TE-364, THORAD, and other engineering and maintenance activities.

## Agena Procurement

The Agena launch vehicle is a versatile second stage used by NASA in combination with Thor and Atlas boosters for a variety of automated earth orbit, and lunar and planetary exploration missions. FY 1968 funds will provide for continued procurement of the basic Agena vehicle in addition to the Thor and Atlas boosters. Funds will be utilized to adapt the basic Agena vehicle to various individual mission requirements. FY 1968 funds will also be needed for launch support requirements and Sustaining Engineering and Maintenance.

## Centaur Procurement

The Centaur vehicle is a high-performance, general purpose launch vehicle for use on automated lunar, planetary, scientific, and applications missions which exceed the capabilities of the Agena vehicle. In calendar year 1967, four Surveyors will be launched on the Centaur vehicle. The FY 1968 budget will be used to fund the supporting services for these missions. FY 1968 funds will also be utilized to provide vehicle hardware and other supporting services for later launches of the Orbiting Astronomical Observatory, Applications Technology Satellite, Mariner Mars 1969 and Surveyor. Funds will also be required for Sustaining Engineering and Maintenance.

## SCHEDULE OF LAUNCHES

The overall mission plan for launches during this period is:

| Vehicle | Calendar Year 1966 | Calendar Year 1967 | Calender Year 1968 |
|---|---|---|---|
| Scout | 1 | 6(+2 B/U)* | 8(+1 B/U)* |
| Delta | 4 | 7 | 9 |
| Agena | 7 | 5 | 4 |
| Centaur | 4 | 4 | 3 |
| Total | 16 | 22(+2 B/U) | 24(+1 B/U) |

* "B/U" indicates backup missions. Above table includes Advanced Research and Technology missions.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS — BIOSCIENCE PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Bioscience program has two principal objectives. The first is the search for extraterrestrial life with primary emphasis directed to Mars. This objective involves research intended to determine if the Martian surface provides a possible environment for life; whether life in some form exists, and if so, its characteristics; and if no life exists on Mars evaluate, by analytic study of evidence of chemical evolution, the probability of its previous or future occurrence. A planetary quarantine program is in operation to minimize the possibility that terrestrial organisms could contaminate Mars. The Voyager spacecraft will provide the first capability for landing a sterilized scientific package on the surface of Mars.

The second objective is directed towards attaining a thorough understanding of the effects of the space environment on terrestrial organisms. Its implementation includes ground-based experiments, the Biosatellite project, and development of flight experiments for other missions.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Supporting research and technology | $11,100 | $11,550 | $14,300 |
| Biosatellite | 23,300 | 30,000 | 30,000 |
| Total | $34,400 | $41,550 | $44,300 |

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

The Exobiology program in pursuit of the search for extraterrestrial life conducts ground-based analytical studies of the origin of life on earth. The information and understanding derived from these studies is



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the best source for the development of testable hypotheses regarding the origin and nature of planetary life. This research ranges from the analysis of fossil remains, and simulation studies of Jupiter's atmosphere, to the development of automated life detection equipment intended to increase the reliability of the data by broadening the analysis of individual samples.

Research in Environmental Biology is concerned with the response or interaction of living earth systems with the variables of the space environment, including such space flight factors as weightlessness, acceleration, vibration, radiation and magnetism. The study of the effects of exotic environments has shown that some earth organisms, have survived simulated Martian conditions for extended periods of time with no physiological impairment. Research on hydrogen-fixing bacteria has shown promise of being able to supplement current life support systems with biological systems of higher efficiency for long duration missions.

Emphasis in Behavioral Biology has been placed on the capacity of organisms to adjust to alterations in gravity, particularly the determination of responsiveness of gravity receptors to transient and prolonged stimulation. Research involving neurophysiological, biochemical, and behavioral analyses has emphasized those brain-behavior relationships which maintain activation and alertness. Other research has been concerned with problems of information storage and retrieval in living systems.

The Physical Biology program supports research in comparative physiology, bio-instrumentation, and molecular biology. Research in comparative physiology includes studies on living organisms which specifically lend themselves to investigations in orbiting biological vehicles on the nutritional requirements of living organisms for prolonged space travel, and on the phenomena and dynamics of various physiological and behavioral systems. In biological telemetry, work is proceeding on the development of a multichannel implantable sensing device in order to measure, simultaneously, a number of biological and behavioral activities and to enable measurement of normally inaccessible physiological activities under a variety of conditions. In molecular biology, work on the coding of amino acids during protein synthesis has led to calculations that the numerical possibilities of amino acids sequence in DNA (deoxyribonucleic acid) are of such magnitude that they can account for the evolution of all living forms.

Current evidence indicates that the conditions encountered in space flight (cold, vacuum, ultraviolet solar radiation, etc.) will not reduce microbial life to undetectable levels. The Planetary Quarantine program seeks to develop methods whereby terrestrial organisms will not be transported to the planets prior to thorough exploration with life detection

payloads. It is particularly important to assure that life detection instruments which are to perform the scientific experiments in the search for extraterrestrial life are free from contamination in order to prevent false positive information from being obtained. During the past year, work has been directed at the problem of developing realistic methods for reducing the microbial load on a spacecraft during assembly and reduction of physical degradation of spacecraft components from the stress placed upon them by the terminal heat sterilization process immediately prior to launch.

## Biosatellite

The first Biosatellite was successfully launched on December 14, 1966, and was flown for three days with all experiments operating successfully. However, the spacecraft was not recovered due to failure of the retro-rocket system to function. This first flight and the backup, scheduled for March, 1967, both have the same payload and the objective of determining the effects of the space environment on biological payloads of seedlings, plants, and simple forms of life, especially with reference to interaction with a known intensity of ionizing radiation. The 30-day flight will investigate the effects of weightlessness on a primate's general metabolic behavior and performance, and cardiovascular and nervous systems. The 21-day flight consists of general biology experiments to determine the effects of weightlessness on plant growth and development, growth of isolated human cells, gross body composition and function in mammals, and circadian (24 hour) rhythms.

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

## SCHEDULE OF LAUNCHES

| Project | Mission | Calendar Year |
|---|---|---|
| Biosatellite | Biosatellite I | 1966 |
| | Biosatellite B | 1967 |
| | Biosatellites D and F (30 day) | 1968 |
| | Biosatellites C and E (21 day) | 1969 |

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF SPACE SCIENCE AND APPLICATIONS SPACE APPLICATIONS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

This program combines the Communications and Applications Technology Satellites and Meteorological Satellites program shown separately in the FY 1967 and prior budgets. It also includes the Geodetic Explorers project, which was previously funded under the Physics and Astronomy program. The Meteorological Flight Experiments project, previously identified separately is now made a part of the appropriate Space Applications flight project.

The objectives of the Space Applications Program are to: (1) develop a capability to expand human knowledge of the phenomena in the atmosphere and space, and support the exploration of space, by conducting a broad-based program of applications-oriented research and technology development (National Aeronautics and Space Act of 1958), (2) develop and test procedures, instruments, subsystems, spacecraft, and interpretive techniques in the various applications areas, (3) accomplish long-range studies of the potential benefits to be gained from, and the problems involved in, utilization of space activities for peaceful and technological purposes for the benefits of mankind, (4) fulfill NASA's responsibilities under the Communications Satellite Act of 1962, and (5) develop and implement for the Environmental Science Services Administration (ESSA), Department of Commerce, the operational meteorological satellite system.

Communications Satellites offer the possibility of direct voice broadcasting to all parts of the world. Meteorological satellites offer the possibility of predicting weather conditions on a global basis, provide data on hurricanes, typhoons, cyclones, and other destructive weather disturbances. Applications Technology Satellites offer the means to test various techniques and scientific and technological experiments at medium and synchronous altitudes. Navigation satellites would provide traffic control, search and rescue, and communication systems for aircraft and ships. Geodetic satellites offer the means to determine the size and shape of the earth and the vector properties of its gravitational field. Earth resources survey via satellite would offer valuable data in such areas as agriculture and forestry; geology and mineralogy; hydrology and water resources; geography and cartography; and oceanography.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Supporting research and technology. | $10,839 | $11,630 | $16,600 |
| TIROS/TOS improvements..... | 2,500 | 3,100 | 7,500 |
| Nimbus: | | | |
| Nimbus A-D..... | 22,560 | 23,400 | 29,500 |
| Nimbus E and F..... | --- | --- | 5,000 |
| Meteorological soundings..... | 2,730 | 3,000 | 3,000 |
| French satellite (FR-2)..... | --- | 100 | 100 |
| Applications technology satellites: | | | |
| A-E..... | 34,431 | 28,470 | 19,800 |
| F and G..... | --- | --- | 15 700 |
| Geodetic satellites (A-E)..... | 4,993 | 1,600 | 4,700 |
| Voice broadcast satellite..... | --- | --- | 2,300 |
| Total..... | $78,053 | $71,300 | $104,200 |

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

The Supporting Research and Technology effort is being conducted in six areas as follows: Meteorology, Communications, Navigation, Applications Technology, Earth Resources, and Geodesy.

In Meteorology, the areas of endeavor are to: (1) develop and evaluate components for potential meteorological satellite system application; (2) design and develop satellite sensors for the detection and controlled acquisition of meteorological data directly from the atmosphere and from other sources; (3) investigate scientific techniques and tools for the systematic observation, analysis, and subsequent interpretation of meteorological atmospheric phenomena; and (4) conduct system optimization analyses.

In Communications, the effort is primarily in the active satellite area. The objectives are to: (1) make system comparison studies to determine the merits of advanced concepts and techniques applicable to small terminal multiple access communications and satellite aids to lunar and planetary communications; (2) evaluate and develop components and subsystems required for broadcast applications and future communications systems; (3) study propagation effects and develop components and subsystems in the frequency region between 10 to 100 GHz in order to make more frequencies available for space communications; and (4) improve interference analysis and prediction methods needed for developing frequency sharing criteria. Data analysis consisting of reliability, spacecraft degradation, and lifetime data for ECHO-II, RELAY, and SYNCOM will continue in FY 1968.

In Navigation and data collection, the efforts are to: (1) conduct studies and experiment development on data and voice transmission systems to relay information via a satellite to ships, aircraft, and other mobile

platforms; (2) develop space technology to provide position determinations for ships and aircraft; (3) pursue studies of future navigation and traffic control satellite concepts; and (4) design systems for the collection and retrieval of data from moving platforms such as balloons, ocean-going buoys, ships, and aircraft.

In Applications Technology, the endeavors are to: (1) perform systems studies directed at improvement of stabilization techniques for spacecraft; and (2) study spacecraft equipment to improve amplification and antenna system capabilities and to increase useful lifetime.

The Earth Resources effort was budgeted under Apollo Applications prior to FY 1968. Its objectives are to: (1) develop remote sensing devices such as high resolution and multispectral cameras, radar, infrared, and other devices for obtaining data via satellite in the fields of agriculture and forestry, geography, geology, hydrology, and oceanography; and (2) conduct studies leading to improved interpretation techniques for remote sensor data, and definition of programs in the various disciplines.

The Geodesy efforts are to: (1) conduct studies, feasibility analyses, and configuration definition of geodetic spacecraft; (2) analyze geodetic requirements by various disciplines in terms of spacecraft mission and instrumentation configuration; (3) analyze the feasibility and effectiveness of geodetically optimized ground-based spacecraft observation systems, and of data analysis techniques for active and passive geodetic satellites; and (4) undertake research into the geodetic effectiveness and feasibility of advanced observation systems and techniques, to provide more precise and detailed measurement of geodetic data and to calibrate geodetic observation methods intended for extraterrestrial use. Funds are required in FY 1968 to continue or initiate new effort in the above endeavors.

## TIROS/TOS Improvements

The objective of the project is to provide the technology needed to meet the meteorological requirements for the establishment, operation, and improvement of an operational satellite system for imaging the atmosphere over the entire globe regularly and dependably. Ten TIROS R&D spacecraft, including TIROS X funded by ESSA, have been launched. One additional spacecraft, TIROS M is scheduled for launch in 1968 to meet ESSA requirements for an early day-night capability in a single spacecraft. Funds for FY 1968 are required to complete development and qualification of the TIROS M spacecraft and to continue effort on TOS Improvement subsystems.

## Nimbus

The objectives of Nimbus are to: (1) develop a spacecraft with adequate power supply and stabilization to test a number of meteorological sensors; (2) develop a variety of meteorological sensors to obtain day and night cloud cover, and atmospheric data such as temperature, wind, water vapor, and pressure at various altitudes over the globe; and (3) test these sensors,

associated data acquisition, and data handling techniques prior to recommending their use on the operational systems of ESSA. The successful launch of Nimbus I on August 28, 1964 and Nimbus II on May 15, 1966 proved the basic spacecraft configuration and the usefulness of the meteorological sensors tested. Major developmental effort is currently being applied to Nimbus B and D scheduled for launch in 1968 and 1970, respectively. Significant spacecraft and meteorological sensor advances are being developed for testing on these two flights, such as: (1) a 50-watt radioisotope thermoelectric generator (RTG) which will demonstrate the feasibility of RTG long life power supplies for meteorological satellites; (2) new experiments for determining the temperature profile and the water vapor content of the atmosphere such as spectrometers developed by NASA and ESSA; (3) a sensor to measure the solar flux in the ultraviolet spectral region to determine its influence on the upper layers of the atmosphere; and (4) initial experimentation in collecting, recording, and relaying data from a number of sensors placed on and above the earth's surface to record atmospheric and meteorological data. Follow-on flights, Nimbus E and F, which are an evolutionary extension of Nimbus technology, will test improved and advanced meteorological sensors, fulfill special data requirements of the atmospheric sciences research community and provide the basis for further significant technological advances in meteorological satellites.

In FY 1968, funds are required for data processing from Nimbus II, spacecraft and experiment development, integration and test of Nimbus B, development of Nimbus D spacecraft and experiments, final definition and design studies for Nimbus E and F, and initiate procurement of long lead time experiments.

## Meteorological Soundings

This project consists of the following areas of effort: (1) large research rockets; (2) small developmental sounding rockets; and (3) field experiment support. The objectives are: (1) to use large research rockets to explore atmospheric characteristics, to develop and improve sensors and techniques for measuring the characteristics of the atmosphere in the region 30 to 60 miles above the earth; (2) to develop small meteorological sounding rockets for a reliable, inexpensive, self-sufficient system, which will provide routine measurements of the basic atmospheric parameters in the region 20 to 40 miles above the earth; and (3) to provide field experiment support for conducting sounding rocket experiments in cooperation with other countries, on a cost-sharing basis. The data from these experiments are made available immediately to all participants and later to the scientific community at large. The FY 1968 funds are required to provide for the launch of approximately 50 large research rockets, a number of small developmental rockets, and for continuation, extension, and development of field experiment support jointly with countries in South America, Europe, and Asia.

## French Satellite FR-2

The objective of this project is to provide for U.S. cooperation with France in a space meteorology experiment involving free floating balloons and an earth orbiting satellite. The objective of the experiment is to provide the in situ speed and direction of air masses at various altitudes. These data will assist in understanding the structure of the atmosphere and extending the weather forecasts. France will design, build, test, and launch the balloons; design, build, test, and deliver the satellite to the U.S. launch site; and provide NASA the technical data acquired. NASA will provide a Scout vehicle, backup vehicle, launch services, technical assistance during the spacecraft development and test phases, and assist in data acquisition and analysis. One launch, with backup if required, is scheduled for 1969. Funds for FY 1968 are required to continue analysis of balloon and spacecraft antenna, electronics, balloon position fixing techniques, data collection system comparison and general project support.

## Applications Technology Satellites

This project includes the design, development, launch, and evaluation of seven spacecraft capable of performing communications, meteorological, gravity gradient stabilization, scientific, and other technological experiments. One gravity gradient stabilized satellite will be launched into a 6,500 mile circular orbit basically to evaluate the gravity gradient system. Two launches of spin stabilized satellites into synchronous orbit are scheduled (one of these was successfully launched on December 6, 1966). Two launches, of gravity gradient stabilized spacecraft, into synchronous orbit are also scheduled. Two additional spacecraft, ATS F and G are planned for launch in 1970-71 to develop the technology for erecting and accurately pointing large antennas in space, use of multibeam phased array antennas, obtain accurate angle measurements, and test applications technology experiments requiring an accurately stabilized platform. The FY 1968 funds are required for spacecraft development, gravity gradient stabilization development, scientific and other technological experiments, and for operational support of the first five spacecraft. Also, FY 1968 funds are required for a detailed study, analysis and preliminary design of the last two satellites, associated ground system modifications, and initial experiment definition.

## Geodetic Satellites

The Geodetic Satellites project was previously budgeted in the Physics and Astronomy program.

The objectives of the Geodetic Satellites project are to: (1) support the acquisition of geodetic measurement data required by the investigations in geometric geodesy, gravimetric geodesy and system intercomparison, and (2) evaluate the application to geodesy of such instrumentation as radar/laser altimeters, lasers and unified S-band tracking techniques, and the application of basic satellite geodesy systems to support a world-wide time and frequency calibration, and synchronization standard. GEOS I was successfully launched

November 6, 1965 and PAGEOS I (ECHO type balloon) was successfully launched June 24, 1966. Four additional GEOS type launches are scheduled for the 1968-71 period. The GEOS-B spacecraft currently being developed will be instrumented like the GEOS-I with the addition of two C-band transponders. The GEOS C-E spacecraft will be instrumented to supply data for improving the description of the earth's gravitational field and to enable several observational networks to obtain data to complete a unified world datum accurate to within ± 10 meters. Funds for FY 1968 are required for completion of GEOS-B spacecraft and for launch support, data analysis from GEOS-I and PAGEOS-I, and for initial hardware procurement for GEOS C-E.

## Voice Broadcast Satellite

The objectives of this project are to develop the capability and demonstrate the feasibility of broadcasting aural program material directly to conventional FM and/or shortwave AM radios. The spacecraft transponder could be made wideband to make possible an alternative mode permitting transmission of wideband program material to specially designed receivers for experimental purposes.

Two flights are presently scheduled for the 1971-72 period which will carry the necessary equipment aboard a large spacecraft structure to demonstrate the capability for transmission of aural program material via satellites to radios on earth. An active spacecraft stabilization system is planned, but passive control system augmentation is also being considered. A large aperture spacecraft antenna and a high power transmitter are required to provide signals of sufficient magnitude to be received by the receiving systems. In addition, antenna pointing and orientation systems will provide efficient transmission of aural program material to specified areas. Since the power required for aural broadcasting will be several kilowatts, both large sun oriented solar cell arrays and body mounted solar converters will be considered. Voice broadcast satellites in various orbits are being studied. The results of these efforts will be used in selecting the orbit for the project. In FY 1968, funds are required for definition studies and system analysis.

## SCHEDULE OF LAUNCHES

Schedule of Significant Research and Development Events

| Project | Mission | Calendar Year |
|---|---|---|
| TOS* | Launch of B through H and refurbished prototypes 1 and 2 | 1967-69 |
| TIROS | Launch of TIROS-M | 1968 |
| Nimbus | Launch of Nimbus-B | 1968 |
| | Launch of Nimbus-D | 1970 |
| | Launch of Nimbus-E | 1971 |
| | Launch of Nimbus-F | 1973 |

| Project | Mission | Calendar Year |
|---|---|---|
| French Satellite | Launch of French Satellite (FR-2) | 1969 |
| ATS | Launch of ATS-A | 1967 |
| | Launch of ATS-C | 1968 |
| | Launch of ATS-D | 1968 |
| | Launch of ATS-E | 1969 |
| | Launch of ATS-F | 1970 |
| | Launch of ATS-G | 1971 |
| Geodetic | Launch of GEOS-B | 1968 |
| | Launch of GEOS-C | 1969 |
| | Launch of GEOS-D | 1970 |
| | Launch of GEOS-E | 1971 |
| Voice Broadcast | Launch of -A | 1971 |
| | Launch of -B | 1972 |
| INTELSAT** | Launch of INTELSAT-I | 1967 |
| | Launch of INTELSAT-II-B | 1967 |
| | Launch of INTELSAT-II-C | 1967 |
| | Launch of INTELSAT-II-D | 1967 |

* Funded by ESSA.
** Funded by COMSAT.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — BASIC RESEARCH PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The Basic Research program supports fundamental research in the physical and mathematical sciences. It is aimed at providing an understanding of the physical phenomena pertinent to other NASA programs concerned with current and future aircraft and space activities. This basic research is carried out principally in NASA's Research and Flight Centers with some contract assistance by universities, industrial research laboratories, and other Government research centers. Since fundamental understanding of physical phenomena in many fields of science is required to develop the technology for NASA's programs, basic research in NASA encompasses a wide spectrum of disciplines. It ranges from very fundamental studies into the nature and properties of atoms and molecules to the more applied research areas of determining the best materials for the supersonic transport airplane. Although much of the Basic Research program cannot be identified with current NASA projects, it increases our knowledge of those scientific areas related to NASA's missions.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Supporting research and technology..... | $22,000 | $21,465 | $23,500 |
| Total..... | $22,000 | $21,465 | $23,500 |

BASIS OF FUND REQUIREMENTS:

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

Fluid physics phenomena of significance to aircraft and spacecraft propulsion and power generation, as well as to atmospheric entry dynamics, communication and simulation in laboratory tests, are being pursued in the disciplines of fluid mechanics, aerodynamics, and gaseous physics.

Electrophysics is a research program to attain a better understanding of the interaction of acoustic, magnetic, electric, nuclear and gravitation forces with the electrons and ions of the atomic and molecular constituents of solids, liquids, and gases. This new information is the basis for advanc-

ing the state of knowledge of various technologies, especially electronics, space power systems, and propulsion.

The broad goal of our materials research is to understand the behavior of materials under the diverse environmental conditions encountered in aerospace missions. With such an understanding, materials can be rationally designed to cope with high vacuum, high temperature, ionizing radiation, micrometeorite impact, corrosive fluids and electromagnetic fields.

The basic research program in applied mathematics is concerned with the investigation and development of mathematical techniques necessary for application to the many problems of science and technology which arise in connection with the aerospace missions of NASA. Mathematical research is extremely valuable in that firm bases for continued research in the other disciplines of science and engineering are provided and, in many instances, significant economies are achieved through the elimination of costly non-mathematical experimentation.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY  SPACE VEHICLE SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objectives of this program are to identify and solve critical space vehicle design problems associated with launch and exit through the atmosphere, flight through space, entry into the atmosphere of the earth and other planets, and landing. The program is directed toward advancing the technology for future space vehicles and missions and toward supporting and improving the capabilities of current vehicles.

Research using a variety of advanced ground-based facilities is conducted in spacecraft and launch vehicle aerothermodynamics and structures and in a number of space environmental technological areas, such as high-energy radiation and meteoroids. Selected critical flight experiments are carried out in close association with the ground-based research to verify and extend the laboratory results. The new research knowledge from these and other efforts is combined with design and operational experience to produce formal, authoritative design criteria to insure reliable and efficient space vehicles.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Supporting research and technology | $26,450 | $26,635 | $29,000 |
| Lifting body flight and landing tests | 1,000 | 1,000 | 1,000 |
| Scout re-entry project | 3,000 | 4,050 | 4,500 |
| Small space vehicle flight experiments | 3,000 | 2,250 | 2,500 |
| Project Fire | 50 | --- | --- |
| Project Pegasus (Saturn-launched meteoroid experiment) | 1,500 | --- | --- |
| Total | $35,000 | $33,935 | $37,000 |

BASIS OF FUND REQUIREMENTS:

## Supporting Research and Technology

The requested funds support an ongoing aggressive program of research and advanced technology in space vehicle aerothermodynamics, structures, and space environmental factors, and a related program to develop authoritative space vehicle design criteria. The overall program is carried out at all major NASA centers and is focused on clearly foreseen and the most pressing technological needs of the advancing national space program.

In FY 1968 special attention will be given to advanced terminal descent systems such as the flexible parawing to permit the recovery of manned spacecraft on land. Research will also be continued on advanced manned spacecraft concepts for near-earth application having improved maneuvering performance during atmosphere entry. Research on easily refurbished ablative heat protection systems for recoverable spacecraft will be conducted.

Work will be continued on the entry of probes into the atmosphere of Mars and on atmospheric retardation techniques for soft-landed instrument packages. Research will be conducted on heating and the design of heat protection systems for vehicles entering the atmosphere at the very high speeds of return from planetary flight. Complex questions surrounding the use of both blunt and pointed configurations will be investigated.

Attention will be given to the structural and thermal control problems of large orbiting telescopes. Research will continue on advanced concepts of lightweight erectable structures for applications such as very large orbiting radio-telescope antennas.

Substantial research efforts will continue on the effects of various space environmental factors on manned and unmanned spacecraft and their systems and on means of protection and control. Research will be conducted on high-energy proton and electron radiation and improved shielding techniques. Effort will continue toward further enlarging of the knowledge of the meteoroid environment and to evolve reliable but lightweight protection against meteoroid penetration.

The advancing program for development of authoritative design criteria to improve space vehicle reliability and efficiency will continue.

## Lifting Body Flight and Landing Tests

The M-2 and HL-10 manned research vehicles, representing concepts of future spacecraft with improved atmospheric maneuvering capability, were constructed to investigate the problems of approach and landing and flight characteristics in the transonic regime. Both vehicles have been flown

successfully in glides from air drops at Flight Research Center. The continuing program will include exploration of vehicle behavior through the transonic speed range and the expected addition of a third test vehicle, the SV-5, supplied by the Air Force.

## Scout Re-entry Project

Scout-launched anchor-point flight experiments in entry heating and heat protection system performance are conducted to correlate, verify, and extend laboratory results. FY 1968 funds support two flight experiments to determine the heating rates associated with turbulent boundary layers at high Mach numbers and to determine the conditions under which transition from laminar to turbulent flow takes place. Also provided for is the development of intermediate re-entry speed experiments to determine heat shield performance and the interaction between the external flow field and ablating surfaces for application to the problem of re-entry at 50,000-plus feet per second.

## Small Space Vehicle Flight Experiments

A program of selected flight experiments using small sounding rocket types of launch vehicles and other techniques is carried out to provide data needed under actual flight conditions. Principal effort in FY 1968 is a continuing series of balloon- and rocket-launched parachute and decelerator experiments to investigate deployment, loads, and stability at high altitudes where atmospheric density is representative of that expected on Mars.

Also included are a series of ablation materials performance experiments at intermediate speeds which aid in linking ground-based research with the higher speed Scout-launched experiments.

## SCHEDULE OF LAUNCHES

| Project | Event | Calendar Year |
|---|---|---|
| Re-entry | Re-entry F | 1968 |
| | Re-entry G | 1968 |
| | Re-entry H | 1969 |
| | Re-entry I | 1969 |

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY ELECTRONICS SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The purpose of the program is to establish the knowledge and technology which will fulfill the requirements of future space and aeronautical systems. Research is performed both in-house and under contract in the areas of guidance, control, communications and tracking, instrumentation, data processing, and electronic components. Flight experiments are employed to substantiate experimental results obtained in laboratory investigations and to acquire environmental data needed to design advanced sensors or systems.

Guidance research is directed toward the definition of requirements and characteristics of future space guidance and navigation systems, and developing the system elements capable of attaining these goals. Analytical studies establish performance goals of the sensors and concepts developed through research in inertial, optical, and electromagnetic phenomena. Research in control and stabilization develops the technology for space and aeronautical control systems for both manned and unmanned vehicles. Emphasis is placed on the precise pointing and control of space experiments, and the development of aeronautical flight control and display systems through studies, simulation, and flight tests of advanced concepts and components.

Communications and tracking system research provides the technology for future system configurations through a broad program of study and development extending over most of the electromagnetic spectrum. The efforts include research on antennas, active energy sources, and information theory.

Advances in instrumentation and data processing lead to increased knowledge of our environment and the performance of man and his mechanical aids in that environment. The research program seeks ways to exploit technology such as the laser and miniaturized components for new instrumentation concepts, and more efficient techniques for processing the multitude of data accumulated through space exploration.

New components, which exhibit greater reliability, and increased operating life are necessities in the technological world of today. Research in electronic techniques and components centers on the electrical characteristics of materials, manufacturing processes, and inspection techniques to meet these objectives.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Supporting research and technology | $29,848 | $31,797 | $39,200 |
| Flight projects | 2,452 | 1,800 | 1,000 |
| Total | $32,300 | $33,597 | $40,200 |

BASIS OF FUND REQUIREMENTS:

## Supporting Research and Technology

Funds in fiscal year 1968 are required to expand support of guidance research in advanced inertial systems, optical sensors, and navigation techniques. Long life control systems; precise pointing techniques; and simple, economical controls and displays for general aviation aircraft require continuing support. Development of advanced spacecraft antennas, energy sources, and optical technology for space astronomy and communications will receive increased emphasis in fiscal year 1968. Computer memory concepts, which offer reduced size, weight, and power consumption, and improved data handling techniques, will require increased support as will the continued exploitation of advanced technology for instrumentation applications. Fiscal year 1968 funds are needed to expand the research for reliable components and seek solutions to interconnection problems of integrated circuits. New components capable of surviving extreme temperatures will receive increased emphasis. Systematic study and development of integrated avionics systems for advanced aircraft will require expanded support.

## Flight Projects

Radio attenuation characteristics of spacecraft entering the earth or planetary atmospheres is a continuing problem in spacecraft communications. Project RAM (Radio Attenuation Measurement) launches are scheduled in 1967 and 1968 to investigate this problem at velocities of 28,000 feet per second. Funds are requested to provide a second launch in 1968 if required and to complete data reduction and evaluation of experimental results.

Project Scanner provided limited verification of the existence of relatively stable gradients in the earth's radiation profile which can be used to design precise horizon sensors. Statistical evaluation of these gradients over a wide range of seasonal and geographical conditions is the objective of the Earth Coverage Horizon Measurement experiment. Advanced studies to determine feasible experiments have been initiated. Funds are required in fiscal year 1968 to begin project definition studies.



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## SCHEDULE OF LAUNCHES

| Project | Event | Calendar Year |
|---|---|---|
| RAM C/Scout | RAM C-B | 1967 |
| | RAM C-C | 1968 |

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 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 unique environments of space and aeronautical flight; (2) to define the essential requirements for sustaining and protecting man in these environments; (3) to develop the technology necessary to provide suitable life support and protective systems; and (4) to integrate man's capabilities with those of machines to obtain composite systems of superior performance.

The success, and the spectrum of missions-of-choice available to future aeronautical and manned space missions are dependent upon the timely solutions to these technology problem areas: physiological effects, human engineering, extravehicular technology, personal protective systems, and life support. The understanding of the physiological effects on man as he responds to long term manned space flight and future aeronautical flight regimes is necessary for effective integration of man as a functional part of the total system. Human engineering is essential to human factors in aviation, maintainability in space, and for the appropriate design for man in the man-machine complex. Extravehicular technology provides the astronaut with work aids, translation devices and other astronaut augmentation systems for use in free space as well as lunar surface environments. Protective systems provide the astronaut with protection from all noxious environmental factors and with personal life support systems. Life support is one of the most difficult technology areas because of the many subsystems capabilities that must be integrated as a functional system in the spacecraft.

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

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Supporting research and technology..... | $13,000 | $14,675 | $19,500 |
| Small biotechnology flight projects..... | 1,900 | 1,500 | 1,500 |
| Total..... | $14,900 | $16,175 | $21,000 |

BASIS OF FUND REQUIREMENTS:

## Supporting Research and Technology

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

## Small Biotechnology Flight Projects

These projects cover a continuing series of small flight experiments designed either to validate results of laboratory research or to obtain essential information not obtainable from research in the laboratory. Work on experiments in FY 1968 will include the measurement of physiological processes in humans and animals under conditions of stress encountered in aerial and space flight and tests of life support and protective equipment designed for zero-gravity.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY

SPACE POWER AND ELECTRIC PROPULSION SYSTEMS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

Current space power system technology is not yet satisfactory for such future space missions as high power, direct broadcast communications satellites, science probes and orbiters to the distant planets and long duration manned earth orbital, lunar and planetary missions. The space power program is aimed at providing the research and technology necessary for the improvement and/or development of a limited number of solar, chemical and nuclear systems at a rate consistent with the estimated mission requirements ranging from watts to kilowatts in the early 1970's to megawatts in the 1980's and 90's.

The electric propulsion part of this program is aimed at providing the research and technology leading to the early application of small solar powered, electric thrustor systems for spacecraft position control; and to the development of both solar (kilowatt class) and nuclear (kilowatt and megawatt class) powered primary propulsion systems. The unique capability of some kinds of electric thrustors to develop very low thrust levels ($10^{-5}$ to $10^{-6}$ pounds) for attitude and position control, and the high specific impulses obtainable from all electric thrustors offer promise of significant improvements in spacecraft operational simplicity, weight, trip time and payload.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Supporting research and technology | $38,200 | $34,940 | $34,200 |
| SNAP-8 development | 4,000 | 5,500 | 9,700 |
| Space electric rocket test (SERT) | 3,000 | --- | 1,100 |
| Total | $45,200 | $40,440 | $45,000 |

BASIS OF FUND REQUIREMENTS:

## Supporting Research and Technology

The purpose of the nuclear electric power generation technology program is to provide a broad option and design basis for the selection and evaluation of energy conversion equipment to be used in conjunction with AEC developed isotope or reactor heat sources. The energy conversion systems and concepts receiving primary emphasis include (1) the Brayton cycle gas turboelectric system, (2) the Rankine cycle alkali metal turboelectric system, (3) thermionic direct conversion systems and (4) the magnetohydrodynamic (MHD) concept. Since nuclear space power systems are compact and entirely self-contained and therefore not dependent upon the sun, they are required for missions to the more distant planets where the available solar energy is very low or for near-earth missions requiring extended dark time operation.

The purpose of the solar electric power generation technology program is to broaden the existing technology base to meet the high power, long life requirements anticipated for the 1970's. Primary emphasis is on solar cell power systems up to 50 kilowatts in size. Major areas of work include solar cell array deployment concepts, compact storage and reduced assembly cost in order to make such high power systems practical. In addition, work is needed on high power electric regulation and distribution equipment to complement the high power solar cell array program. Much of this high power regulation and distribution equipment work is also applicable to nuclear power system generation technology.

The chemical power generation technology program is concerned primarily with reducing battery and fuel cell specific weight and increasing life and resistance to the space environment. Major areas of work include sterilizeable and impact resistant batteries for planetary landers, low and high temperature batteries, hybrid metal/gas batteries for decreased weight, long life fuel cells with improved off-design performance, and a basic electro-chemistry program to guide rational choices of new electrolytes and electrodes for both fuel cells and batteries.

The electric thrustor system program is aimed at the early application of small thrustors for spacecraft position control and the eventual use of electric thrustors for spacecraft propulsion beginning with relatively low powered, unmanned solar electric systems and ultimately unmanned and manned nuclear electric powered systems. Major areas of work include resistojet and electrostatic thrustors for spacecraft position control and electrostatic and electromagnetic (MHD) thrustors for spacecraft propulsion.

## SNAP-8 Development

The objective of this project is to obtain the technology leading to the eventual development of a 10,000 hour, 35 electrical kilowatt nuclear

electric generating system suitable for space applications in the mid-1970's and beyond. Current emphasis is on component and system technology, including both performance and endurance. Technical problems requiring correction have been identified in the present turbine mechanical design and a life problem has been found to exist in the boiler tubes. Corrective actions are being taken in both areas, as well as continuing endurance tests on other major components such as the alternator, pump and condensor.

## Space Electric Rocket Test (SERT)

The overall objective of the SERT flight program is to provide information on the operations of electric thrustor systems in the space environment. SERT I successfully demonstrated that an ion beam could be neutralized in space. A second flight is planned for 1969 to provide a long term evaluation (minimum of six months) of the performance and reliability of an ion thrustor system and to study the effects of ion engines on other spacecraft components such as radio frequency interference. Current plans are to utilize a THORAD-Agena vehicle.

### SCHEDULE OF LAUNCHES

| Project | Event | Calendar Year |
|---|---|---|
| SERT II | SERT II | 1969 |

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — NUCLEAR ROCKETS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The objective of the Nuclear Rockets program is to develop the necessary research, design and engineering data, test hardware and general technology of nuclear engine systems utilizing graphite solid core reactors for possible advanced space missions and to investigate and evaluate advanced reactor concepts which may offer improvements in nuclear rocket propulsion technology.

Through the use of nuclear rocket propulsion, significant performance advantages accrue to many possible advanced space missions such as lunar logistics operation, deep space probes, with heavy spacecrafts and manned exploration of the planets.

The major areas of effort are the research and engineering of the nuclear reactor, the development of certain non-nuclear components, and the integration of the reactor and non-reactor components into a complete experimental engine system.

This program supports the objective of continued development of nuclear rocket technology for possible future use. However, if a decision is reached to proceed with the development of a nuclear rocket engine, an activity carried under allowance for contingency in the overall national budget, the program described herein will provide the logical nuclear rocket technology support.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Supporting research and technology | $20,644 | $16,506 | $16,500 |
| NERVA | 35,356 | 33,494 | 26,000 |
| NRDS operations | 2,000 | 3,000 | 4,000 |
| Total | $58,000 | $53,000 | $46,500 |

BASIS OF FUND REQUIREMENTS:

## Supporting Research and Technology

The supporting research and technology effort supplies three basic needs: (1) general supporting research and technology data for current projects; (2) basic technology for the development of future generations of nuclear rocket engines and vehicles; and (3) feasibility analyses of advanced nuclear propulsion concepts.

This effort also includes special studies of safety problems associated with the overall nuclear rocket program.

## NERVA

The objective of the NERVA technology effort is to develop the technology of nuclear rocket engine systems utilizing graphite solid core reactors. During FY 1968, effort will be directed towards the test activities required to satisfy the remaining objectives of the NERVA technology program. The objectives of these tests include determination of the most desirable techniques for starting and controlling a nuclear rocket engine, demonstration of shut down techniques and demonstration of the capabilities of the downward firing test stand.

## NRDS Operations

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

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY CHEMICAL PROPULSION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

Propulsion represents one of the greatest limitations in capability for exploring space. Chemical fuels and oxidizers are the basis for today's total space capability. Chemical engines are the only useable propulsion systems for space vehicle launches in the foreseeable future. The realization of the potential inherent in chemical systems for development of future mission capability depends primarily upon increasing our knowledge of chemical propulsion processes, the investigation of new concepts and techniques and adding to the store of knowledge leading to a sound technological basis for an improved system for experimental engineering work and eventually development.

Research and advanced technology covers basic studies and experiments related to aspects of launch vehicle, spacecraft or auxiliary propulsion criteria, such as measurements of chemical and physical properties of propellants, combustion phenomenon, ignition, non-equilibrium and classical thermodynamic processes, examination and development of new materials, and the processes of fluid mechanics, gas dynamics, heat transfer, and solid mechanics. Analyses are made of the functions a space propulsion system must perform, the performance levels that can be met and in the broad cycle efficiency sense, the conditions under which it might best perform. New methods and design concepts are assessed. Future requirements and new problem areas are identified for further work.

The experimental engineering program bridges the technological gap between propulsion research technology and the initiation of mission oriented propulsion system developments. The work involves the design, fabrication and test of experimental propulsion systems and of subcomponents to determine and demonstrate practicability of the engineering aspects to meet known or foreseen requirements of launch vehicles, and engines for upper stage and spacecraft. Tests of experimental systems are required in the evolution process necessary to produce advanced propulsion designs with operating parameters and selection of a design for development and use. Design criteria, preliminary engineering specifications, fabrication process specifications and ability to evaluate and analyze development requirements, costs and schedules, and facility and equipment needs are developed in this phase of the work. The results provide a sound basis for selection of an advanced propulsion system and thereby minimize costs during the development phase.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Supporting research and technology..... | $32,950 | $30,138 | $38,000 |
| M-1 engine project..... | 2,000 | --- | --- |
| Large solid motor project.... | 4,750 | 3,500 | --- |
| Total..... | $39,700 | $33,638 | $38,000 |

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 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 applications during the next decade. It includes examination of high performance propulsion systems using hydrogen and fluorine propellants or space-storable propellants suitable for use after extended duration flight in the space environment. The experimental program also covers work on advanced high performance engine systems that will succeed the discontinued M-1 engine.

The solid propellant motor program includes research on non-destructive 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 develop the technology related to solid motor development to the point of demonstrated applicability to launch vehicles, spacecraft, and auxiliary propulsion use.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY — AERONAUTICS PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The role of the NASA's Aeronautics program is to provide through research the technology to improve the efficiency, utility, and safety of aircraft. The program encompasses work in aerodynamics, structures, materials, air breathing propulsion, operational aspects, including safety, noise, and sonic boom, and pilot and aircraft integration. Studies in these areas point to the most profitable paths for 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 wing for the F-111 all appeared several years ago as NASA research concepts. 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 through research the over-all capabilities of practical vehicles based on these concepts.

During development of new aircraft NASA conducts extensive wind tunnel tests, simulator programs, and flight investigations using appropriate testbed aircraft to verify predicted performance and operational characteristics and to aid in the solution of problems of a developmental nature. This advanced technical development in support of military and civil aircraft procurement is performed by NASA at the request of the cognizant government agencies and in cooperation with the requesting agency's contractor.

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

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Supporting research and technology..... | $10,186 | $9,582 | $18,600 |
| X-15 research aircraft..... | 883 | 878 | 4,000 |
| Supersonic transport..... | 12,331 | 11,090 | 11,100 |
| V/STOL aircraft..... | 3,200 | 5,550 | 7,100 |
| Hypersonic ramjet engine..... | 5,000 | 2,000 | 7,000 |
| XB-70 flight research program..... | 9,896 | 2,000 | 10,000 |
| Aircraft noise reduction..... | --- | 4,800 | 3,500 |
| Quiet engine development..... | --- | --- | 2,000 |

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Delta X-15 aircraft..... | --- | --- | 1,000 |
| F-111 aircraft..... | --- | --- | 500 |
| F-106 aircraft..... | --- | --- | 2,000 |
| Total | $41,496 | $35,900 | $66,800 |

BASIS OF FUND REQUIREMENTS:

Supporting Research and Technology

The Supporting Research and Technology program in Aeronautics in FY 1968 will include studies directed toward improvement of subsonic, supersonic, and hypersonic aircraft. For example wind-tunnel and analytical investigations aimed at improving stability and control of general aviation aircraft; analytical studies to improve flutter prediction methods for use in the designs of transonic and supersonic aircraft; research on the development of analytical and experimental techniques to obtain more accurate methods of prediction of the dynamic response of an airplane to atmospheric turbulence; research to determine noise generation and transmission processes in fan blade rows and associated ducting; research on inlets, exits, and afterbodies typical of high bypass ratio propulsion systems anticipated for very large subsonic aircraft; research on aircraft noise alleviation both in engines and in aircraft operations; research on methods to improve control of aircraft on wet runways, in rough air and during instrument flying; and improved methods for control of future, huge jet transport aircraft will be conducted.

X-15 Research Aircraft

The X-15 Research program provides data on manned, maneuverable hypersonic flight. The X-15 provides the only means in the world for studying hypersonic flight in its true environment. Major programs which will use this X-15 capability in the future are the Hypersonic Ramjet Experiment and the advanced technology delta wing designed to investigate the programs of hypersonic cruise aircraft propulsion systems and configurations, respectively.

In addition to a continuing program in basic hypersonic flight research, the operational success of the X-15 program has opened its use to space sciences as a carrier vehicle for certain experiments requiring its unique performance capabilities.

Total funding responsibility for the operational support of the X-15 research program, conducted in cooperation with the Department of Defense since its inception, will be transferred to the NASA on January 1, 1968, for

the remainder of FY 1968 and all subsequent years, in accordance with the decision of the NASA-DOD Aeronautics and Astronautics Coordinating Board. This support has cost approximately $8,000,000 per year. Therefore, operational support of the program for one-half of fiscal year 1968 is $4,000,000.

## Supersonic Transport

By inter-agency agreement, NASA will continue to provide technical support and assistance to the FAA* in the evolution of the U.S. prototype supersonic transport. In addition, NASA will conduct a continuing research program to provide the technology for improved and advanced airframes, propulsion systems, and operational concepts applicable to this type of aircraft. Aerodynamic research will be directed to extend the technological state-of-the-art to higher cruise speeds, increase aerodynamic efficiency throughout the speed range, and improve supersonic flow field patterns to minimize generation of sonic boom. The effects of low-density fuels such as liquid methane and hydrogen on the characteristics of the aerodynamic configuration will be determined.

Wind tunnel tests and associated direct technical support will be provided for the National Supersonic Transport Development program as required. This support will include necessary use of NASA facilities and key personnel by the FAA and its contractors in the course of prototype development.

Operational research on sonic boom will be concentrated upon further exploration of various atmospheric effects on boom signatures such as temperature, turbulence, wind shears and humidity. In addition, laboratory studies of structural response to booms and field tests of boom seismic effects will be expanded following the initiation of these programs in the later part of the present fiscal year.

The General Purpose Airborne Simulator (modified Jet-Star aircraft) and the new six-degree-of-freedom motion Advanced Aircraft Simulator will be used to investigate handling qualities problems unique to supersonic transport operations and to simulate a complete SST mission profile.

An increasingly larger in-house propulsion research effort is being conducted to provide the advanced technology required for second generation supersonic transport engines. Some of the promising compressor and turbine blade element designs will be incorporated into single stage and multistage wheels for further research, and advanced cooling techniques and the use of advanced materials will also receive consideration and study during this period.

* Currently the Department of Transportation.

## V/STOL Aircraft

Research on V/STOL aircraft will be directed at improving the performance of the more promising types and at easing the difficult flight control problem existing during the transition from conventional flight to hover, particularly during poor or zero visibility conditions. Wind tunnel and flight research will be continued on the hingeless and jet flap rotor principles offering the potential of increasing the cruise performance of helicopters, reducing the rotor generated vibration and improving the control power. Studies will continue on the use of small wings and auxiliary thrusting devices to reduce the rotor thrust and lift requirements in cruise, and hence increase efficiency. Much of this activity will be a cooperative effort with the U.S. Army in view of the great importance of helicopters to that organization.

Studies to define acceptable handling qualities for V/STOL aircraft and studies of the way in which the various promising concepts can meet these criteria will continue with wind-tunnel models particularly aided when the new V/STOL facility comes into operation and in flight research. Flight programs using the P-1127 fighter and the XC-142A transport will be active in 1968. Through the NASA/Air Force V/STOL Technology Panel, plans are being made for a jet-fighter VTOL research airplane program now in the feasibility study stage by NASA and AFSC.

The growing air breathing propulsion research program will expand to include research on propulsion systems appropriate for V/STOL aircraft. Lift fan types and light weight turbojets of small volume will receive special attention. Noise control will form a major constraint in this research.

## Hypersonic Ramjet Engine

This project was initiated to accelerate the technological advancement of air breathing propulsion for hypersonic atmospheric flight. Three contractors participated in parallel feasibility and preliminary design studies of a liquid hydrogen fueled research engine capable of operating at speeds between Mach 3 and 8 with combustion occurring in both a subsonic and supersonic air stream. The Garrett Corporation was selected to conduct the detailed design, experimental wind tunnel verification, fabrication, and proof test of its proposed concept. This engine must be capable of withstanding the severe environment of hypersonic flight, and regeneratively cooled surfaces will be used within the engine to maintain structural integrity.

Upon delivery of the research engine to the NASA, a test program will be initiated to determine the performance levels and operational problems associated with this hypersonic propulsion system. This will be accomplished by using the X-15 aircraft as a test vehicle to obtain the necessary test environment.

## XB-70 Flight Research Program

The NASA research portion of the XB-70 program began in FY 1963 with installation of instrumentation in the two XB-70A aircraft during manufacture and the subsequent acquisition of certain data during the preliminary USAF flight test program. The second phase, beginning early November 1966 consists of continuation and expansion of the initial program plus the start of research which could not be done during the USAF flight program.

In the second phase basic theories and the results of small-scale tests performed in ground-based facilities will be evaluated. Efforts will be directed toward analysis of the effects of vehicle size and weight; the effects of inertia combined with low aerodynamic damping at the higher operating altitudes of the SST; and the effects of structural elasticity and deformation on the basic aerodynamics of the vehicle. The highest priority tests during this second phase are directed toward a better understanding of sonic boom phenomena and their effect on persons on the ground.

During the first phase, NASA funded the instrumentation and data acquisition for those measurements of interest to NASA and the FAA. The cost of operating the aircraft was funded by the Air Force. In the second phase--the present NASA-USAF XB-70 Flight Research program authorized by a NASA-DOD Memorandum of Understanding signed on May 28, 1965--the total cost of the program is shared equally by the Air Force and the NASA.

The FAA participates in the overall planning of the program, including determination of the specific program objectives and priority of the objectives and is kept informed on the progress of the program.

## Aircraft Noise Reduction

Two important aspects of aircraft noise alleviation are covered by the research to be carried out in this program area (1) the research and development necessary to provide means for minimizing the noise radiated from the compressor and fan discharge ducts of turbofan engines such as are installed in presently operating commercial jet aircraft, and (2) research directed toward developing a more positive means for accurate flight path control which would be required in order to make use of steeper approach paths for landing thus increasing the distance of the aircraft from the ground in the vicinity of the airport and lowering the noise level.

## Quiet Engine Development

Basic research has shown that the elements of a turbojet engine can each be modified in design to permit substantial noise reduction with small penalty in performance. Information on the successful operation of such a propulsion system is unavailable. The interaction of the various components will differ substantially from any turbojet propulsion system now in use. The objective of the Quiet Engine project is to combine all of these low noise elements into a single operating system having approximately 20,000 pounds of thrust, and designed to operate at high subsonic flight speeds.

## Delta X-15 Aircraft

The NASA and the USAF have been engaged in formulating a joint long-range program planning effort on Hypersonic Aircraft Technology. A minimal contractual study was initiated in FY 1967 concerned with an analysis of the feasibility of converting an X-15 to a delta-wing configuration and the generation of preliminary and limited design data. FY 1968 funds are requested for an overall engineering design prerequisite to the fabrication and assembly of this delta-wing X-15 airplane.

## F-111 Aircraft

The objectives of this program are to obtain in-flight verification and validation of wind tunnel and theoretical prediction of aerodynamic characteristics and performance of variable geometry aircraft to define areas in which more research is needed and to provide confidence for the design of future vehicles. The F-111 is the first production variable-sweep aircraft to reach flight status. A number of problems can be investigated only in flight research such as the combined and inter-related effects of aerodynamics; structures; systems; inlets and exits; and the pilot-in-the-loop. This program will be carried out using an F-111 loaned to NASA by the Air Force under a reimbursable support agreement; NASA funds the maintenance and spare parts and operational support of the aircraft.

## F-106 Aircraft

To maintain a high level of performance at off-design conditions, the inlet and exhaust systems of supersonic aircraft will be required to undergo a considerable change in geometry. The performance and operation of these systems are sensitive to the manner in which they are integrated into the airframe design, and the interactions between airframe and propulsion system exert a strong influence on total performance. To study these problems, a small jet engine will be installed in a nacelle and mounted on the lower wing of an F-106 airplane in a location representative of that proposed for the supersonic transport.



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RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF TRACKING AND DATA ACQUISITION

TRACKING AND DATA ACQUISITION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

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

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

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

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

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Operations..... | $127,510 | $197,400 | $228,800 |
| Equipment..... | 89,755 | 59,650 | 55,100 |
| Supporting research and technology..... | 13,800 | 13,800 | 13,800 |
| Total..... | $231,065 | $270,850 | $297,700 |

BASIS OF FUND REQUIREMENTS:

## Operations

Funds are required for the operation and maintenance of the worldwide tracking and data acquisition facilities. Most of the increase in the FY 1968 operations program is related to the cost of staffing and operating additional Manned Space Flight Network stations and providing communication services required for support of the Apollo program. Small increases also are included to enable the Deep Space Network and the Satellite Network to meet the increasing support requirements of unmanned flight projects.

## Equipment

The tracking and data acquisition support requirements for forthcoming missions establish the equipments that must be procured and the facilities that must be modified. Procurement of equipments to meet Apollo requirements will continue in FY 1968 as well as for the support of future unmanned missions. Funds also are needed to provide for sustaining modifications and maintenance which are continuing requirements for all tracking and data acquisition facilities.

## Supporting Research and Technology

Supporting Research and Technology is the activity whereby concepts, techniques, and hardware are developed, tested, and evaluated for use in the various networks to meet support requirements of new flight projects. The program for FY 1968 will emphasize improvements for increasing the reliability and lifetime of existing systems and for determining techniques for efficient utilization of these systems to meet upcoming requirements.

RESEARCH AND DEVELOPMENT

FISCAL YEAR 1968 ESTIMATES

SUMMARY

OFFICE OF TECHNOLOGY UTILIZATION — TECHNOLOGY UTILIZATION PROGRAM

PROGRAM OBJECTIVES AND JUSTIFICATION:

The primary objectives of the Technology Utilization program are to establish effective mechanisms and systems for assuring that all new scientific, technological and engineering knowledge resulting from NASA programs is identified, collected, evaluated and made available in the form which is most useful; to establish effective mechanisms for announcing and disseminating this new knowledge in order to assure the widest practical application and utilization thereof; and to improve our understanding of the management of large scale research and development programs and the impact of the space program on the Nation's economy.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Thousands of Dollars) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Identification | $1,220 | $1,265 | $1,265 |
| Evaluation | 680 | 650 | 650 |
| Dissemination | 2,000 | 2,085 | 2,085 |
| Analysis | 850 | 1,000 | 1,000 |
| Total | $4,750 | $5,000 | $5,000 |

BASIS OF FUND REQUIREMENTS:

Identification

Teams of specialists from universities, research institutions and private industry, with the assistance of Technology Utilization officers at NASA Headquarters and field installations, search through selected areas of NASA scientific and technical endeavor in order to record significant NASA advances which have potential utility for the non-aerospace sector of the nation.

Evaluation

Research institutions whose services are primarily directed toward industrial clients make preliminary evaluations of technological innovations reported to NASA, analyze and formulate potential industrial uses for selected innovations, and where appropriate, prepare brief reports describing these technological advances.

## Dissemination

Universities and research institutions are employed to develop regional capabilities to store, retrieve, and interpret to local industry the technology developed by NASA. These information centers strengthen our national technical resources by encouraging rapid localized application of the technology generated in the course of NASA activities. Biomedical application teams assist medical research institutions in defining medical problems in engineering terms, scour NASA technology for solutions to these problems, and then assist the medical research institutions in adapting NASA technology to practical solution of the defined problems. This pilot program started this past year is proving to be a very effective mechanism to relate NASA information to the important unmet community needs in the field of medical research and health care.

## Analysis

A major area of concern is that of promoting a better understanding both within and outside the Agency of new and improved techniques for managing large and complex research and development activities. This concern has included support of research in such areas as the organization and management of large R&D projects, the diversified roles of the research director, government-industry contractors systems, and top level policy and decision making in large R&D organizations.

## 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] *Administration,* and for the acquisition or condemnation of real property, as authorized by law, [$83,000,000] *$54,200,000,* to remain available until expended. (*42 U.S.C. 2451, et seq., 50 U.S.C. 151–160, 511–515; Independent Offices Appropriation Act, 1967; additional authorizing legislation to be proposed.*)

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# NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

## FISCAL YEAR 1968 ESTIMATES

## CONSTRUCTION OF FACILITIES

Program and Financing (in thousands of dollars)

| | Budget Plan | | | Costs to this appropriation | | |
|---|---|---|---|---|---|---|
| | 1966 | 1967 | 1968 | 1966 | 1967 | 1968 |
| **Program by activities:** | | | | | | |
| Direct program: | | | | | | |
| 1. Manned space flight..... | 17,478 | 43,821 | 27,900 | 381,286 | 115,350 | 68,450 |
| 2. Scientific investigations in space..... | 8,024 | 4,879 | 6,985 | 20,365 | 17,592 | 9,100 |
| 3. Space applications..... | ..... | ..... | ..... | 1,360 | 8 | ..... |
| 4. Space technology..... | 13,435 | 8,589 | 8,335 | 42,244 | 39,000 | 21,400 |
| 5. Aircraft technology..... | 682 | 21,011 | 3,170 | 4,124 | 4,800 | 12,650 |
| 6. Supporting activities..... | 18,589 | 6,700 | 7,810 | 119,810 | 65,450 | 27,600 |
| Total direct program costs, funded..... | 58,208 | 85,000 | 54,200 | 569,189 | 242,200 | 139,200 |
| Reimbursable program: | | | | | | |
| 3. Space applications..... | ..... | ..... | ..... | 917 | 1,547 | ..... |
| Total program costs, funded..... | 58,208 | 85,000 | 54,200 | 570,106 | 243,747 | 139,200 |
| Change in selected resources[1]... | ..... | ..... | ..... | -299,291 | -107,805 | -47,200 |
| 10 Total..... | 58,208 | 85,000 | 54,200 | 270,815 | 135,942 | 92,000 |

## CONSTRUCTION OF FACILITIES

Program and Financing (in thousands of dollars) - Continued

| | Budget Plan | | | Costs to this appropriation | | |
|---|---|---|---|---|---|---|
| | 1966 | 1967 | 1968 | 1966 | 1967 | 1968 |
| 10 Total..... | 58,208 | 85,000 | 54,200 | 270,815 | 135,942 | 92,000 |
| Financing: | | | | | | |
| 21 Unobligated balance available, start of year, for completion of prior year budget plans.... | ..... | ..... | ..... | -293,492 | -128,103 | -77,161 |
| 22 Unobligated balance transferred from "Research and development" (75 Stat. 355, 76 Stat. 731, 77 Stat. 439 and 78 Stat. 658) | ..... | ..... | ..... | -44,486 | ..... | ..... |
| Reprogramming to or from prior year budget plans..... | 2,732 | ..... | ..... | ..... | ..... | ..... |
| 24 Unobligated balance available, end of year, for completion of prior year budget plans.... | ..... | ..... | ..... | 128,103 | 77,161 | 39,361 |
| New obligational authority.. | 60,940 | 85,000 | 54,200 | 60,940 | 85,000 | 54,200 |
| New obligational authority: | | | | | | |
| 40 Appropriation..... | 60,000 | 83,000 | 54,200 | 60,000 | 83,000 | 54,200 |
| 42 Transferred from "Research and development" (79 Stat. 534 and 80 Stat. 676)..... | 940 | 2,000 | ..... | 940 | 2,000 | ..... |
| 43 Appropriation (adjusted).... | 60,940 | 85,000 | 54,200 | 60,940 | 85,000 | 54,200 |

## CONSTRUCTION OF FACILITIES

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

| | Budget Plan | | | Costs to this appropriation | | |
|---|---|---|---|---|---|---|
| | 1966 | 1967 | 1968 | 1966 | 1967 | 1968 |
| Relation of obligations to expenditures: | | | | | | |
| 71 Total obligations (affecting expenditures) | ..... | ..... | ..... | 270,815 | 135,942 | 92,000 |
| 72 Obligated balance, start of year | ..... | ..... | ..... | 618,608 | 316,977 | 172,919 |
| 74 Obligated balance, end of year | ..... | ..... | ..... | -316,977 | -172,919 | -104,919 |
| 90 Expenditures | ..... | ..... | ..... | 572,446 | 280,000 | 160,000 |

| | 1965 | 1966 Adjustments | 1966 | 1967 | 1968 |
|---|---|---|---|---|---|
| [1]Selected resources as of June 30 are as follows: | | | | | |
| Unpaid undelivered orders | 515,037 | ..... | 215,702 | 107,897 | 60,697 |
| Advances | 1,252 | -1,191 | 105 | 105 | 105 |
| Total selected resources | 516,289 | -1,191 | 215,807 | 108,002 | 60,802 |

| | 1966 actual | 1967 estimate | 1968 estimate |
|---|---|---|---|
| Note.--Reconciliation of budget plan to obligations: | | | |
| Total budget plan | 58,208 | 85,000 | 54,200 |
| Deduct portion of budget plan to be obligated in subsequent years | 30,184 | 45,000 | 24,200 |
| Add obligations of prior year budget plans | 242,791 | 95,942 | 62,000 |
| Total obligations | 270,815 | 135,942 | 92,000 |



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

SUMMARY OF CONSTRUCTION OF FACILITIES BUDGET PLAN BY LOCATION

| Location | Fiscal Year 1966 | Fiscal Year 1967 | Fiscal Year 1968 |
|---|---|---|---|
| Ames Research Center..... | $2,749,000 | --- | $5,365,000 |
| Electronics Research Center..... | 5,000,000 | $7,500,000 | 6,220,000 |
| Goddard Space Flight Center..... | 2,400,000 | 710,000 | 565,000 |
| Jet Propulsion Laboratory..... | 940,300 | 350,000 | 3,125,000 |
| John F. Kennedy Space Center, NASA. | 6,916,570 | 35,758,000 | 24,885,000 |
| Langley Research Center..... | 8,250,000 | 6,100,000 | --- |
| Lewis Research Center..... | 867,000 | 16,000,000 | 2,115,000 |
| Manned Spacecraft Center..... | 4,180,000 | 9,100,000 | 2,425,000 |
| Marshall Space Flight Center..... | 1,955,690 | --- | 870,000 |
| Michoud Assembly Facility..... | 296,819 | 700,000 | 2,010,000 |
| Various Locations..... | 19,376,417 | 3,577,000 | 2,880,000 |
| Wallops Station..... | 1,048,000 | 205,000 | 740,000 |
| Facility Planning and Design..... | 4,228,160 | 5,000,000 | 3,000,000 |
| Total Plan..... | $58,207,956 | $85,000,000 | $54,200,000 |

The geographic location of NASA installations is shown on the following page. Installations for which construction projects are requested in the fiscal year 1968 budget are identified.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# INSTALLATION SUMMARY
## CONSTRUCTION OF FACILITIES
### FISCAL YEAR 19 68 BUDGET ESTIMATES

*(Dollars in thousands)*

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

INSTALLATION MISSION

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

| LAND | NO. ACRES |
|---|---|
| NASA-OWNED | 225.7 |
| OTHER GOVERNMENT AGENCY-OWNED | |
| NON-FEDERAL *(Leases, easements)* | |
| **TOTAL LAND** | 225.7 |
| **TOTAL CAPITAL INVESTMENT*** *(Including NASA-Owned Land) (as of June 30, 1966)* | $195,697 |

| PROJECT LINE ITEM | COGNIZANT OFFICE | FY 1959 THRU CURRENT YEAR | FY 19 68 *(Estimated)* | FUTURE YEARS *(Estimated)* | TOTAL ALL YEARS *(Estimated)* |
|---|---|---|---|---|---|
| Space Science Research Laboratory | SSA | 98 | 2,195 | | 2,293 |
| Heater Replacement, 3.5 foot Wind Tunnel | ART | 190 | 3,170 | | 3,360 |
| ALL OTHER PROJECTS | | 50,422 | | | |
| **TOTALS** | | 50,710 | 5,365 | | |

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* *Includes work in process.*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# INSTALLATION SUMMARY

## CONSTRUCTION OF FACILITIES

### FISCAL YEAR 1968 BUDGET ESTIMATES

*(Dollars in thousands)*

| NASA INSTALLATION | COGNIZANT PROGRAM OFFICE FOR INSTALLATION | LOCATION OF INSTALLATION | COUNTY | NEAREST CITY |
|---|---|---|---|---|
| Electronics Research Center | Advanced Research and Technology | Cambridge, Massachusetts | Middlesex | Cambridge, Massachusetts |

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.

| LAND | NO. ACRES |
|---|---|
| NASA-OWNED | 6.3 |
| OTHER GOVERNMENT AGENCY-OWNED | |
| NON-FEDERAL *(Leases, easements)* | |
| TOTAL LAND | 6.3 |
| TOTAL CAPITAL INVESTMENT* *(Including NASA-Owned Land) (as of June 30, 1966)* | $2,887 |

| PROJECT LINE ITEM | COGNIZANT OFFICE | FY 1959 THRU CURRENT YEAR | FY 1968 *(Estimated)* | FUTURE YEARS *(Estimated)* | TOTAL ALL YEARS *(Estimated)* |
|---|---|---|---|---|---|
| Qualifications and Standards/Component Technology | ART | 133 | 4,200 | | 4,333 |
| Special Purpose Laboratory | ART | 145 | 2,020 | | 2,165 |
| Center Support Facilities III | | | | | |
| ALL OTHER PROJECTS | | 26,122 | | | |
| TOTALS | | 26,400 | 6,220 | | |

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* *Includes work in process.*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# INSTALLATION SUMMARY

## CONSTRUCTION OF FACILITIES

### FISCAL YEAR 19 68 BUDGET ESTIMATES

*(Dollars in thousands)*

| NASA INSTALLATION | COGNIZANT PROGRAM OFFICE FOR INSTALLATION | LOCATION OF INSTALLATION | COUNTY | NEAREST CITY |
|---|---|---|---|---|
| Goddard Space Flight Center | Space Science and Applications | Greenbelt, Maryland | Prince George's | 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 cis-lunar 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.

| LAND | NO. ACRES |
|---|---|
| NASA-OWNED | 552.7 |
| OTHER GOVERNMENT AGENCY-OWNED | 638.8 |
| NON-FEDERAL *(Leases, easements)* | 3.0 |
| TOTAL LAND | 1,194.5 |
| TOTAL CAPITAL INVESTMENT* *(Including NASA-Owned Land) (as of June 30, 1966)* | $ 272,276 |

| PROJECT LINE ITEM | COGNIZANT OFFICE | FY 1959 THRU CURRENT YEAR | FY 1968 *(Estimated)* | FUTURE YEARS *(Estimated)* | TOTAL ALL YEARS *(Estimated)* |
|---|---|---|---|---|---|
| Utility Modification and Installation | SSA | 35 | 565 | | 600 |
| ALL OTHER PROJECTS | | 82,807 | | | |
| TOTALS | | 82,842 | 565 | | |

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* *Includes work in process.*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# INSTALLATION SUMMARY

## CONSTRUCTION OF FACILITIES

### FISCAL YEAR 19 68 BUDGET ESTIMATES

*(Dollars in thousands)*

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

INSTALLATION MISSION

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

| LAND | NO. ACRES |
|---|---|
| NASA-OWNED | 145.9 |
| OTHER GOVERNMENT AGENCY-OWNED | |
| NON-FEDERAL *(Leases, easements)* | 25.8 |
| TOTAL LAND | 171.7 |
| TOTAL CAPITAL INVESTMENT* *(Including NASA-Owned Land) (as of June 30, 1966 )* | $ 126,612 |

| PROJECT LINE ITEM | COGNIZANT OFFICE | FY 1959 THRU CURRENT YEAR | FY 19 68 *(Estimated)* | FUTURE YEARS *(Estimated)* | TOTAL ALL YEARS *(Estimated)* |
|---|---|---|---|---|---|
| Space Flight Operations Facility Systems Development Laboratory | SSA | 66 | 1,195 | | 1,261 |
| Standby Power Plant for Space Flight Operations Facility | TDA | 135 | 1,930 | | 2,065 |
| ALL OTHER PROJECTS | | 38,965 | | | |
| TOTALS | | 39,166 | 3,125 | | |

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* *Includes work in process.*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# INSTALLATION SUMMARY

## CONSTRUCTION OF FACILITIES

### FISCAL YEAR 19 68 BUDGET ESTIMATES

*(Dollars in thousands)*

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

INSTALLATION MISSION

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

| LAND | NO. ACRES |
|---|---|
| NASA-OWNED | 84,424 |
| OTHER GOVERNMENT AGENCY-OWNED | |
| NON-FEDERAL *(Leases, easements)* | 3,340 |
| **TOTAL LAND** | 87,764 |
| **TOTAL CAPITAL INVESTMENT*** *(Including NASA-Owned Land) (as of June 30, 19 66 )* | $ 808,549 |

| PROJECT LINE ITEM | COGNIZANT OFFICE | FY 1959 THRU CURRENT YEAR | FY 1968 *(Estimated)* | FUTURE YEARS *(Estimated)* | TOTAL ALL YEARS *(Estimated)* |
|---|---|---|---|---|---|
| Launch Complex 39 | MSF | 473,257 | 16,660 | | 489,917 |
| Alteration and Rehabilitation of Launch Complex Nos. 34 and 37 | MSF | 97,860 | 5,725 | | 103,585 |
| Utility Installation | MSF | 68,047 | 210 | | 68,257 |
| Alterations to Launch Complex 17 | SSA | 4,664 | 2,290 | 3,000 | 9,954 |
| ALL OTHER PROJECTS | | 238,012 | | | |
| **TOTALS** | | 881,840 | 24,885 | | |

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* *Includes work in process.*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# INSTALLATION SUMMARY

## CONSTRUCTION OF FACILITIES

### FISCAL YEAR 1968 BUDGET ESTIMATES

*(Dollars in thousands)*

| NASA INSTALLATION | COGNIZANT PROGRAM OFFICE FOR INSTALLATION | LOCATION OF INSTALLATION | COUNTY | NEAREST CITY |
|---|---|---|---|---|
| Lewis Research Center | Advanced Research and Technology | Cleveland, Ohio<br>Sandusky, Ohio 1/ | Cuyahoga<br>Erie | Cleveland, Ohio<br>Sandusky, Ohio |

INSTALLATION MISSION

Research and development in the areas of advanced propulsion and space power generation. Basic and applied research is conducted in-house on materials and metallurgy; cryogenic and liquid-metal heat-transfer fluids; pumps and turbines; combustion processes, propellants, tankage, injectors, chambers, and nozzles; system control dynamics; plasmas and magnetohydrodynamics; space meteoroid damage and zero-gravity effects. The Center maintains technical management of NASA contracts on chemical and electric propulsion and on nuclear and solar space power systems, including the Centaur and Agena engine programs.

| LAND | NO. ACRES |
|---|---|
| NASA-OWNED | 6,330 |
| OTHER GOVERNMENT AGENCY-OWNED | |
| NON-FEDERAL *(Leases, easements)* | 65 |
| TOTAL LAND | 6,395 |
| TOTAL CAPITAL INVESTMENT* *(Including NASA-Owned Land) (as of June 30, 1966)* | $ 292,229 |

| PROJECT LINE ITEM | COGNIZANT OFFICE | FY 1959 THRU CURRENT YEAR | FY 1968 *(Estimated)* | FUTURE YEARS *(Estimated)* | TOTAL ALL YEARS *(Estimated)* |
|---|---|---|---|---|---|
| Land Acquisition (Cleveland) | ART | -0- | 15 | | 15 |
| Land Acquisition (Plum Brook) | ART | 96 | 2,100 | | 2,196 |
| ALL OTHER PROJECTS | | 108,028 | | | |
| TOTALS | | 108,124 | 2,115 | | |

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* *Includes work in process.*

1/ Includes Plum Brook Station at Sandusky, Ohio.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# INSTALLATION SUMMARY
## CONSTRUCTION OF FACILITIES
### FISCAL YEAR 1968 BUDGET ESTIMATES

*(Dollars in thousands)*

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

INSTALLATION MISSION

The Manned Spacecraft Center conducts the development of spacecraft for manned space flight programs. The Center is also responsible for manned space flight operations and conduct of astronaut training.

| LAND | NO. ACRES |
|---|---|
| NASA-OWNED | 1,620 |
| OTHER GOVERNMENT AGENCY-OWNED | |
| NON-FEDERAL *(Leases, easements)* | |
| TOTAL LAND | 1,620 |
| TOTAL CAPITAL INVESTMENT* *(Including NASA-Owned Land) (as of June 30, 1966)* | $ 294,709 |

| PROJECT LINE ITEM | COGNIZANT OFFICE | FY 1959 THRU CURRENT YEAR | FY 1968 *(Estimated)* | FUTURE YEARS *(Estimated)* | TOTAL ALL YEARS *(Estimated)* |
|---|---|---|---|---|---|
| Modifications to the Environmental Testing Laboratory | MSF | 48,261 | 1,900 | | 50,161 |
| Center Support Facilities | MSF | 21,245 | 525 | | 21,770 |
| ALL OTHER PROJECTS | | 22,931 | | | |
| TOTALS | | 92,437 | 2,425 | | |

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* *Includes work in process.*

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# INSTALLATION SUMMARY
## CONSTRUCTION OF FACILITIES
### FISCAL YEAR 19 68 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 Marshall Space Flight Center conducts 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.

| LAND | NO. ACRES |
|---|---|
| NASA-OWNED | |
| OTHER GOVERNMENT AGENCY-OWNED | 1,797 |
| NON-FEDERAL *(Leases, easements)* | 64 |
| TOTAL LAND | 1,861 |
| TOTAL CAPITAL INVESTMENT* *(Including NASA-Owned Land) (as of June 30, 1966)* | $ 376,519 |

| PROJECT LINE ITEM | COGNIZANT OFFICE | FY 1959 THRU CURRENT YEAR | FY 1968 *(Estimated)* | FUTURE YEARS *(Estimated)* | TOTAL ALL YEARS *(Estimated)* |
|---|---|---|---|---|---|
| Water Pollution Control | MSF | 38 | 350 | | 388 |
| Fire Surveillance System | MSF | 60 | 520 | | 580 |
| ALL OTHER PROJECTS | | 139,460 | | | |
| TOTALS | | 139,558 | 870 | | |

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* *Includes work in process.*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# INSTALLATION SUMMARY

## CONSTRUCTION OF FACILITIES

### FISCAL YEAR 1968 BUDGET ESTIMATES

*(Dollars in thousands)*

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

INSTALLATION MISSION

The Michoud Assembly Facility manufacturers of the first stage booster of the Saturn family of launch vehicles.

| LAND | NO. ACRES |
|---|---|
| NASA-OWNED | 905 |
| OTHER GOVERNMENT AGENCY-OWNED | 6 |
| NON-FEDERAL *(Leases, easements)* | |
| **TOTAL LAND** | 911 |
| **TOTAL CAPITAL INVESTMENT*** *(Including NASA-Owned Land) (as of June 30, 1966)* | $134,450 |

| PROJECT LINE ITEM | COGNIZANT OFFICE | FY 1959 THRU CURRENT YEAR | FY 1968 *(Estimated)* | FUTURE YEARS *(Estimated)* | TOTAL ALL YEARS *(Estimated)* |
|---|---|---|---|---|---|
| Extension of Saturn Boulevard to State Road System | MSF | 84 | 1,130 | | 1,214 |
| Repair, Rehabilitation and Improvements | MSF | 23,460 | 880 | | 24,340 |
| ALL OTHER PROJECTS | | 20,038 | | | |
| **TOTALS** | | 43,582 | 2,010 | | |

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* *Includes work in process.*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# INSTALLATION SUMMARY

## CONSTRUCTION OF FACILITIES

### FISCAL YEAR 19 68 BUDGET ESTIMATES

*(Dollars in thousands)*

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

INSTALLATION MISSION

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

| LAND | NO. ACRES |
|---|---|
| NASA-OWNED | 6,561.3 |
| OTHER GOVERNMENT AGENCY-OWNED | |
| NON-FEDERAL *(Leases, easements)* | 9.6 |
| TOTAL LAND | 6,570.9 |
| TOTAL CAPITAL INVESTMENT* *(Including NASA-Owned Land) (as of June 30, 1966 )* | $ 82,567 |

| PROJECT LINE ITEM | COGNIZANT OFFICE | FY 19 59 THRU CURRENT YEAR | FY 19 68 *(Estimated)* | FUTURE YEARS *(Estimated)* | TOTAL ALL YEARS *(Estimated)* |
|---|---|---|---|---|---|
| Power and Steam Distribution System Renovation | SSA | 44 | 740 | 500 | 1,284 |
| ALL OTHER PROJECTS | | 37,060 | | | |
| TOTALS | | 37,104 | 740 | | |

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* *Includes work in process.*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# INSTALLATION SUMMARY
## CONSTRUCTION OF FACILITIES
### FISCAL YEAR 19 68 BUDGET ESTIMATES

*(Dollars in thousands)*

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

INSTALLATION MISSION

| LAND | NO. ACRES |
|---|---|
| NASA-OWNED | |
| OTHER GOVERNMENT AGENCY-OWNED | |
| NON-FEDERAL *(Leases, easements)* | Not |
| TOTAL LAND | Applicable |
| TOTAL CAPITAL INVESTMENT* *(Including NASA-Owned Land) (as of June 30, 19 )* | $ Not Applicable |

| PROJECT LINE ITEM | COGNIZANT OFFICE | FY 19 59 THRU CURRENT YEAR | FY 19 68 *(Estimated)* | FUTURE YEARS *(Estimated)* | TOTAL ALL YEARS *(Estimated)* |
|---|---|---|---|---|---|
| Phased Array Antenna System | TDA | 26 | 2,880 | | 2,906 |
| ALL OTHER PROJECTS | | 646,048 | | | |
| TOTALS | | 646,074 | 2,880 | | |

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* *Includes work in process.*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# INSTALLATION SUMMARY

## CONSTRUCTION OF FACILITIES

### FISCAL YEAR 19 68 BUDGET ESTIMATES

*(Dollars in thousands)*

| NASA INSTALLATION | COGNIZANT PROGRAM OFFICE FOR INSTALLATION | LOCATION OF INSTALLATION | COUNTY | NEAREST CITY |
|---|---|---|---|---|
| All | Office of the Deputy Administrator | Not Applicable | Not Applicable | Not Applicable |

INSTALLATION MISSION

See justification.

| LAND | NO. ACRES |
|---|---|
| NASA-OWNED | |
| OTHER GOVERNMENT AGENCY-OWNED | |
| NON-FEDERAL *(Leases, easements)* | Not |
| TOTAL LAND | Applicable |
| TOTAL CAPITAL INVESTMENT* *(Including NASA-Owned Land) (as of June 30, 19 )* | $ Not Applicable |

| PROJECT LINE ITEM | COGNIZANT OFFICE | FY 19 59 THRU CURRENT YEAR | FY 1968 *(Estimated)* | FUTURE YEARS *(Estimated)* | TOTAL ALL YEARS *(Estimated)* |
|---|---|---|---|---|---|
| Facility Planning and Design | AD | 51,803 | 3,000 | Not Applicable | Not Applicable |
| ALL OTHER PROJECTS | | | | | |
| TOTALS | | 51,803 | 3,000 | | |

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

* *Includes work in process.*

## NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

## PROPOSED APPROPRIATION BILL

## ADMINISTRATIVE OPERATIONS

For necessary expenses, not otherwise provided for, of the operation of the National Aeronautics and Space Administration, including uniforms or allowances therefor, as authorized by [the Act of September 1, 1954, as amended] *law* (5 U.S.C. [2131] *5901; 80 Stat. 299*); minor construction; supplies, materials, services, and equipment; awards; *purchase of not to exceed three and* hire, maintenance and operation of administrative aircraft; purchase and hire of motor vehicles (including purchase of not to exceed [thirty-one] *twenty-three* passenger motor vehicles, [of which sixteen shall be] for replacement only); and maintenance, repair, and alteration of real and personal property: [$640,000,000] *$671,300,000*: *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, 1967; additional authorizing legislation to be proposed.)*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

ADMINISTRATIVE OPERATIONS

Program and Financing (in thousands of dollars)

| | Budget Plan | | | Costs to this appropriation | | |
|---|---|---|---|---|---|---|
| | 1966 | 1967 | 1968 | 1966 | 1967 | 1968 |
| Program by activities: | | | | | | |
| Direct program: | | | | | | |
| 1. Manned space flight..... | 313,268 | 330,405 | 338,680 | 323,005 | 329,299 | 337,832 |
| 2. Scientific investigations in space..... | 72,179 | 79,114 | 79,239 | 66,029 | 78,075 | 78,451 |
| 3. Space applications..... | 12,408 | 13,185 | 13,741 | 10,391 | 12,912 | 13,525 |
| 4. Space technology..... | 141,757 | 142,306 | 153,782 | 139,128 | 141,428 | 153,089 |
| 5. Aircraft technology..... | 38,173 | 46,485 | 49,597 | 37,535 | 46,199 | 49,380 |
| 6. Supporting activities.... | 33,401 | 35,988 | 36,261 | 28,569 | 35,287 | 35,723 |
| Total direct program costs, funded..... | 611,186 | 647,483 | 671,300 | 604,657 | 643,200 | 668,000 |
| Reimbursable program: | | | | | | |
| 3. Space applications..... | 872 | 770 | 779 | 594 | 803 | 779 |
| 4. Space technology..... | 27 | 75 | 75 | 22 | 76 | 75 |
| 6. Supporting activities.... | 733 | 1,455 | 1,446 | 813 | 1,563 | 1,446 |
| Total reimbursable program costs..... | 1,632 | 2,300 | 2,300 | 1,429 | 2,442 | 2,300 |



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## ADMINISTRATIVE OPERATIONS

Program and Financing (in thousands of dollars) - Continued

| | Budget Plan | | | Costs to this appropriation | | |
|---|---|---|---|---|---|---|
| | 1966 | 1967 | 1968 | 1966 | 1967 | 1968 |
| Total program costs, funded | 612,818 | 649,783 | 673,600 | 606,086 | 645,642 | 670,300 |
| Change in selected resources[1] | ..... | ..... | ..... | 6,732 | 4,141 | 3,300 |
| 10 Total | 612,818 | 649,783 | 673,600 | 612,818 | 649,783 | 673,600 |
| Financing: | | | | | | |
| Receipts and reimbursements from: | | | | | | |
| 11 Administrative budget accounts | ..... | ..... | ..... | -1,476 | -2,120 | -2,069 |
| 14 Non-Federal sources[2] | ..... | ..... | ..... | -156 | -180 | -231 |
| 25 Unobligated balance lapsing | ..... | ..... | ..... | 634 | ..... | ..... |
| New obligational authority | ..... | ..... | ..... | 611,820 | 647,483 | 671,300 |
| New obligational authority: | | | | | | |
| 40 Appropriation | | | | 584,000 | 640,000 | 671,300 |
| 41 Transferred to "Operating expenses, Public Buildings Service," General Services Administration (79 Stat. 531 and 80 Stat. 674) | | | | -76 | -417 | ..... |
| 42 Transferred from "Research and development" (79 Stat. 534 and 80 Stat. 676) | | | | 27,896 | 7,900 | ..... |
| 43 Appropriation (adjusted) | | | | 611,820 | 647,483 | 671,300 |

## ADMINISTRATIVE OPERATIONS

Program and Financing (in thousands of dollars) - Continued

| | Budget Plan | | | Costs to this appropriation | | |
|---|---|---|---|---|---|---|
| | 1966 | 1967 | 1968 | 1966 | 1967 | 1968 |
| Relation of obligations to expenditures: | | | | | | |
| 10 Total obligations | ..... | ..... | ..... | 612,818 | 649,783 | 673,600 |
| 70 Receipts and other offsets (items 11-17) | ..... | ..... | ..... | -1,632 | -2,300 | -2,300 |
| 71 Obligations affecting expenditures | ..... | ..... | ..... | 611,186 | 647,483 | 671,300 |
| 72 Obligated balance, start of year | ..... | ..... | ..... | 117,220 | 106,465 | 114,748 |
| 74 Obligated balance, end of year | ..... | ..... | ..... | -106,465 | -114,748 | -116,048 |
| 77 Adjustments in expired accounts | ..... | ..... | ..... | -2,526 | ..... | ..... |
| 90 Expenditures | ..... | ..... | ..... | 619,415 | 639,200 | 670,000 |

| | 1965 | 1966 adjustments | 1966 | 1967 | 1968 |
|---|---|---|---|---|---|
| [1]Selected resources as of June 30 are as follows: | | | | | |
| Unpaid undelivered orders | 49,623 | -2,978 | 53,285 | 57,426 | 60,726 |
| Advances | 716 | -588 | 220 | 220 | 220 |
| Total selected resources | 50,339 | -3,566 | 53,505 | 57,646 | 60,946 |

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



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

ADMINISTRATIVE OPERATIONS

SUMMARY OF OBLIGATIONS BY INSTALLATION
(Thousands of dollars)

| | Fiscal Year 1966 | Fiscal Year 1967 | Fiscal Year 1968 |
|---|---|---|---|
| MANNED SPACE FLIGHT | | | |
| John F. Kennedy Space Center, NASA | $81,952 | $92,658 | $99,575 |
| Manned Spacecraft Center | 86,543 | 94,989 | 97,636 |
| Marshall Space Flight Center | 128,441 | 127,753 | 126,289 |
| SPACE SCIENCE AND APPLICATIONS | | | |
| Goddard Space Flight Center | 64,365 | 71,211 | 72,240 |
| Wallops Station | 9,337 | 10,011 | 10,188 |
| ADVANCED RESEARCH AND TECHNOLOGY | | | |
| Ames Research Center | 33,211 | 33,739 | 33,954 |
| Electronics Research Center | 6,346 | 12,252 | 19,264 |
| Flight Research Center | 9,380 | 9,485 | 9,630 |
| Langley Research Center | 63,529 | 63,302 | 68,265 |
| Lewis Research Center | 66,383 | 66,283 | 66,996 |
| Space Nuclear Propulsion Office | 1,822 | 2,039 | 2,091 |
| SUPPORTING OPERATIONS | | | |
| NASA Headquarters | 59,877 | 63,761 | 65,172 |
| TOTAL | $611,186 | $647,483 | $671,300 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

ADMINISTRATIVE OPERATIONS

DISTRIBUTION OF OBLIGATIONS BY FUNCTION
BY INSTALLATION

(In thousands)

| FUNCTION | TOTAL NASA | SUBTOTAL OMSF | J. F. KENNEDY SPACE CENTER, NASA | MANNED SPACECRAFT CENTER | MARSHALL SPACE FLIGHT CENTER | SUBTOTAL OSSA | GODDARD SPACE FLIGHT CENTER | WALLOPS STATION | SUBTOTAL OART | AMES RESEARCH CENTER | ELECTRONICS RESEARCH CENTER | FLIGHT RESEARCH CENTER | LANGLEY RESEARCH CENTER | LEWIS RESEARCH CENTER | SPACE NUCLEAR PROPULSION OFFICE | NASA HEADQUARTERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Personnel** | | | | | | | | | | | | | | | | |
| FY 1966 | $383,214 | $168,083 | $29,848 | $51,718 | $86,517 | $47,300 | $42,436 | $4,864 | $132,726 | $24,027 | $4,070 | $6,923 | $44,434 | $51,719 | $1,553 | $35,105 |
| FY 1967 | 413,304 | 181,582 | 33,579 | 59,287 | 88,716 | 52,017 | 46,748 | 5,269 | 142,526 | 25,684 | 7,574 | 7,116 | 46,539 | 53,864 | 1,749 | 37,179 |
| FY 1968 | 422,790 | 183,862 | 35,476 | 60,623 | 87,763 | 52,340 | 46,989 | 5,351 | 148,211 | 25,811 | 11,375 | 7,224 | 47,716 | 54,293 | 1,792 | 38,377 |
| **Travel** | | | | | | | | | | | | | | | | |
| FY 1966 | 17,845 | 8,356 | 840 | 4,338 | 3,178 | 2,557 | 2,454 | 103 | 4,144 | 703 | 238 | 227 | 1,474 | 1,310 | 192 | 2,788 |
| FY 1967 | 18,601 | 8,713 | 1,059 | 4,519 | 3,135 | 2,701 | 2,535 | 166 | 4,266 | 718 | 300 | 216 | 1,529 | 1,296 | 207 | 2,921 |
| FY 1968 | 19,021 | 8,733 | 1,079 | 4,519 | 3,135 | 2,805 | 2,661 | 144 | 4,544 | 718 | 580 | 216 | 1,529 | 1,294 | 207 | 2,939 |
| **Automatic Data Processing** | | | | | | | | | | | | | | | | |
| FY 1966 | 40,309 | 18,069 | 948 | 7,008 | 10,113 | 6,990 | 6,876 | 114 | 14,307 | 2,751 | 454 | 97 | 8,442 | 2,563 | - | 943 |
| FY 1967 | 36,067 | 17,875 | 1,330 | 6,296 | 10,249 | 7,869 | 7,807 | 62 | 9,059 | 1,943 | 1,071 | 23 | 5,741 | 281 | - | 1,264 |
| FY 1968 | 40,792 | 17,708 | 1,342 | 6,209 | 10,157 | 8,942 | 8,866 | 76 | 12,993 | 2,095 | 2,098 | 24 | 8,576 | 200 | - | 1,149 |
| **Facilities Services** | | | | | | | | | | | | | | | | |
| FY 1966 | 102,852 | 69,313 | 42,678 | 11,937 | 14,698 | 10,148 | 6,996 | 3,152 | 21,690 | 4,563 | 957 | 1,290 | 6,567 | 8,313 | - | 1,701 |
| FY 1967 | 109,570 | 74,021 | 47,874 | 13,373 | 12,774 | 11,469 | 8,148 | 3,321 | 22,627 | 4,252 | 1,830 | 1,354 | 6,799 | 8,392 | - | 1,453 |
| FY 1968 | 117,494 | 80,178 | 52,639 | 14,839 | 12,700 | 11,204 | 7,794 | 3,410 | 24,490 | 4,163 | 2,870 | 1,376 | 7,534 | 8,547 | - | 1,622 |
| **Technical Services** | | | | | | | | | | | | | | | | |
| FY 1966 | 23,939 | 8,852 | 31 | 2,938 | 5,883 | 1,074 | 1,008 | 66 | 1,145 | 320 | 146 | 191 | 333 | 79 | 76 | 12,868 |
| FY 1967 | 24,551 | 8,102 | - | 2,608 | 5,494 | 1,409 | 1,297 | 112 | 1,307 | 177 | 569 | 84 | 327 | 70 | 80 | 13,733 |
| FY 1968 | 25,091 | 7,786 | 8 | 2,596 | 5,182 | 1,278 | 1,169 | 109 | 2,086 | 207 | 1,127 | 82 | 357 | 224 | 89 | 13,941 |
| **Administrative Support** | | | | | | | | | | | | | | | | |
| FY 1966 | 43,027 | 24,263 | 7,607 | 8,604 | 8,052 | 5,633 | 4,595 | 1,038 | 6,659 | 847 | 481 | 652 | 2,279 | 2,399 | 1 | 6,472 |
| FY 1967 | 45,390 | 25,107 | 8,816 | 8,906 | 7,385 | 5,757 | 4,676 | 1,081 | 7,315 | 965 | 908 | 692 | 2,367 | 2,380 | 3 | 7,211 |
| FY 1968 | 46,112 | 25,233 | 9,031 | 8,850 | 7,352 | 5,859 | 4,761 | 1,098 | 7,876 | 960 | 1,214 | 708 | 2,553 | 2,438 | 3 | 7,144 |
| **Total** | | | | | | | | | | | | | | | | |
| FY 1966 | $611,186 | $296,936 | $81,952 | $86,543 | $128,441 | $73,702 | $64,365 | $9,337 | $180,671 | $33,211 | $6,346 | $9,380 | $63,529 | $66,383 | $1,822 | $59,877 |
| FY 1967 | 647,483 | 315,400 | 92,658 | 94,989 | 127,753 | 81,222 | 71,211 | 10,011 | 187,100 | 33,739 | 12,252 | 9,485 | 63,302 | 66,283 | 2,039 | 63,761 |
| FY 1968 | 671,300 | 323,500 | 99,575 | 97,636 | 126,289 | 82,428 | 72,240 | 10,188 | 200,200 | 33,954 | 19,264 | 9,630 | 68,265 | 66,996 | 2,091 | 65,172 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

ADMINISTRATIVE OPERATIONS

DISTRIBUTION OF OBLIGATIONS BY OBJECT CLASSIFICATION
BY FUNCTION

(In thousands)

| Object Classification | Total NASA | Personnel | Travel | Automatic Data Processing | Facilities Services | Technical Services | Administrative Support |
|---|---|---|---|---|---|---|---|
| FISCAL YEAR 1966 | | | | | | | |
| Personnel compensation | $354,155 | $354,155 | --- | --- | --- | --- | --- |
| Personnel benefits | 25,577 | 25,577 | --- | --- | --- | --- | --- |
| Benefits for former personnel | 2 | 2 | --- | --- | --- | --- | --- |
| Travel & transp. of persons | 19,466 | 258 | $17,845 | --- | --- | --- | $1,363 |
| Transportation of things | 4,480 | 624 | --- | --- | --- | --- | 3,856 |
| Rents, communications, and utilities | 47,259 | --- | --- | $19,777 | $15,571 | --- | 11,911 |
| Printing and reproduction | 6,169 | --- | --- | --- | --- | --- | 6,169 |
| Other services | 97,679 | 1,669 | --- | 11,243 | 54,815 | $20,958 | 8,994 |
| Services of other agencies | 14,067 | 929 | --- | --- | 10,441 | 1,727 | 970 |
| Supplies and materials | 19,089 | --- | --- | --- | 11,627 | --- | 7,462 |
| Equipment | 17,854 | --- | --- | 9,289 | 5,140 | 1,254 | 2,171 |
| Lands and structures | 5,258 | --- | --- | --- | 5,258 | --- | --- |
| Grants, subsidies & contributions | --- | --- | --- | --- | --- | --- | --- |
| Insurance claims and indemnities | 131 | --- | --- | --- | --- | --- | 131 |
| Totals | $611,186 | $383,214 | $17,845 | $40,309 | $102,852 | $23,939 | $43,027 |
| FISCAL YEAR 1967 | | | | | | | |
| Personnel compensation | $379,868 | $379,868 | --- | --- | --- | --- | --- |
| Personnel benefits | 29,274 | 29,274 | --- | --- | --- | --- | --- |
| Benefits for former personnel | 37 | 37 | --- | --- | --- | --- | --- |
| Travel & transp. of persons | 20,619 | 471 | $18,601 | --- | --- | --- | $1,547 |
| Transportation of things | 5,435 | 908 | --- | --- | --- | --- | 4,527 |
| Rents, communications, and utilities | 50,742 | --- | --- | $19,333 | $18,517 | --- | 12,892 |
| Printing and reproduction | 6,623 | --- | --- | --- | --- | --- | 6,623 |
| Other services | 105,661 | 2,053 | --- | 13,818 | 58,773 | $21,765 | 9,252 |
| Services of other agencies | 14,063 | 693 | --- | 14 | 10,494 | 1,826 | 1,036 |
| Supplies and materials | 19,482 | --- | --- | --- | 12,015 | --- | 7,467 |
| Equipment | 11,169 | --- | --- | 2,902 | 5,349 | 960 | 1,958 |
| Lands and structures | 4,422 | --- | --- | --- | 4,422 | --- | --- |
| Grants, subsidies & contributions | 50 | --- | --- | --- | --- | --- | 50 |
| Insurance claims and indemnities | 38 | --- | --- | --- | --- | --- | 38 |
| Totals | $647,483 | $413,304 | $18,601 | $36,067 | $109,570 | $24,551 | $45,390 |
| FISCAL YEAR 1968 | | | | | | | |
| Personnel compensation | $388,561 | $388,561 | --- | --- | --- | --- | --- |
| Personnel benefits | 30,106 | 30,106 | --- | --- | --- | --- | --- |
| Benefits for former personnel | 2 | 2 | --- | --- | --- | --- | --- |
| Travel & transp. of persons | 20,987 | 444 | $19,021 | --- | --- | --- | $1,522 |
| Transportation of things | 5,269 | 711 | --- | --- | --- | --- | 4,558 |
| Rents, communications, and utilities | 56,586 | --- | --- | $21,929 | $21,346 | --- | 13,311 |
| Printing and reproduction | 6,529 | --- | --- | --- | --- | --- | 6,529 |
| Other services | 109,764 | 2,270 | --- | 13,544 | 62,561 | $21,924 | 9,465 |
| Services of other agencies | 15,718 | 696 | --- | 16 | 11,730 | 2,207 | 1,069 |
| Supplies and materials | 19,841 | --- | --- | --- | 12,344 | --- | 7,497 |
| Equipment | 13,674 | --- | --- | 5,303 | 5,339 | 960 | 2,072 |
| Lands and structures | 4,174 | --- | --- | --- | 4,174 | --- | --- |
| Grants, subsidies & contributions | 50 | --- | --- | --- | --- | --- | 50 |
| Insurance claims and indemnities | 39 | --- | --- | --- | --- | --- | 39 |
| Totals | $671,300 | $422,790 | $19,021 | $40,792 | $117,494 | $25,091 | $46,112 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

ADMINISTRATIVE OPERATIONS

DISTRIBUTION OF OBLIGATIONS BY OBJECT CLASSIFICATION
BY INSTALLATION

(In thousands)

| Object Classification | Total NASA | J. F. Kennedy Space Center, NASA | Manned Spacecraft Center | Marshall Space Flight Center | Goddard Space Flight Center | Wallops Station | Ames Research Center | Electronics Research Center | Flight Research Center | Langley Research Center | Lewis Research Center | Space Nuclear Propulsion Office | HDQTRS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISCAL YEAR 1966 | | | | | | | | | | | | | |
| Personnel compensation | $354,155 | $27,764 | $47,906 | $80,178 | $39,105 | $4,483 | $22,252 | $3,738 | $6,424 | $41,199 | $48,089 | $1,432 | $31,585 |
| Personnel benefits | 25,577 | 1,844 | 3,332 | 5,720 | 2,949 | 307 | 1,654 | 262 | 455 | 3,018 | 3,490 | 117 | 2,429 |
| Benefits for former personnel | 2 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 2 |
| Travel & transp. of persons | 19,465 | 1,853 | 4,606 | 3,314 | 2,521 | 169 | 719 | 245 | 231 | 1,490 | 1,321 | 192 | 2,805 |
| Transportation of things | 4,480 | 1,383 | 615 | 215 | 1,287 | 73 | 48 | 39 | 24 | 295 | 229 | 3 | 269 |
| Rents, communications, and utilities | 47,259 | 6,159 | 8,505 | 8,442 | 7,375 | 388 | 4,420 | 736 | 282 | 5,285 | 3,080 | --- | 2,587 |
| Printing and reproduction | 6,169 | 1,543 | 801 | 973 | 477 | 41 | 27 | 44 | 8 | 160 | 74 | --- | 2,021 |
| Other services | 97,679 | 29,533 | 15,229 | 19,861 | 6,811 | 1,124 | 1,651 | 706 | 1,510 | 3,142 | 4,347 | 77 | 13,688 |
| Services of other agencies | 14,067 | 8,212 | 714 | 2,343 | 194 | 70 | 161 | 153 | 19 | 70 | 127 | 1 | 2,003 |
| Supplies and materials | 19,089 | 1,857 | 2,335 | 5,094 | 2,162 | 1,484 | 756 | 177 | 288 | 2,467 | 1,820 | --- | 649 |
| Equipment | 17,854 | 1,070 | 1,410 | 1,053 | 1,116 | 419 | 1,112 | 244 | 113 | 5,962 | 3,517 | --- | 1,838 |
| Lands and structures | 5,253 | 719 | 1,089 | 1,245 | 367 | 673 | 410 | 2 | 25 | 440 | 288 | --- | --- |
| Grants, subsidies & contributions | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Insurance claims and indemnities | 131 | 15 | 1 | 3 | 1 | 106 | 1 | --- | 1 | [illegible] | 1 | --- | 1 |
| Totals | $611,186 | $81,952 | $86,543 | $128,441 | $64,365 | $9,337 | $33,211 | $6,346 | $9,380 | $63,529 | $66,383 | $1,822 | $59,877 |
| FISCAL YEAR 1967 | | | | | | | | | | | | | |
| Personnel compensation | $379,863 | $30,892 | $54,539 | $81,497 | $42,860 | $4,811 | $23,797 | $6,847 | $6,587 | $43,106 | $49,970 | $1,573 | $33,389 |
| Personnel benefits | 29,274 | 2,308 | 4,171 | 6,534 | 3,330 | 360 | 1,770 | 512 | 488 | 3,209 | 3,716 | 163 | 2,713 |
| Benefits for former personnel | 37 | --- | --- | --- | --- | --- | --- | --- | --- | --- | 26 | --- | 11 |
| Travel & transp. of persons | 20,619 | 2,300 | 4,775 | 3,270 | 2,703 | 250 | 731 | 345 | 220 | 1,557 | 1,310 | 209 | 2,955 |
| Transportation of things | 5,435 | 1,920 | 685 | 210 | 1,407 | 100 | 39 | 80 | 30 | 382 | 250 | 8 | 324 |
| Rents, communications, and utilities | 50,742 | 8,405 | 8,616 | 8,125 | 7,852 | 409 | 4,326 | 1,655 | 274 | 5,203 | 3,216 | --- | 2,661 |
| Printing and reproduction | 6,623 | 1,760 | 700 | 975 | 434 | 50 | 27 | 95 | 20 | 160 | 60 | --- | 2,342 |
| Other services | 105,661 | 32,291 | 16,553 | 18,705 | 9,039 | 1,279 | 1,956 | 1,642 | 1,287 | 3,442 | 3,957 | 80 | 15,429 |
| Services of other agencies | 14,063 | 8,250 | 695 | 2,420 | 160 | 75 | 170 | 276 | 21 | 21 | 130 | 6 | 1,839 |
| Supplies and materials | 19,482 | 2,425 | 2,650 | 4,550 | 1,918 | 1,570 | 690 | 371 | 350 | 2,462 | 1,850 | --- | 641 |
| Equipment | 11,169 | 1,195 | 955 | 800 | 819 | 480 | 150 | 425 | 131 | 3,320 | 1,497 | --- | 1,397 |
| Lands and structures | 4,422 | 902 | 645 | 662 | 689 | 626 | 82 | --- | 76 | 440 | 300 | --- | --- |
| Grants, subsidies & contributions | 50 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 50 |
| Insurance claims and indemnities | 38 | 10 | 5 | 5 | --- | 1 | 1 | 4 | 1 | --- | 1 | --- | 10 |
| Totals | $647,483 | $92,658 | $94,989 | $127,753 | $71,211 | $10,011 | $33,739 | $12,252 | $9,485 | $63,302 | $66,283 | $2,039 | $63,761 |
| FISCAL YEAR 1968 | | | | | | | | | | | | | |
| Personnel compensation | $388,561 | $32,794 | $55,807 | $80,631 | $43,139 | $4,879 | $23,835 | $10,305 | $6,692 | $44,162 | $50,342 | $1,600 | $34,375 |
| Personnel benefits | 30,106 | 2,426 | 4,309 | 6,447 | 3,397 | 363 | 1,813 | 740 | 493 | 3,311 | 3,792 | 176 | 2,839 |
| Benefits for former personnel | 2 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 2 |
| Travel & transp. of persons | 20,987 | 2,300 | 4,775 | 3,270 | 2,789 | 210 | 731 | 655 | 220 | 1,551 | 1,310 | 209 | 2,967 |
| Transportation of things | 5,269 | 1,800 | 615 | 210 | 1,347 | 100 | 39 | 130 | 40 | 392 | 250 | 11 | 330 |
| Rents, communications, and utilities | 56,586 | 9,300 | 8,665 | 8,125 | 9,547 | 420 | 4,633 | 3,088 | 274 | 6,180 | 3,480 | --- | 2,874 |
| Printing and reproduction | 6,529 | 1,760 | 700 | 975 | 337 | 50 | 27 | 130 | 25 | 160 | 60 | --- | 2,305 |
| Other services | 109,764 | 35,841 | 17,121 | 18,476 | 8,404 | 1,477 | 1,782 | 1,852 | 1,214 | 4,181 | 3,975 | 89 | 15,352 |
| Services of other agencies | 15,718 | 8,420 | 1,695 | 2,390 | 160 | 78 | 170 | 633 | 21 | 21 | 135 | 6 | 1,989 |
| Supplies and materials | 19,841 | 2,750 | 2,510 | 4,355 | 1,988 | 1,500 | 690 | 555 | 350 | 2,650 | 1,850 | --- | 643 |
| Equipment | 13,674 | 1,165 | 840 | 750 | 819 | 480 | 150 | 1,171 | 200 | 5,162 | 1,501 | --- | 1,436 |
| Lands and structures | 4,174 | 1,009 | 594 | 655 | 313 | 630 | 83 | --- | 100 | 490 | 300 | --- | --- |
| Grants, subsidies & contributions | 50 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 50 |
| Insurance claims and indemnities | 39 | 10 | 5 | 5 | --- | 1 | 1 | 5 | 1 | --- | 1 | --- | 10 |
| Totals | $671,300 | $99,575 | $97,636 | $126,289 | $72,240 | $10,188 | $33,954 | $19,264 | $9,630 | $63,265 | $66,996 | $2,091 | $65,172 |



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ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1968 ESTIMATES

JOHN F. KENNEDY SPACE CENTER, NASA

MISSION:

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

1. Launch vehicle checkout and preparation.

2. Spacecraft and payload checkout and preparation.

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

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

5. Operation and coordination of supporting facilities, ground support equipment, and tracking and data acquisition and logistics support required for operation of all NASA activities at ETR and WTR.

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

DESCRIPTION:

The Kennedy Space Center is adjacent to the National Eastern Test Range launch area. It is situated approximately 50 miles East of Orlando, Florida, in northeast Brevard County.

The total land area occupied by the installation is approximately 87,800 acres, including 84,303 acres owned by NASA. In addition to the land area occupied, the state of Florida has dedicated to the United States exclusive use rights to some 53,563 acres of state-owned submerged lands. Included in the NASA-owned lands are 3,300 acres of producing citrus groves, situated in the buffer zone, which are out-leased.

In addition to the operation and maintenance of all facilities at the Kennedy Space Center, the center is responsible for certain facilities within the National Eastern Test Range launch area. The capital investment as of June 30, 1966, was $808,549,000.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Dollars in Thousands) | | |
|---|---|---|---|
| | 1965 | 1966 | 1967 |
| Authorized Permanent Positions, end of year..... | 2,589 | 2,720 | 2,720 |
| Administrative Operations..... | $81,952 | $92,658 | $99,575 |

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1968 ESTIMATES

## MANNED SPACECRAFT CENTER

MISSION:

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

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

1. The design, development, and fabrication of the Apollo spacecraft, including the Command and Service Modules (CSM), and the Lunar Module (LM).

2. Overall program management and control of the spacecraft including module integration, testing and qualification.

3. Conduct of a program of flight hardware testing such as the static propulsion system tests at White Sands Test Facility (WSTS) and spacecraft environmental testing at MSC.

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

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

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

The longer duration flights planned for the Apollo Applications missions will make it necessary to use the experienced personnel of this center to up-grade spacecraft and lunar module subsystems. This center is also responsible for the development of earth sensor experiment modules and biomedical, bioscience and behavorial experiment modules to be flown on AAP missions.

DESCRIPTION:

The Manned Spacecraft Center is located on NASA Road 1, two miles east of the town of Webster, Texas. The site is approximately 20 miles southeast of downtown Houston and 25 miles northwest of Galveston, Texas. A portion of the site borders on Clear Lake, which provides water access to the Gulf of Mexico through Galveston Bay. Total NASA-owned land consists of 1,620 acres. The capital investment of the Manned Spacecraft Center at the Clear Lake Site as of June 30, 1966 was $294,708,578. The center holds an additional 55,880 acres under use agreement at the White Sands Test Facility with a capital investment of $19,486,664. Combined capital investment of the Manned Spacecraft Center as of June 30, 1966, was $314,195,242.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Dollars in thousands) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Authorized Permanent Positions, end of year..... | 4,737 | 4,634 | 4,634 |
| Administrative Operations..... | $86,543 | $94,989 | $97,636 |

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1968 ESTIMATES

## GEORGE C. MARSHALL SPACE FLIGHT CENTER

**MISSION:**

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

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

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

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

In carrying out its management responsibilities for these programs, the Marshall Space Flight Center has developed the capability to:

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

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

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

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

In support of its assigned programs, Marshall also maintains the research and development capability to conduct advanced studies on launch vehicle and space systems, space navigation techniques, astronautics, and space science investigations. Its capability for both research and for the management of



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industrial operations give the Marshall Space Flight Center a highly flexible base for manned space programs.

DESCRIPTION:

Operations of the Marshall Space Flight Center are conducted at three primary locations.

The first location, the main Marshall Space Flight Center site is near Huntsville, Alabama, on Army property at the Redstone Arsenal. The center occupies 1,797 acres under a nonrevocable use permit from the Army, and 64 leased acres. The capital investment as of June 30, 1966 was $376,519,000. Certain facilities such as the Redstone Arsenal Army Air Field and some utilities are used jointly by NASA and the Army. The Huntsville location has deep-water access via the Tennessee River, Ohio River, and Mississippi River.

The second location, the Michoud Assembly Facility, is located 15 miles east of New Orleans, Louisiana. The main facility occupies 897 acres. The Slidell Central Computer Facility, a satellite facility 20 miles to the northeast, occupies 14 additional acres bringing the total acreage to 911. The capital investment as of June 30, 1966, was $134,450,000. Michoud facility space totals 3,483,862 square feet, including the main assembly plant, covering an area of 43 acres under one roof. MSFC exercises overall management of the facility, while a support contractor provides administrative and technical services, and the vehicle prime contractors produce the Uprated Saturn I and Saturn V booster stages at this location. The Michoud Assembly Facility is on the Gulf Intra-Coastal Waterway, and has deep-water access via the Mississippi River.

The third location, the Mississippi Test Facility, is in southwest Mississippi, approximately 50 miles northeast of New Orleans, Louisiana. Total land area is 138,870 acres of which 13,428 acres make up the actual test area owned by NASA. The remaining 125,442 acres are held as a buffer zone. In the buffer area, 7,568 acres are owned by NASA, and 117,874 acres are under restrictive easement. Capital investment for the Mississippi Test Facility as of June 30, 1966, was $215,994,000. Test stands include a dual-position stand for testing the Saturn V first stage (S-IC), and two stands for testing the 1,000,000 pound thrust Saturn V second stage (S-II). MSFC exercises overall management of the facility, while a support contractor provides administrative and technical services, and the vehicle prime contractors are responsible for conducting tests on the stands. The site has deep-water access for transporting large boosters via the Pearl River and the Intra-Coastal Waterway.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Dollars in Thousands) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Authorized Permanent Positions, end of year..... | 7,271 | 7,030 | 7,030 |
| Administrative Operations..... | $128,441 | $127,753 | $126,289 |

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1968 ESTIMATES

GODDARD SPACE FLIGHT CENTER

MISSION:

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

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

Goddard Space Flight Center is responsible for the development of the sounding rocket program; the management of communications and meteorological satellite programs, such as the Applications Technology and Nimbus Satellites; the management of scientific satellite projects to include the Orbiting Geophysical (OGO), Orbiting Solar (OSO) and the Orbiting Astronomical (OAO) Observatories and the Explorer series; project management of NASA's Delta launch vehicle; and management and operation of two world-wide tracking and data acquisition networks, the Space Tracking and Data Acquisition Network and the Manned Space Flight Network. During 1966, Goddard was assigned two new scientific satellite programs, the Small Standard Satellite to study space environment inside the earth's magnetosphere and the X-ray Explorer project to investigate recently discovered X-ray sources in space.

Significant achievements of the Goddard Space Flight Center in 1966 were:

Scientific Satellites - Three scientific satellites, the Orbiting Geophysical Satellite (OGO III), Explorers XXXII (AE-B) and XXXIII (IMP-D) were successfully orbited in 1966. OGO III assisted in the detailed mapping of the sunside of the magnetosphere accomplished by OGO I; AE-B continued the study of the neutral helium atom belt around the earth discovered by Explorer XVII; and IMP-D provided the first definitive proof of the earth's magnetosphere extending beyond the moon's orbit on the side opposite the sun.

Meteorological Satellites - Nimbus II successfully completed its six-month operating span in November 1966. The Medium Resolution Infrared Radiometer (MRIR) pictures obtained may result in the successful plotting of the jet stream flow as an aid to aviation. ESSA I through III were successfully launched and initiated the Tiros Operational Satellite series. ESSA III carried an advanced cartwheel design for continuous earth viewing and an advanced vidicon camera system producing additional data.

Sounding Rockets - The Sounding Rockets program consisted of 158 scientific rocket launchings in 1966. Of the total 158 rockets launched, 80 carried space research experiments, including 13 launches with experiments of foreign scientists. The first successful launching of a rocket system capable of pointing to specific locations in space occurred in 1966. This new device should prove to be a valuable and relatively inexpensive astronomy research tool.

Communications Satellite - The highly successful launch of the first Applications Technology Satellite, a complex second-generation communications meteorology scientific satellite, occurred in 1966. The satellite provides a capability for the study of several scientific disciplines.

Tracking and Data Acquisition - The Space Tracking and Data Acquisition Network, comprised of 14 stations located throughout the world, provided communications and tracking coverage for automated scientific and applications satellites launched in 1966 and for similar operating satellites launched prior to 1966. The successful Gemini manned flight launches VIII through XII were supported by the Manned Space Flight Network. The Manned Space Flight Network which provides global tracking support for the United States manned space flight program also supported the two unmanned Apollo/Saturn launches, while converting to support new phases of the Apollo program.

DESCRIPTION:

The Goddard Space Flight Center, located 15 miles northeast of Washington, D. C. and 1 mile east of the Baltimore-Washington Parkway, Greenbelt, Maryland exit, is situated on a 553 acre main site. Three additional plots of 639 acres comprise our remote site area and contain the Goddard Antenna Test Range, the Magnetic Fields Component Test Facility, the Attitude Control Test Facility, the STADAN Engineering and Real Time Station, the Manned Space Flight Training Facility and the 40-foot Antenna Test Bed. Total capital investment as of June 30, 1966, was $272,276,000.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Dollars in Thousands) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Authorized Permanent Positions, end of year..... | 3,712 | 3,782 | 3,782 |
| Administrative Operations..... | $64,365 | $71,211 | $72,240 |

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1968 ESTIMATES

## WALLOPS STATION

MISSION:

Wallops Station, formerly the Pilotless Aircraft Research Station of the National Advisory Committee for Aeronautics (NACA), was designated Wallops Station when the resources and facilities of NACA were transferred to the National Aeronautics and Space Administration (NASA) in 1958. Wallops' early mission included wind tunnel and laboratory investigations of a variety of aerodynamic problems of flight, as well as serving as a launch site for meteorological and sounding rockets.

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

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

Wallops Station's achievements during the past calendar year include: the launching of 336 sounding rockets and 267 test rockets; participation in a number of international projects highlighted by two solar eclipse expeditions to Greece and Brazil involving more than 20 launches; and the first helicopter recovery in midair of a rocket-launched parachute and payload. The station continues to play a noteworthy role in the training of foreign nationals in the techniques of launch operations. Twenty personnel from Brazil, France, and Spain received training at Wallops Station during the past calendar year and a total of 143 persons from 24 countries visited the installation to observe its operation or seek assistance in establishing a sounding rocket launch facility of their own.

DESCRIPTION:

Wallops Station includes three separate areas on the Atlantic Coast of Virginia's eastern shore: The main base (formerly Chincoteaque Naval Air Station), the Wallops Island launching site and the Wallops mainland. The administrative offices, the range control center, support shops and the main telemetry building are located on the main base. Wallops Island is about seven miles southeast of the main base and is connected to the mainland by a causeway and bridge. The island is about five miles long and its widest point is only one-half mile. Located on the island are rocket storage buildings, blockhouses, assembly shops and the launch sites. The Wallops mainland is a one-half mile strip west of the island and houses the radar and optical tracking sites. The Eastville tracking site located about 50 miles south of Wallops Station, was recently acquired at no acquisition cost from the Air Force as a transfer of excess real property. The acquisition of the Eastville site from the Air Force assured that the NASA camera tracking facilities located thereon may continue in operation.

Wallops Station, totaling 6,561 acres, consists of 2,313 acres on the main base; 3,000 acres on Wallops Island, 108 acres on the mainland tracking site; and 1,140 acres of unusable marsh land. The Eastville tracking site consists of an additional 53 acres of government-owned property. The total capital investment as of June 30, 1966, was $82,567,000.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Dollars in Thousands) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Authorized Permanent Positions, end of year | 518 | 518 | 518 |
| Administrative Operations | $9,337 | $10,011 | $10,188 |

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1968 ESTIMATES

AMES RESEARCH CENTER

MISSION:

The mission of the Ames Research Center has been broadened significantly since the establishment of NASA and now includes a major research responsibility in the life sciences, a flight project management responsibility and the operational responsibility for the NASA Convair 990 aircraft to conduct airborne scientific experiments in addition to the traditional research mission in the physical sciences. In the current and budget years, the installation has flight project management responsibility for the Pioneer and Biosatellite projects. Pioneer will provide scientific observations of phenomena in interplanetary space from an unmanned spacecraft, and the Biosatellite project will explore the biological effects of the space environment on primates and other earth organisms.

Research in the physical sciences includes studies in atmosphere entry and environmental physics, guidance and control systems, and aeronautics. The work in entry and environmental physics includes basic studies of the physics of high temperature gases, the stability, control and performance of a wide range of spacecraft configurations, and of materials and structures for spacecraft. In the area of gas physics, particular emphasis is placed on problems associated with flight into earth and other planetary atmospheres. Through this effort, significant contributions have been made to the design of the Mercury, Gemini and Apollo spacecraft, the design of Mars entry vehicles, and the design of ballistic missiles. The work in guidance and control systems is broad in nature and is applicable to manned and unmanned spacecraft, as well as aircraft. Current emphasis in guidance systems is directed mainly at current and follow-on manned missions. This includes an intensive effort in the area of midcourse navigation and terminal guidance with a smaller effort directed at studies involving lunar approach, lunar landing, and rendezvous. The research in control systems is directed at examining various techniques applicable to unmanned satellites and probes and techniques applicable to vertical and short take-off (V/STOL) aircraft, the supersonic transport, and manned spacecraft. The research program in aeronautics is directed at fundamental studies in aerodynamics, propulsion and operating problems associated with supersonic aircraft with particular emphasis on the supersonic transport, a wide variety of V/STOL vehicles and with hypersonic research aircraft. This includes studies of piloting problems with numerous fixed-base, moving-base, and flight simulators.

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

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

DESCRIPTION:

The installation was established in 1940 and is located at the southern end of San Francisco Bay on land contiguous to the U.S. Naval Air Station, Moffett Field, California. Its physical plant comprises many specialized facilities for aerospace research in the traditional physical sciences as well as the space sciences and life sciences, all of which are included in the mission of the center. These include conventional wind tunnels, entry-heating simulators, and free-flight ballistic test facilities capable of conducting tests at speeds up to and above earth escape speed as well as laboratories equipped to study solar and environmental factors. The Installation occupies about 226 acres of land. Certain other facilities, such as the utilities and airfield runways, are used jointly by NASA and the Navy. The total capital investment as of June 30, 1966, was $195,697,000.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Dollars in Thousands) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Authorized Permanent Positions, end of year... | 2,223 | 2,171 | 2,171 |
| Administrative Operations..... | $33,211 | $33,739 | $33,954 |

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1968 ESTIMATES

ELECTRONICS RESEARCH CENTER

MISSION:

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

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

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

Electronics research being managed and conducted by the center during FY 1967 and FY 1968 is largely contracted with industry and universities and is focused in the following areas:

1. Space electronics materials and components.

2. Guidance and navigation of space vehicles, spacecraft, and supporting ground based equipment.

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

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

5. Electronic power conditioning and distribution.

6. Space and ground based instrumentation technology.

7. Space and ground based computers and computing systems.

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

9. Optical communications.

An in-house research effort is being conducted by the center staff on those tasks offering great promise for space electronics technology and on those problems requiring first-hand experience on the part of the center personnel in order to contract related research with industry and universities.

DESCRIPTION:

The Electronics Research Center is being constructed on a tract in the Kendall Square area of Cambridge, Massachusetts. The site, one and a half miles west of the center of Boston, Massachusetts, is immediately north of the Massachusetts Institute of Technology and one and a half miles from Harvard University. The tract being acquired by the city for NASA use is bounded on the north by Binney Street, on the south by Broadway, on the east by Third Street, and on the west by the New York Central Railroad. In addition to the center site, an auxiliary site will be required for the field tests and research that cannot be conducted at the main site. The total area to be occupied at the Kendall Square site in Cambridge is 29 acres. The total capital investment as of June 30, 1966, was $2,887,000.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Dollars in Thousands) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Authorized Permanent Positions, end of year... | 510 | 741 | 1,041 |
| Administrative Operations..... | $6,346 | $12,252 | $19,264 |

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1968 ESTIMATES

## FLIGHT RESEARCH CENTER

**MISSION:**

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

The current and projected programs at this center include aeronautics projects, such as X-15, XB-70, supersonic transport and hypersonic research; space vehicle systems projects in which the flight behavior of advanced reentry vehicles including M-2, F-2 and HL-10 heavyweight lifting bodies is studied; and electronic systems projects such as display, guidance, and control in advanced flight missions and improvements on systems and sensors used in biomedical monitoring, tracking, and data acquisition.

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

**DESCRIPTION:**

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

The physical plant consists of an office-laboratory building with adjoining shops, a flight maintenance hangar and a calibration hangar, and a high temperature loads calibration facility. Auxiliary buildings include warehouses, an auxiliary power systems building, and a communications building.

The main station of the three-station radar range operated by the center is located on the third floor of the office-laboratory building. The total capital investment as of June 30, 1966, was $40,178,000.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Dollars in Thousands) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Authorized Permanent Positions, end of year..... | 603 | 590 | 590 |
| Administrative Operations..... | $9,380 | $9,485 | $9,630 |

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1968 ESTIMATES

LANGLEY RESEARCH CENTER

MISSION:

The Langley Research Center focuses its capabilities on the advancement of the aeronautical and space programs of the United States. In this effort, a broad range of activities are conducted to identify new technological opportunities for important progress in flight; to expose and master critical problems that will confront the attainment of advanced flight objectives; to provide sound design, construction, and operations guidance for progressive flight endeavors; and to manage and support the undertaking of major national flight projects. For this purpose, the center has evolved a highly competent staff in aerodynamics, fluid physics, flight environments, structures and materials, dynamic loading, energy conversion, navigation and control, electronics systems and instrumentation, crew performance and vehicular accommodation, life support, systems integration, and flight operations. Their work involves the development and use of a unique research complex of advanced wind tunnel and jet facilities, flight environment and operations simulators, flight hardware development and evaluation laboratories, experimental aircraft, free flight models, rocket propelled flight systems, and space vehicles.

The research program in aeronautics is directed to the provision of a rational technological basis for the successful development and utilization of practicable supersonic and high subsonic speed transports, high performance military aircraft, advanced hypersonic ramjet powered vehicles, and improved V/STOL aircraft. In this endeavor, special emphasis is placed on the refinement of aircraft configurations for increased efficiency and the extension of performance capabilities; the definition and provision of proper stability and control for advanced flight operation; the achievement of optimum man/machine compatibility for maximum mission effectiveness; the specification of critical aircraft loading conditions and structural dynamic characteristics; the provision of improved aircraft construction technologies especially for the accommodation of severe aerodynamic heating, corrosive atmospheres, cryogenic storage, and fatiguing stresses; the establishment of a technical understanding of the aircraft noise problem and its alleviation; the refinement and configuration integration of advanced propulsion systems, including the development of the hypersonic ramjet engine and the hingeless helicopter rotor; the attainment of all weather operational capabilities, particularly in aircraft terminal areas; and the enhancement of flight safety. Experience gained in such advanced research also provides an eminent basis for Langley support of the military services, the FAA, and industry in their progressive aircraft development efforts, as in the F-111 and the supersonic transport programs.

The Langley Research Center also executes a broad range of research programs to provide a rational technological basis for future space developments, and manages and supports a large number of current space projects. Especially prominent are its contributions to the knowledge of atmosphere entry aerothermodynamics, heat shielding, and the circumvention of communications "blackout" for earth orbital, lunar, and planetary missions; the prediction of the structural dynamic characteristics of large launch vehicles and spacecraft landing systems; the establishment of requirements and advanced design concepts for controlled atmosphere entry and landing spacecraft, reusable launch systems, manned orbital research laboratories, manned orbital telescopes, and expandable space structures; the definition and alleviation of space environment hazards to vehicular systems and materials; the evaluation and enhancement of the ability of man to work in the space domain, including the performance of vehicular rendezvous, lunar landing maneuvers, emergency backup of automated navigation and control systems, and extravehicular operations in weightless flight and under lunar gravitation; and the generation of improved technology for long duration life support and electrical power systems, advanced guidance and stabilization equipment, instrumentation and communication devices, solid and hybrid propellant rocket motors, and aerospace materials. Langley also develops wide ranges of crucial technology for the Apollo and follow-on manned space flight programs, and provides research and development support for a number of other unmanned spacecraft and launch vehicle projects. Langley is responsible for management of the Lunar Orbiter project for detailed photographic surveys of the moon; for the operation of the Scout launch vehicle in its various national and international satellite and entry vehicle applications; and for other vehicular systems and experiments for evaluation of the earth's atmospheric characteristics, the radiation and micrometeoroid hazards of the earth and moon environments, the lunar gravitational field, the mechanical properties of the lunar surface, and the precise interconnection of earth mapping systems. Langley also conducts an intensive program of research on the design and operation of advanced planetary exploration spacecraft, and has a major role in the development of the Mars atmosphere probing and landing vehicles and experiments of the Voyager program.

The depth and scope of these research and development activities should contribute vitally to the attainment of national flight aspirations.

DESCRIPTION:

The Langley Research Center, Hampton, Virginia, is located approximately 100 air miles south of Washington, D. C. The center is divided into two separate areas adjacent to the runway facilities of the Langley Air Force Base, and occupies 772 acres of government owned land. The West Area consists of 750 acres of which 430 acres are owned by NASA and 320 acres are under permit from the Air Force. The East Area consists of 22 acres under permit from the Air Force. Runways, some utilities, and certain other facilities are used jointly by NASA and the Air Force. In addition, there are 110 acres of NASA owned land located in the city of Newport News, Virginia, 3,276 acres under permit from other government agencies, and 26 acres under lease. The total acreage owned, under permit, or leased, is 4,184. The total capital investment as of June 30, 1966, was $299,586,000.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Dollars in Thousands) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Authorized Permanent Positions, end of year | 4,233 | 4,136 | 4,236 |
| Administrative Operations | $63,529 | $63,302 | $68,265 |

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1968 ESTIMATES

LEWIS RESEARCH CENTER

MISSION:

The principle mission of the Lewis Research Center has always been aircraft and spacecraft propulsion. During World War II, many improvements were made in reciprocating aircraft engines, engine fuels, superchargers, and other engine accessories. After the war, all facilities were converted for research on turbojet engines, and a rocket laboratory was built. The maximum operating altitude of turbojet engines was greatly increased, pioneer work was done on afterburners, combustion efficiency and the efficiency of compressors and turbines was improved, and an air cooled turbine blade was developed. Rocket work proceeded slowly at first, but the feasibility of using high energy fluorine and hydrogen instead of kerosene as the fuel, was demonstrated. With the establishment of the NASA, work on ion propulsion and spacecraft power systems expanded from theoretical studies and bench type experiments to tests with hardware of practical sizes, and new facilities were added to develop systems which will power and propel our advanced future missions.

The center is now concentrating on research and development in the areas of advanced propulsion and space power generation. This includes work on turbojet engines for supersonic aircraft, on high energy chemical, nuclear, and electric rocket engines and research on space power systems for converting chemical, nuclear, and solar energy into electricity. Basic and applied research is conducted on materials and metallurgy; cryogenic and liquid metal heat transfer fluids; pumps and turbines; combustion processes, propellants, tankage, injectors, chambers, and nozzles; system control dynamics; plasmas and magnetohydrodynamics; space meteoroid damage and zero gravity effects. In the space power area, a major effort is concentrated on turboelectric. thermoelectrical, and thermionic energy conversion systems.

This in-house research provides technical input and direction to the related development, or contractual, efforts for which Lewis has managerial responsibility. For example, the Lewis Research Center maintains technical management of NASA contracts on electric propulsion, nuclear and solar turboelectric space power systems, and liquid hydrogen rocket technology. In addition, Lewis has the development responsibility for the Atlas-Centaur and the Atlas-Agena launch vehicles.

Major research tools, or facilities, at the Lewis Research Center (including the Plum Brook Station) are designed to simulate various flight conditions and range from atmospheric wind tunnels to large space environment facilities (vacuum tanks). A large 60-megawatt thermal reactor is now available for studying radiation effects on materials and components, simulating various flux levels associated with spacecraft applications of nuclear energy.

DESCRIPTION:

The Lewis Research Center occupies two sites. The older one, established in 1941, is on the southwest edge of Cleveland, Ohio, and consists of over 90 laboratory buildings, shops, wind tunnels, space environment tanks and other special facilities, all built for conducting research on advanced propulsion systems or spacecraft power generating systems. The Cleveland facilities occupy 364 acres of which about 15 acres are leased from Cleveland. A newer site, established in 1956, is located south of Sandusky, Ohio, on land formerly occupied by the Plum Brook Ordnance Works. Known as the Plum Brook Station, it occupies 6,031 acres, of which 5,981 are owned and 50 are in easements. There are over 200 buildings on this site, approximately 55 built by the NASA, the rest by the former tenants. The research programs at Plum Brook are under the technical direction of personnel located at Cleveland. They are conducted at the larger site because of the need for large separation distances to minimize hazards. A nuclear reactor is used to test components of nuclear powered propulsion systems; large rockets are operated with fluorine, hydrogen and other high energy fuels; and turbopumps are developed for cryogenic propellants. The total capital investment of the Lewis Research Center, including the Plum Brook Station, as of June 30, 1966, was $292,229,000.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Dollars in Thousands) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Authorized Permanent Positions, end of year..... | 4,819 | 4,676 | 4,676 |
| Administrative Operations..... | $66,383 | $66,283 | $66,996 |



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ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1968 ESTIMATES

## SPACE NUCLEAR PROPULSION OFFICE

### MISSION:

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

The major areas of effort are the research and engineering of the nuclear reactor, and the development of certain nonnuclear components into a complete experimental engine system. Because of progress in developing the graphite solid core reactor, the current emphasis is moving to the engine system phase which includes development of the nonnuclear components and the integration with the reactor.

### DESCRIPTION:

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

The office consists of a headquarters office located at Germantown, Maryland; and three field extensions located in Ohio, New Mexico, and Nevada. At the Nevada location, the Nuclear Rocket Development Station (NRDS) was established to provide a site for ground static testing of the reactors, engines, and eventually, vehicles associated with nuclear rocket development. The NRDS consists of a 90,000 acre site approximately 90 miles northwest of Las Vegas. The total capital investment of NASA funded facilities as of June 30, 1966, was $31,881,000.

### SUMMARY OF RESOURCES REQUIREMENTS:

| | (Dollars in Thousands) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Authorized Permanent Positions, end of year..... | 117 | 117 | 117 |
| Administrative Operations..... | $1,822 | $2,039 | $2,091 |

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1968 ESTIMATES

NASA HEADQUARTERS

MISSION:

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

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

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

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

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

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

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

Apollo - To provide a broad national capability for manned space exploration, including earth orbital, lunar orbital, and lunar surface operations, and to achieve the specific objective of manned lunar landing and return within this decade;

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

Advanced Missions - To plan a broad program of explorations which will achieve and maintain a position of space leadership for the United States. The Office of Manned Space Flight has launch responsibility for all major manned and unmanned missions utilizing NASA launch vehicles. This office also has over-all institutional responsibility for the three installations primarily concerned with the manned space flight programs. These installations are: the George C. Marshall Space Flight Center, including Mississippi Test Facility, Michoud Assembly Facility, and Slidell where a computer facility is located; the Manned Spacecraft Center, including NASA activities at the White Sands Test Facility; and the John F. Kennedy Space Center, NASA, including NASA activities at the Eastern and Western Test Ranges.

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

The Office of Space Science and Applications has an over-all institutional responsibility for those NASA installations primarily involved in space science and applications programs. These are the Goddard Space Flight Center, Wallops Station, the Jet Propulsion Laboratory (a government-owned facility operated for NASA by the California Institute of Technology), and the NASA Pasadena Office, a component field activity.

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

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

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

The component field offices represent NASA in the southwestern area and provide technical, contractual, and administrative support to NASA centers and NASA Headquarters for programs and projects located in southern California and other areas west of Denver, Colorado.

The NASA Office--Downey, located at Downey and Seal Beach, California provides contract management support for the Apollo command and service module and the Saturn S-II contracts with North American Aviation, Space and Information Division.

The Western Support Office, Santa Monica, California provides administrative support including personnel, financial, public, technology utilization, facilities, limited technical and other support activities to NASA elements on the West Coast.

The NASA Pasadena Office, Pasadena,California was established May 8, 1966, as a component field activity of the NASA Headquarters Office of Space Science and Applications. Staffing was provided by transferring 69 employees from the former Western Operations Office and by absorbing the NASA Resident Office at JPL. The mission of NaPO is to negotiate and administer NASA contracts with the California Institute of Technology for the operation of the Jet Propulsion Laboratory; provide procurement, contract administration, and financial management services for NASA prime contracts for Voyager systems that are assigned to JPL; provide patent and technology utilization services as they relate to prime and subcontracts at JPL; and perform such additional procurement, contract administration and other functions as may be assigned by the Associate Administrator for Space Science and Applications.

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 Reporters Building and a storage area in Virginia, personnel occupy government-owned buildings. The Western Support Office is located at 150 Pico Boulevard, Santa Monica, California. This office occupies a group of leased buildings and there is no government investment in buildings or land at this location. NASA-O Downey is located in government-owned facilities at Downey and Seal Beach, California. The NASA Pasadena Office is physically located at the Jet Propulsion Laboratory in Pasadena, California.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Dollars in Thousands) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Authorized Permanent Positions, end of year..... | 2,592 | 2,611 | 2,611 |
| Administrative Operations..... | $59,877 | $63,761 | $65,172 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

SUMMARY OF APPROPRIATION BUDGET PLANS BY INSTALLATION

(In millions of dollars)

| Installation | Research and Development | | | Construction of Facilities | | | Administrative Operations | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1966 | 1967 | 1968 | 1966 | 1967 | 1968 | 1966 | 1967 | 1968 | 1966 | 1967 | 1968 |
| John F. Kennedy Space Center, NASA.... | 133.7 | 228.0 | 235.6 | 6.9 | 35.8 | 24.9 | 82.0 | 92.7 | 99.6 | 222.6 | 356.5 | 360.1 |
| Manned Spacecraft Center..... | 1,510.6 | 1,411.6 | 1,401.9 | 4.2 | 9.1 | 2.4 | 86.5 | 95.0 | 97.6 | 1,601.3 | 1,515.7 | 1,501.9 |
| Marshall Space Flight Center..... | 1,548.1 | 1,373.1 | 1,437.4 | 2.0 | - | .9 | 128.4 | 127.7 | 126.3 | 1,678.5 | 1,500.8 | 1,564.6 |
| Michoud Assembly Facility..... | - | - | - | .3 | .7 | 2.0 | - | - | - | .3 | .7 | 2.0 |
| Goddard Space Flight Center..... | 351.3 | 375.0 | 438.5 | 2.4 | .7 | .6 | 64.4 | 71.2 | 72.2 | 418.1 | 446.9 | 511.3 |
| Wallops Station..... | 7.5 | 7.7 | 9.3 | 1.0 | .2 | .7 | 9.3 | 10.0 | 10.2 | 17.8 | 17.9 | 20.2 |
| Jet Propulsion Laboratory..... | 223.2 | 213.8 | 236.6 | .9 | .3 | 3.1 | - | - | - | 224.1 | 214.1 | 239.7 |
| Ames Research Center..... | 61.6 | 62.2 | 68.0 | 2.7 | - | 5.4 | 33.2 | 33.7 | 33.9 | 97.5 | 95.9 | 107.3 |
| Electronics Research Center..... | 8.7 | 14.4 | 22.4 | 5.0 | 7.5 | 6.2 | 6.4 | 12.3 | 19.3 | 20.1 | 34.2 | 47.9 |
| Flight Research Center..... | 17.7 | 9.9 | 25.6 | - | - | - | 9.4 | 9.5 | 9.6 | 27.1 | 19.4 | 35.2 |
| Langley Research Center..... | 122.8 | 92.6 | 107.6 | 8.3 | 6.1 | - | 63.5 | 63.3 | 68.3 | 194.6 | 162.0 | 175.9 |
| Lewis Research Center..... | 251.8 | 170.2 | 170.0 | .9 | 16.0 | 2.1 | 66.4 | 66.3 | 67.0 | 319.1 | 252.5 | 239.1 |
| Space Nuclear Propulsion Office..... | 50.4 | 48.0 | 39.3 | - | - | - | 1.8 | 2.0 | 2.1 | 52.2 | 50.0 | 41.4 |
| NASA Headquarters: | | | | | | | | | | | | |
| Headquarters..... | 175.1 | 152.7 | 173.2 | - | - | - | 56.7 | 61.9 | 63.4 | 231.8 | 214.6 | 236.6 |
| Western Support Office..... | 20.5 | 15.9 | 19.1 | - | - | - | 3.2 | 1.9 | 1.8 | 23.7 | 17.8 | 20.9 |
| Various Locations..... | - | - | - | 19.4 | 3.6 | 2.9 | - | - | - | 19.4 | 3.6 | 2.9 |
| Facility Planning and Design..... | - | - | - | 4.2 | 5.0 | 3.0 | - | - | - | 4.2 | 5.0 | 3.0 |
| Total Budget Plan..... | 4,483.0 | 4,175.1 | 4,384.5 | 58.2 | 85.0 | 54.2 | 611.2 | 647.5 | 671.3 | 5,152.4 | 4,907.6 | 5,110.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 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 | JET PROPULSION LABORATORY | WALLOPS STATION | AMES RESEARCH CENTER | ELECTRONICS RESEARCH CENTER | FLIGHT RESEARCH CENTER | LANGLEY RESEARCH CENTER | LEWIS RESEARCH CENTER | SPACE NUCLEAR PROPULSION OFFICE | NASA HEADQUARTERS | WESTERN SUPPORT OFFICE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Office of Manned Space Flight | | | | | | | | | | | | | | | |
| 1966 | 3,199,507 | 128,859 | 1,506,278 | 1,517,982 | 1,986 | - | 200 | 1,721 | - | - | 2,140 | - | - | 36,631 | 3,710 |
| 1967 | 3,024,000 | 224,050 | 1,407,527 | 1,354,141 | 93 | - | - | 125 | - | - | 1,070 | - | - | 36,794 | 200 |
| 1968 | 3,069,200 | 232,200 | 1,392,000 | 1,390,800 | 100 | - | - | - | - | - | - | - | - | 54,100 | - |
| Office of Space Science and Applications | | | | | | | | | | | | | | | |
| 1966 | 759,093 | 4,647 | 18 | 8,500 | 184,181 | 149,767 | 2,050 | 40,414 | 1,335 | 5 | 75,436 | 183,755 | - | 100,201 | 8,784 |
| 1967 | 607,100 | 3,987 | - | 2,295 | 173,373 | 139,675 | 1,148 | 41,493 | 1,715 | 10 | 42,607 | 118,213 | - | 74,659 | 7,925 |
| 1968 | 694,600 | 3,332 | 5,000 | 23,820 | 215,171 | 154,400 | 2,173 | 42,200 | 1,995 | 25 | 49,469 | 110,233 | - | 72,417 | 14,365 |
| Office of Advanced Research and Technology | | | | | | | | | | | | | | | |
| 1966 | 288,596 | 193 | 3,011 | 20,010 | 9,676 | 20,788 | - | 19,454 | 7,325 | 15,828 | 43,431 | 68,023 | 50,431 | 22,432 | 7,994 |
| 1967 | 268,150 | - | 4,040 | 15,910 | 10,166 | 18,344 | - | 20,531 | 12,694 | 8,011 | 46,460 | 51,946 | 47,985 | 24,324 | 7,739 |
| 1968 | 318,000 | 100 | 4,925 | 21,942 | 10,115 | 21,840 | - | 25,788 | 20,375 | 23,590 | 56,095 | 59,770 | 39,350 | 29,410 | 4,700 |
| Office of Tracking and Data Acquisition | | | | | | | | | | | | | | | |
| 1966 | 231,065 | - | 1,271 | 1,627 | 155,425 | 52,629 | 5,300 | - | - | 1,900 | 1,800 | - | - | 11,113 | - |
| 1967 | 270,850 | - | - | 800 | 191,400 | 55,800 | 6,600 | - | - | 1,900 | 2,450 | - | - | 11,900 | - |
| 1968 | 297,700 | - | - | 800 | 213,100 | 60,400 | 7,100 | - | - | 2,000 | 2,000 | - | - | 12,300 | - |
| Office of Technology Utilization and Policy Planning | | | | | | | | | | | | | | | |
| 1966 | 4,750 | - | - | - | - | - | - | - | - | - | - | - | - | 4,750 | - |
| 1967 | 5,000 | - | - | - | - | - | - | - | - | - | - | - | - | 5,000 | - |
| 1968 | 5,000 | - | - | - | - | - | - | - | - | - | - | - | - | 5,000 | - |
| Total Budget Plan | | | | | | | | | | | | | | | |
| 1966 | 4,483,011 | 133,699 | 1,510,578 | 1,548,119 | 351,268 | 223,184 | 7,550 | 61,589 | 8,660 | 17,733 | 122,807 | 251,778 | 50,431 | 175,127 | 20,488 |
| 1967 | 4,175,100 | 228,037 | 1,411,567 | 1,373,146 | 375,032 | 213,819 | 7,748 | 62,149 | 14,409 | 9,921 | 92,587 | 170,159 | 47,985 | 152,677 | 15,864 |
| 1968 | 4,384,500 1/ | 235,632 | 1,401,925 | 1,437,362 | 438,486 | 236,640 | 9,273 | 67,988 | 22,370 | 25,615 | 107,564 | 170,003 | 39,350 | 173,227 | 19,065 |

1/ Includes $60 million unobligated balance available to finance new program plan.

ADMINISTRATIVE OPERATIONS

FISCAL YEAR 1968 ESTIMATES

JET PROPULSION LABORATORY

The Jet Propulsion Laboratory (JPL) is a government-owned facility which is staffed and managed by the California Institute of Technology under contract with NASA. The contract is administered by the NASA Pasadena Office, which is located at the laboratory, but is organizationally a part of NASA Headquarters. Both JPL and the NASA Pasadena Office are responsible to the Associate Administrator for Space Science and Applications.

Personnel and other administrative-type costs associated with the operation of JPL are funded under the Research and Development appropriation, except for the lease and purchase of administrative aircraft and passenger motor vehicles. These costs are included in the Headquarters Administrative Operations budget.

MISSION:

The Jet Propulsion Laboratory (JPL) is engaged in activities associated with the nation's program of space exploration. This work includes:

1. Lunar and deep space automated scientific missions.

2. Project management of complete spacecraft systems.

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

4. Advanced solid propellant and liquid propellant spacecraft engines.

5. Advanced spacecraft guidance and control systems.

6. Integration of advanced propulsion systems into spacecraft.

Research and development programs represent a highly important aspect of the work of JPL. Extensive research in the space sciences is conducted in support of flight projects. Advanced development and experimental engineering investigations are conceived and executed in the areas comprising space flight technology.

JPL designs and tests flight systems including complete spacecraft and also provides technical direction to contractor organizations. Certain components and spacecraft elements are fabricated, assembled, and tested at JPL.

Space flight operations include the control of flight missions and the collection and evaluation of data. Spacecraft tracking, as well as acquisition of data collected by spacecraft, are accomplished through the facilities

of the Deep Space Network (DSN), with all communications and control centered at the Space Flight Operations Facility at JPL.

Some of the work at JPL is closely associated with other NASA facilities and projects. This is particularly true of world-wide tracking facilities of the Deep Space Network, which supports such projects as the Lunar Orbiter and Pioneer managed at the Langley and Ames Research Centers respectively.

DESCRIPTION:

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

At Pasadena, California, the laboratory occupies 171.7 acres of land, 145.9 of which are owned by NASA and 25.8 leased from the city of Pasadena and commercial sources. At Goldstone, California, facilities are located on 40 acres of land occupied under permit from the Army. At Edwards Air Force Base, Muroc, California, facilities are located on 600 acres of land occupied under permit from the Air Force. The Table Mountain, California, facilities are located on 10.5 acres of land occupied under permit from the Forest Service of the Department of Agriculture. The capital investment value as of June 30, 1966, was $126,612,000.

SUMMARY OF RESOURCES REQUIREMENTS:

| | (Dollars in Thousands) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Authorized Permanent Positions, end of year | 4,400 | 4,650 | 4,650 |
| Administrative Type Cost | $63,647 | $76,663 | $81,355 |

## FISCAL YEAR 1968 ESTIMATES

## CONSOLIDATED STATEMENT

## ON THE AERONAUTICS PROGRAM

Even though the funding shown in the NASA Research and Development budget for the Aeronautics program has increased in FY 1968 by almost 100% over FY 1967, the program shown does not totally reflect the level of effort being conducted. The strong, in-house capability of NASA exemplified by major wind tunnel complexes, operational research aircraft, and extensive flight simulation facilities, operated by government personnel, is being utilized in the conduct of an aggressive aeronautics support program. The magnitude of the total NASA aeronautics research effort, therefore, must consider the portion of the Administrative Operations appropriation which supports aeronautics projects. In addition, the cost of related Construction of Facilities projects should be considered. In addition to the above funding, a considerable amount of work performed in other NASA Research and Technology activities is of indirect or potential benefit to aeronautics. An estimate of this work is shown below as "Other NASA Supporting Research and Technology Applicable to Aeronautics".

| | (Dollars in Millions) | | |
|---|---|---|---|
| | 1966 | 1967 | 1968 |
| Research and development | $41.5 | $35.9 | $66.8 |
| Construction of facilities | .7 | 21.0 | 3.2 |
| Administrative operations | 38.2 | 46.5 | 49.6 |
| Sub-Total | 80.4 | 103.4 | 119.6 |
| Other NASA supporting research and technology applicable to aeronautics | 30.0 | 30.0 | 30.0 |
| Total | $110.4 | $133.4 | $149.6 |
| Number of direct personnel engaged in aeronautics research and development effort | 1,775 | 2,065 | 2,147 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

SUPPORTING RESEARCH AND TECHNOLOGY
(Thousands of dollars)

| | Fiscal Year 1966 | Fiscal Year 1967 | Fiscal Year 1968 |
|---|---|---|---|
| OFFICE OF MANNED SPACE FLIGHT.... | $31,400 | $27,000 | $32,000 |
| Apollo supporting development.. | 31,400 | 27,000 | 32,000 |
| OFFICE OF SPACE SCIENCE AND APPLICATIONS..... | $69,533 | $67,980 | $75,700 |
| Physics and astronomy..... | 20,594 | 19,900 | 19,900 |
| Lunar and planetary exploration | 23,000 | 20,900 | 20,900 |
| Bioscience..... | 11,100 | 11,550 | 14,300 |
| Space applications..... | 10,839 | 11,630 | 16,600 |
| Launch vehicle development..... | 4,000 | 4,000 | --- |
| Launch vehicle procurement..... | --- | --- | 4,000 |
| OFFICE OF ADVANCED RESEARCH AND TECHNOLOGY..... | $193,278 | $185,738 | $218,500 |
| Basic research..... | 22,000 | 21,465 | 23,500 |
| Space vehicle systems..... | 26,450 | 26,635 | 29,000 |
| Electronics systems..... | 29,848 | 31,797 | 39,200 |
| Human factor systems..... | 13,000 | 14,675 | 19,500 |
| Nuclear rockets..... | 20,644 | 16,506 | 16,500 |
| Chemical propulsion..... | 32,950 | 30,138 | 38,000 |
| Aeronautics..... | 10,186 | 9,582 | 18,600 |
| Space power and electric propulsion systems..... | 38,200 | 34,940 | 34,200 |
| OFFICE OF TRACKING AND DATA ACQUISITION..... | $13,800 | $13,800 | $13,800 |
| GRAND TOTAL..... | $308,011 | $294,518 | $340,000 |

# SPECIAL ANALYSIS

## AUTOMATIC
## DATA PROCESSING
## EQUIPMENT

BUDGET ESTIMATES FY 1968

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1968 ESTIMATES

AUTOMATIC DATA PROCESSING EQUIPMENT

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Automatic Data Processing Equipment
General Statement

The utilization of computers within NASA is increasing, as it is with all other agencies of the Federal Government. In NASA, computers are used primarily as an essential tool for conduct of our research and our missions. As such, computer applications are intimately involved in all aspects of NASA's programs. As one of the larger users of computers in the Federal Government, NASA is continuing to expend an appreciable portion of its budget for this use. Our missions and programs are becoming more complex, and the requirements for accuracy and size of calculations are getting even higher, thus requiring faster, larger computers. To manage such an effort on an agency-wide basis is a tremendous task and one that must be approached with caution in order not to inhibit the application of these devices. It is necessary to give some explanation of the techniques NASA uses to manage this growing program, followed by information on requirements, costs and management planning.

Figure 1 illustrates the approach that we have taken in managing ADP resources. In July of 1965, new management procedures for automatic data processing equipment were issued as NASA Handbook 2410.1. The Handbook spells out the policies and responsibilities for ADP management down to the center level, along with the reporting and controls that are applied at all levels. The annual planning report, described in Chapter 2 of the Handbook, provides documentation on requirements, equipment actions, personnel statistics, facilities, and future trends. This report provides all levels of management with necessary knowledge of ADP resources and also furnishes a blueprint for future action. Chapter 3 gives procedures for a formalized acquisition document that is prepared on all equipment actions. This document includes the feasibility studies required by BOB, the procurement methods, the implementation schedules and costs, and is the formal management document for approval to acquire ADP equipment. Finally, Chapter 4 of the Handbook specifies guidelines for selection, acquisition and utilization of automatic data processing equipment in NASA. This section lists the various reviews of utilization that are made, emphasizes the need for competition in procuring computers, and specifies the reporting that is made by the Centers.

The responsibilities as outlined in the Handbook are reflected in Figure 2. The Office of the Administrator has the final responsibility for policy and approval of Automatic Data Processing Equipment (ADPE) plans. The Office of Tracking and Data Acquisition (OTDA) has the responsibility for recommending ADP plans, coordinating requirements from the various institutional offices, reviewing and coordinating ADP utilization, and cooperating with other agencies. The institutional offices, as the regular line management, have the responsibility of reviewing and approving ADP requirements from their Centers, budgeting for approved ADP plans and, of course, managing



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their ADP resources. The field installations have responsibilities for determining their requirements, acquiring approved equipment, establishing local control procedures for utilization, and preparing and submitting reports as specified.

In preparing these procedures, it was recognized that computers are being utilized in many different ways. The main use has been in the major computational facilities of NASA Centers. However, computers are being used increasingly for other purposes. This use is concerned with control of physical systems, which has only become economical as equipment costs have been reduced. Some examples are the real time telemetry processing computers, process control computers, and the automatic checkout computers. Accordingly, management procedures were divided into two major categories.

Figure 3 is an explanation of these categories. Category A covers the commonly known, general purpose computational facilities that include the large centralized facilities within NASA. The right side of Figure 3 lists the Category B, or special purpose uses of computers which are an integral control element of an overall system and cannot easily be utilized by any other user. For Category A equipments, the objective is to get optimum utilization and this is where major management effort is concentrated. Therefore, the Category A equipment is centrally managed and acquisitions require approval at the Administrator's level. For Category B, where equipments cannot be separated from the overall systems in which they are installed, the level of documentation and reporting that is necessary for Category A is not required. This equipment is categorized at the OTDA level, but after categorization action, all management, including procurement, is the responsibility of the program offices. However, the Category B inventory must be reported in the Annual Plan each year and OTDA must be notified if there is a change in use of the equipment so that categorization can be reconsidered.

In order to break down our requirements into meaningful use types, five areas have been identified in the Category A equipments and six within the Category B as shown in Figure 4. For Category A, these are: (a) mission control, which includes not only the active mission control centers but also the mission analysis that supports these centers; (b) the scientific and engineering area, which includes all the research calculations, engineering computations and detailed analysis of scientific data; (c) the data reduction area which includes the processing necessary to get data into a usable form for the experimenter but does not include the detailed analysis which is included in the scientific and engineering area; (d) the administrative area, which covers both business data processing and engineering support data processing, such as master configuration lists for our large systems; and finally (e) the simulation area, which covers that part of digital data processing that actually replaces analog simulation functions. Simulation of entire networks for mission control purposes has been included in the mission control figures. On the Category B side, the requirements are listed by major overall systems in which computers are utilized. These include the tracking networks, the automatic checkout function, mission control support, test data acquisition systems and communications processors.

As shown above, the management of Category A and B computers differs considerably. Therefore, it is necessary to discuss their requirements separately. Since Category A equipments represent the general purpose facilities in NASA and the larger share of costs, these will be discussed first.

## ADP Requirements

### Category A

Figure 5 shows the overall Category A requirements for FY 1965-68, broken down into the various application areas that were explained previously. FY 1965 and 1966 are actual figures while FY 1967 and 1968 are projections. The figures are given as percentages of the 1965 workload. The charts give an appreciation of the growth in workload that has been encountered during this period. It can be seen that NASA's requirements for ADP are beginning to indicate a slowdown in rate of increase. Primarily, this slowdown can be attributed to the actual program oriented functions nearing operational readiness. For example, mission control had a very rapid buildup in order to acquire a capability for Gemini, Apollo, and the Deep Space projects. However, with the completion of Gemini and expected completion of the Surveyor and Oribter projects, 1968 mission control requirements are expected to level off. Although data reduction requirements have increased, improvements in equipment and techniques permit greater amounts of data to be handled for a given period of computer utilization. As a result computer utilization for data reduction is leveling off.

The only major increase in our requirements for 1968 is for scientific and engineering calculations. This increase in workload is attributable to these factors:

1. Increasing knowledge of the techniques for mathematical analysis and computation.

2. Increasing experience of the scientific community in the use of ADP.

3. A large amount of scientific data available for analysis and possible application to future programs.

4. The formulation of highly complex mathematical models for design, research, simulation, etc.

5. The increased capability of the newer machines to process very large mathematical calculations, thus opening many fields for research not feasible before.

The use of computers for simulation is increasing but at the present time is primarily involved with combinations of analog and digital computers. NASA feels, however, that digital computers will be utilized more and more in place of analog computers and is sponsoring some research in this effort. In the business applications area, NASA is experiencing a constant steady growth and will continue to do so for some time. It is becoming increasingly important to our managers to have proper management information techniques available for their use. In addition, the increased complexity of our spacecraft and vehicles has imposed a heavy workload for configuration control.

Category B

Figure 6 shows the computer requirements for the Category B uses within NASA. These are broken out into the various application areas, as explained earlier. It must be mentioned here that the scale for this chart is in dollars. We have found it impossible to assign capacity as a measure, since these computers are totally imbedded in the implementation systems. It is evident that we are indeed slowing down in application of computers for these types of uses. This is occasioned by the nearly complete implementation of many of our instrumentation facilities. In FY 1968 our tracking networks will be heavily operational and there will be few additional requirements that must be met, although there may be some capacity increases by addition of peripherals and/or memory to existing computers. In fact, all the systems except for test data acquisition and the miscellaneous category will be operational by 1968 so that major expansions will not be required. This does not mean that there will not be many new applications but the overall dollar cost will be small since the majority of the computers utilized for Category B are small computers with a low cost.

## Overall ADP Funding

Automatic Data Processing Equipment (ADPE) is such an integral part of NASA's mission that it is found in all elements of our projects and operations. Because of this, ADPE costs are being funded from all three sources of appropriations in NASA. A one line summary of total hardware costs is shown for reference purposes (in thousands):

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| ADPE Costs..... | $80,570 | $79,717 | $73,902 |

In Figures 7, 8, and 9 these same costs are shown first by appropriations, second by category, and finally by lease, purchase and maintenace. As shown, although there are variations within appropriations, overall costs are tending to remain fairly stable over the three years with small declines in FY 1967 and FY 1968. It should be noted that the rise in maintenance costs is caused by our growing capital investment in computers. In our capital investment program, we have phase-funded major procurements through the AO appropriation by exercising options in subsequent years as the equipment becomes available.

This means that for subsequent years we will have continuing investments in third generation systems.

The requirements for ADP in NASA have been discussed and the growth picture was shown by Figures 5 and 6. Although our requirements have steadily increased we now have trends showing leveling off in 1968. NASA believes that accommodating the large increase in ADP requirements shown on Figures 5 and 6 without drastic changes in overall ADPE costs is a major accomplishment and the following factors enabled us to achieve this success:

1. The large procurements in FY 1965.

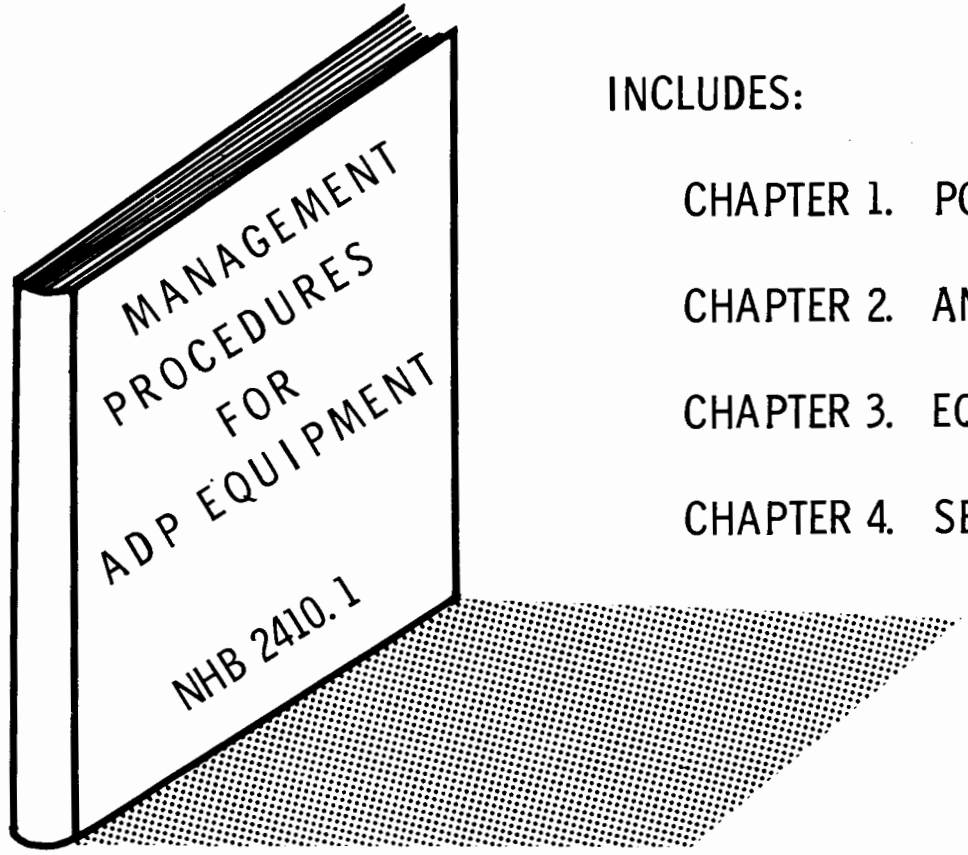
2. The improved cost-per-computation ratio of the newer ADP systems.

3. Centralization of major computational facilities at the Field Centers, thus eliminating many computers with low economic payoff.

4. Better management at the Field Centers that results in higher utilization of our capabilities.

5. Increased sharing of both equipment and software.

# MANAGEMENT PROCEDURES FOR ADP EQUIPMENT (NHB 2410.1)




INCLUDES:

CHAPTER 1. POLICY AND RESPONSIBILITY

CHAPTER 2. ANNUAL ADP PLANNING DOCUMENT

CHAPTER 3. EQUIPMENT ACQUISITION PLANS

CHAPTER 4. SELECTION, ACQUISITION, AND UTILIZATION GUIDELINES

FIGURE 1

# NASA AUTOMATIC DATA PROCESSING (ADP) RESPONSIBILITIES

| | |
|---|---|
| • OFFICE OF ADMINISTRATOR | • POLICY & FINAL APPROVAL OF PLANS |
| • OFFICE OF TRACKING & DATA ACQUISITION | • RECOMMEND AGENCY-WIDE ANNUAL PLAN<br>• COORDINATE REQUIREMENTS<br>• REVIEW AND EVALUATE ADP UTILIZATION<br>• COOPERATION WITH OTHER AGENCIES |
| • INSTITUTIONAL AND PROGRAM DIRECTORS | • REVIEW AND APPROVE REQUIREMENTS<br>• BUDGET FOR APPROVED PLANS<br>• MANAGE THEIR ADP RESOURCES |
| • FIELD INSTALLATIONS | • DETERMINE REQUIREMENTS<br>• ACQUIRE APPROVED EQUIPMENT<br>• ESTABLISH LOCAL UTILIZATION CONTROL PROCEDURES<br>• PREPARE AND SUBMIT SPECIFIED REPORTS (UTILIZATION, ACQUISITION, DISPOSITION) |

FIGURE 2

# ADPE MANAGEMENT CATEGORIES

| CATEGORY A<br>GENERAL PURPOSE | CATEGORY B<br>SPECIAL PURPOSE |
|---|---|
| • STAND ALONE SYSTEM | • INTEGRATED INTO SYSTEM |
| • OPEN USAGE | • DEDICATED TO SPECIFIC SYSTEM |
| • GENERAL PURPOSE PERIPHERALS | • SPECIAL PROJECT INTERFACE REQUIREMENTS |
| • CLOSELY CONTROLLED PRODUCTION | • USAGE DEPENDENT ON SYSTEM USAGE |
| • HIGH USAGE RATES | • PROJECT MANAGED |
| • CENTRALLY MANAGED | |

FIGURE 3

# REQUIREMENTS BY USE TYPE

| CATEGORY A | CATEGORY B |
| --- | --- |
| • MISSION CONTROL | • TRACKING |
| • SCIENTIFIC AND ENGINEERING | • AUTOMATIC CHECKOUT |
| • DATA REDUCTION | • MISSION CONTROL SUPPORT |
| • SUPPORT AND ADMINISTRATIVE | • TEST DATA ACQUISITION |
| • SIMULATION | • COMMUNICATIONS PROCESSING |
| | • OTHERS |

FIGURE 4

FIGURE 5

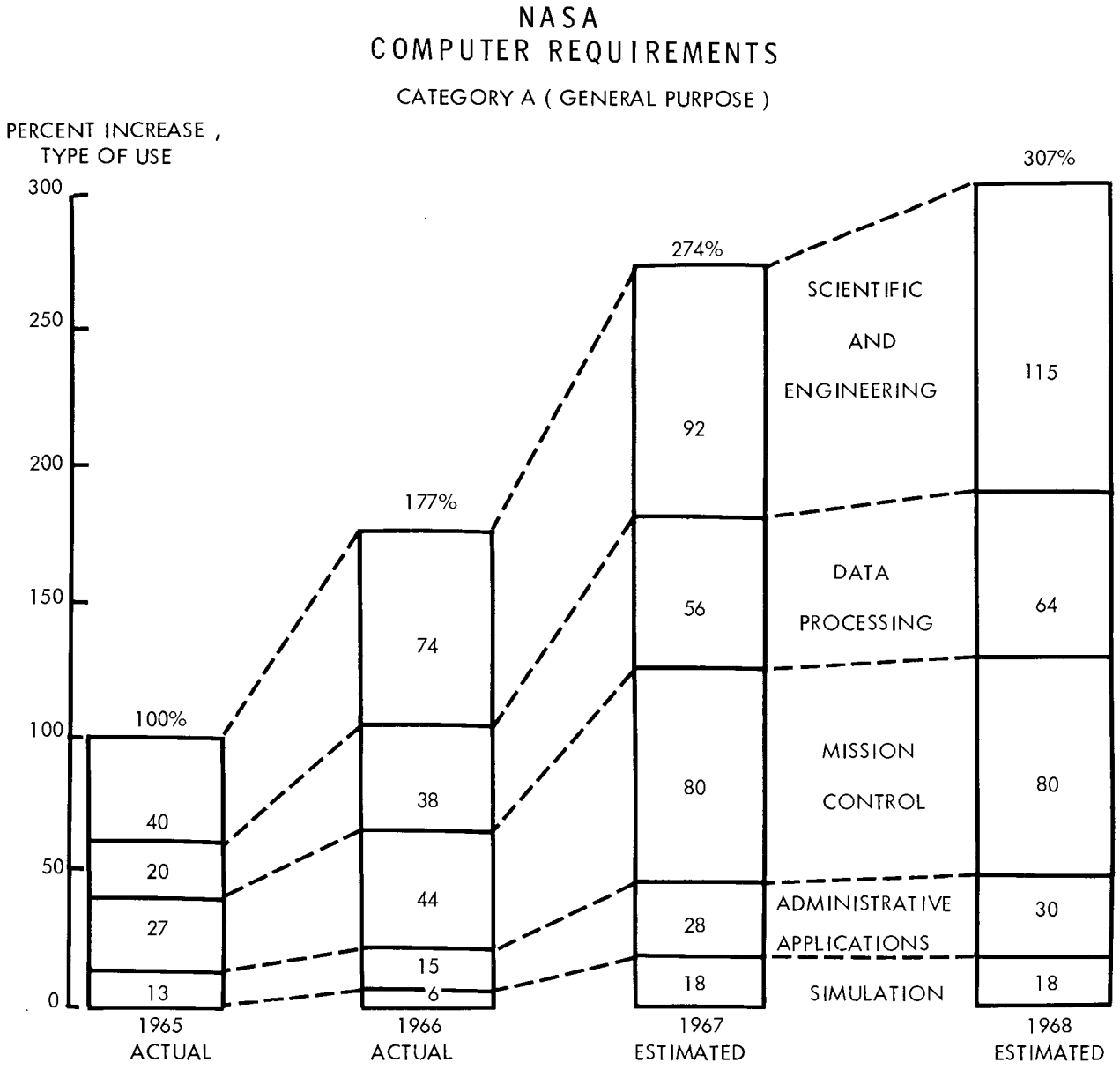



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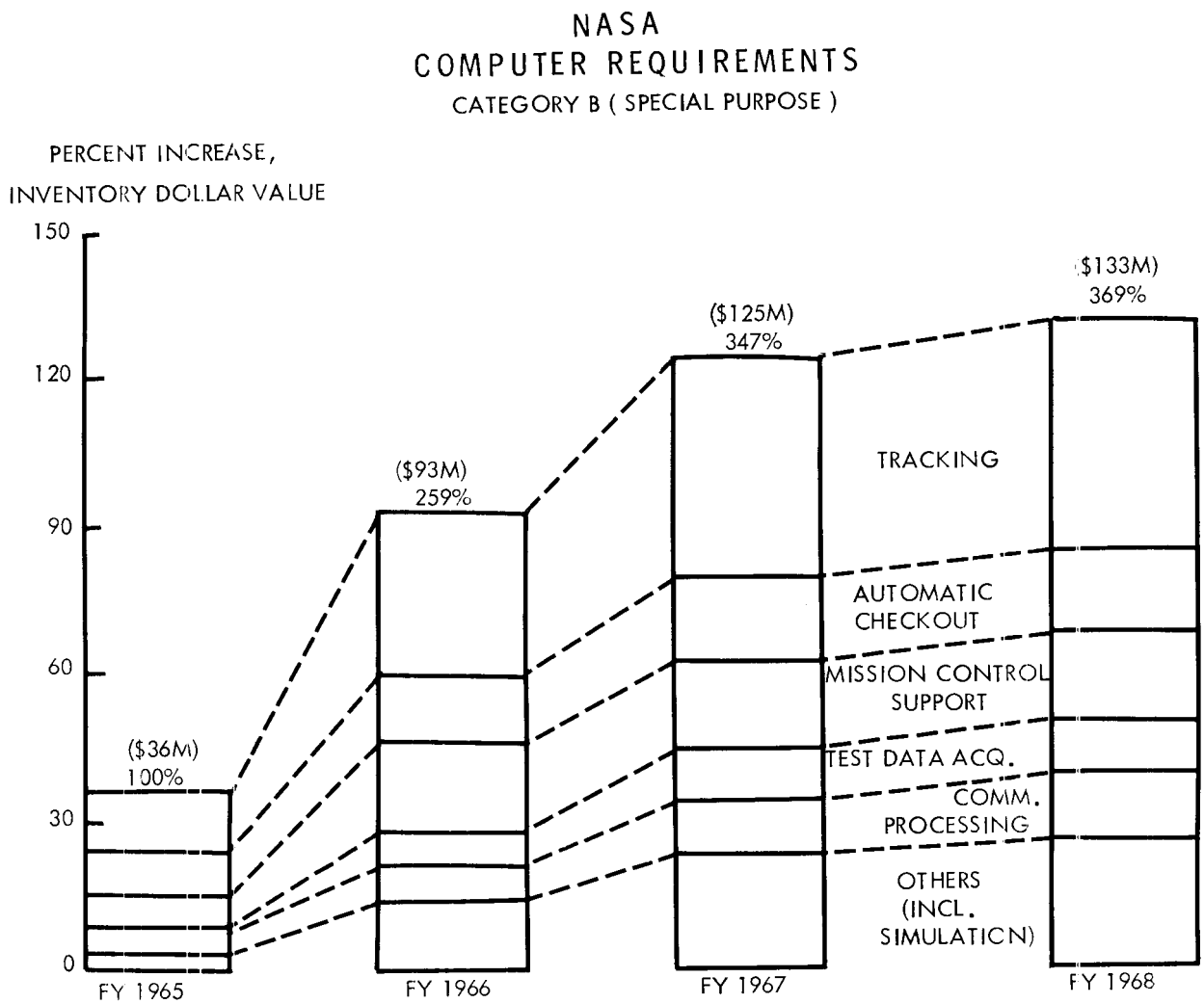
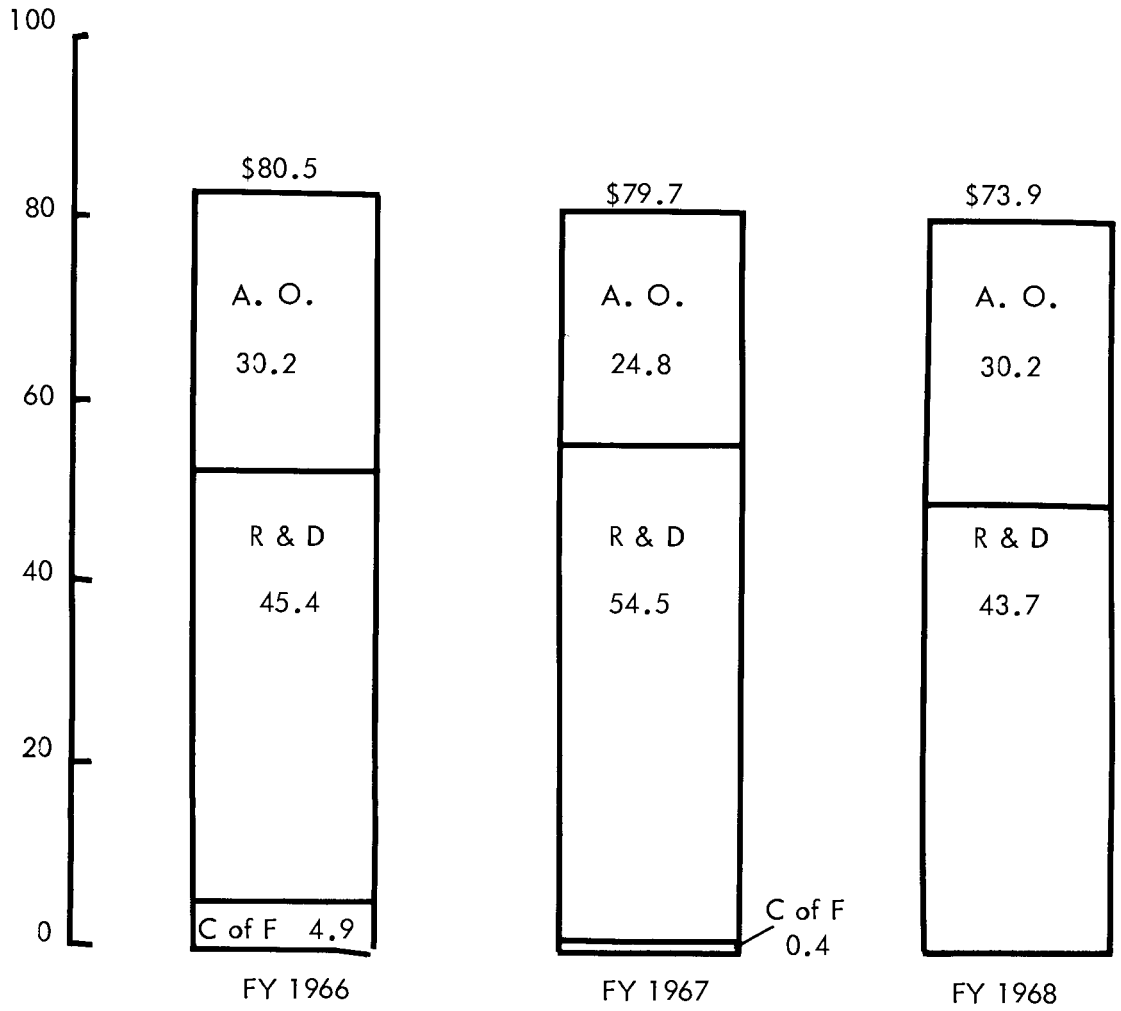
FIGURE 6




SA 19

FIGURE 7

# NASA
## SUMMARY OF ADP COSTS BY APPROPRIATION
( INCLUDES LEASE - MAINTENANCE - PURCHASE COSTS )




SA 20

FIGURE 8

# NASA
## SUMMARY OF ADP COSTS BY CATEGORY

( INCLUDES LEASE-MAINTENANCE-PURCHASE COSTS )

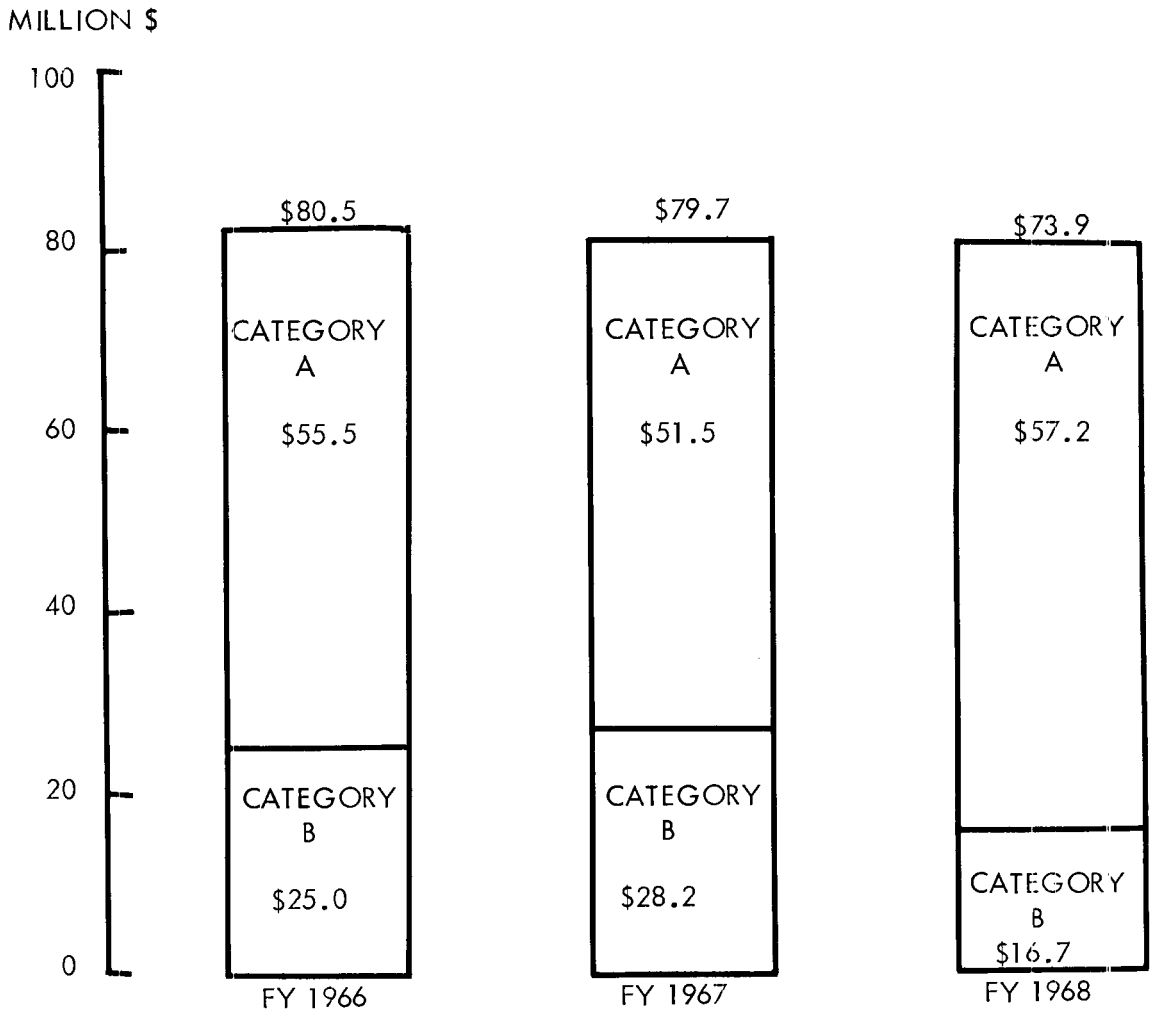
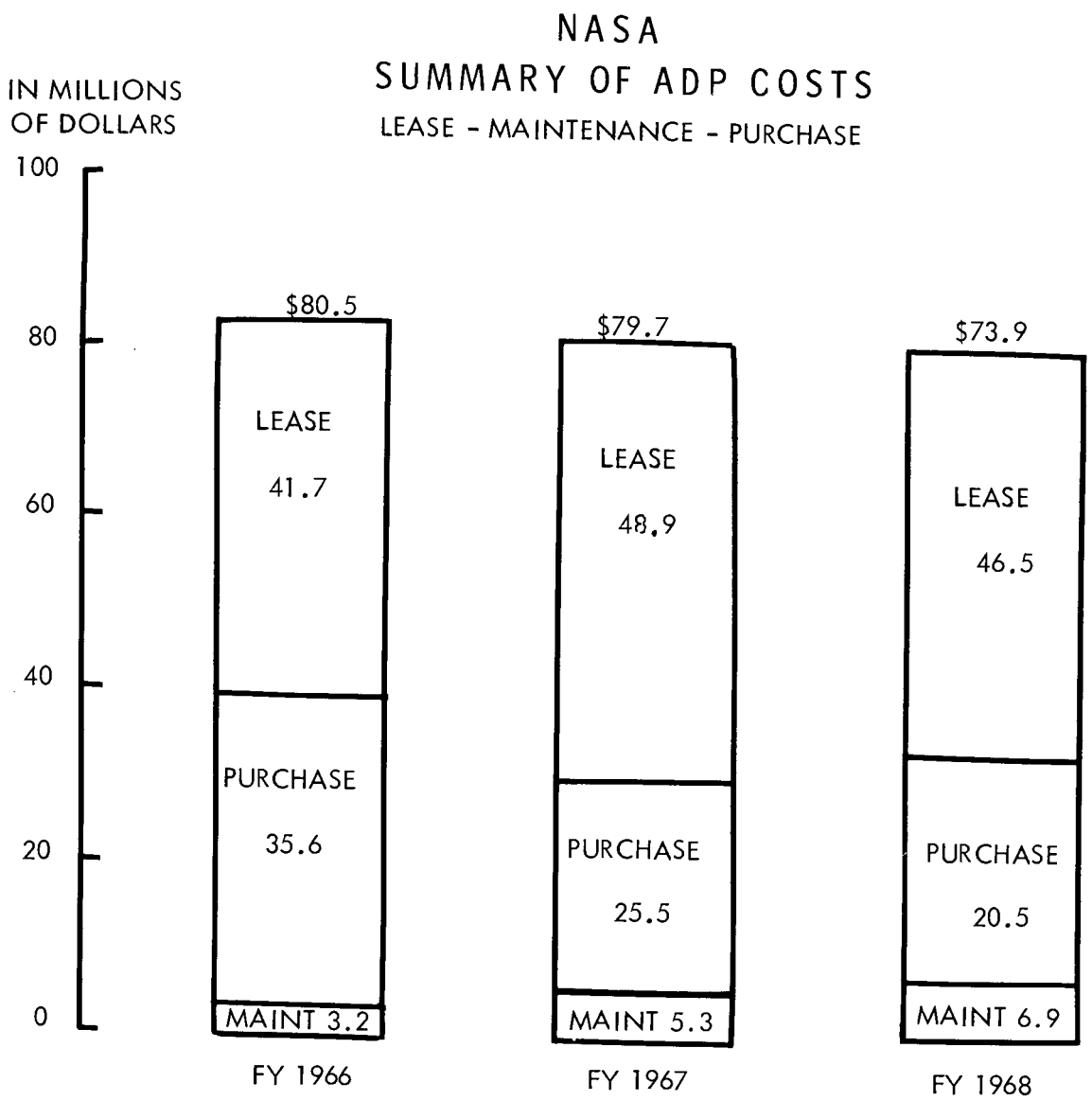


FIGURE 9

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Summary of Automatic Data Processing Requirements

FY 1966 - FY 1968

(In Thousands of Dollars)

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| Ames Research Center | 2,961 | 4,000 | 3,448 |
| Electronics Research Center | 45 | 436 | 1,998 |
| Flight Research Center | 281 | 107 | 371 |
| Goddard Space Flight Center | 15,377 | 19,312 | 18,094 |
| Headquarters | 278 | 203 | 159 |
| Jet Propulsion Laboratory | 8,200 | 12,725 | 10,548 |
| Kennedy Space Center | 5,209 | 2,080 | 4,045 |
| Langley Research Center | 8,388 | 6,435 | 8,494 |
| Lewis Research Center | 2,552 | 278 | 206 |
| Manned Spacecraft Center | 25,782 | 23,064 | 16,169 |
| Marshall Space Flight Center | 10,734 | 10,230 | 9,808 |
| Space Nuclear Propulsion Office | 168 | 360 | 360 |
| Wallops Station | 595 | 487 | 202 |
| Total | 80,570 | 79,717 | 73,902 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Analysis of Automatic Data Processing Equipment

FY 1966 - Summary (Categories A & B)

(In Thousands of Dollars)

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Research and Development** | | | | |
| Ames Research Center | 340 | 62 | 79 | 481 |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | 161 | 3 | 20 | 184 |
| Goddard Space Flight Center | 7,534 | 16 | 1,184 | 8,734 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | 4,848 | 2,751 | 601 | 8,200 |
| Kennedy Space Center | 136 | 385 | 60 | 581 |
| Langley Research Center | --- | 27 | --- | 27 |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | 6,815 | 13,123 | 179 | 20,117 |
| Marshall Space Flight Center | 1,136 | 5,247 | 24 | 6,407 |
| Space Nuclear Propulsion Office | --- | 168 | --- | 168 |
| Wallops Station | 509 | --- | --- | 509 |
| Total, R&D | 21,479 | 21,782 | 2,147 | 45,408 |
| **Administrative Operations** | | | | |
| Ames Research Center | 874 | 1,575 | 31 | 2,480 |
| Electronics Research Center | 27 | 15 | 3 | 45 |
| Flight Research Center | 2 | 72 | 23 | 97 |
| Goddard Space Flight Center | 161 | 5,160 | 114 | 5,435 |
| Headquarters | 165 | 90 | 23 | 278 |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | 1 | 947 | --- | 948 |
| Langley Research Center | 5,460 | 2,849 | 52 | 8,361 |
| Lewis Research Center | 2,163 | 321 | 68 | 2,552 |
| Manned Spacecraft Center | 403 | 4,974 | 288 | 5,665 |
| Marshall Space Flight Center | 33 | 3,898 | 396 | 4,327 |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | 63 | 23 | 86 |
| Total, AO | 9,289 | 19,964 | 1,021 | 30,274 |

FY 1966 Summary (Categories A & B) Cont'd

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Construction of Facilities** | | | | |
| Ames Research Center | --- | --- | --- | --- |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | 1,208 | --- | --- | 1,208 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | 3,680 | --- | --- | 3,680 |
| Langley Research Center | --- | --- | --- | --- |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | --- | --- | --- | --- |
| Marshall Space Flight Center | --- | --- | --- | --- |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | --- | --- | --- |
| Total, CoF | 4,888 | --- | --- | 4,888 |
| **SUMMARY ALL APPROPRIATIONS** | | | | |
| Ames Research Center | 1,214 | 1,637 | 110 | 2,961 |
| Electronics Research Center | 27 | 15 | 3 | 45 |
| Flight Research Center | 163 | 75 | 43 | 281 |
| Goddard Space Flight Center | 8,903 | 5,176 | 1,298 | 15,377 |
| Headquarters | 165 | 90 | 23 | 278 |
| Jet Propulsion Laboratory | 4,848 | 2,751 | 601 | 8,200 |
| Kennedy Space Center | 3,817 | 1,332 | 60 | 5,209 |
| Langley Research Center | 5,460 | 2,876 | 52 | 8,388 |
| Lewis Research Center | 2,163 | 321 | 68 | 2,552 |
| Manned Spacecraft Center | 7,218 | 18,097 | 467 | 25,782 |
| Marshall Space Flight Center | 1,169 | 9,145 | 420 | 10,734 |
| Space Nuclear Propulsion Office | --- | 168 | --- | 168 |
| Wallops Station | 509 | 63 | 23 | 595 |
| Total | 35,656 | 41,746 | 3,168 | 80,570 |



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Analysis of Automatic Data Processing Equipment

FY 1967 - Summary (Categories A & B)

(In Thousands of Dollars)

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Research and Development** | | | | |
| Ames Research Center | 2,196 | 107 | 107 | 2,410 |
| Electronics Research Center | 165 | --- | --- | 165 |
| Flight Research Center | --- | 48 | 36 | 84 |
| Goddard Space Flight Center | 11,077 | 16 | 1,997 | 13,090 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | 5,972 | 5,762 | 991 | 12,725 |
| Kennedy Space Center | --- | 450 | 300 | 750 |
| Langley Research Center | 260 | 152 | 2 | 414 |
| Lewis Research Center | --- | --- | 3 | 3 |
| Manned Spacecraft Center | 2,150 | 15,798 | 232 | 18,180 |
| Marshall Space Flight Center | --- | 5,878 | 58 | 5,936 |
| Space Nuclear Propulsion Office | --- | 360 | --- | 360 |
| Wallops Station | 369 | 11 | 77 | 457 |
| Total, R&D | 22,189 | 28,582 | 3,803 | 54,574 |
| **Administrative Operations** | | | | |
| Ames Research Center | --- | 1,536 | 54 | 1,590 |
| Electronics Research Center | 35 | 236 | --- | 271 |
| Flight Research Center | 4 | --- | 19 | 23 |
| Goddard Space Flight Center | --- | 5,987 | 235 | 6,222 |
| Headquarters | --- | 175 | 28 | 203 |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | --- | 1,330 | --- | 1,330 |
| Langley Research Center | 2,835 | 2,603 | 223 | 5,661 |
| Lewis Research Center | --- | 184 | 91 | 275 |
| Manned Spacecraft Center | --- | 4,397 | 487 | 4,884 |
| Marshall Space Flight Center | 28 | 3,864 | 402 | 4,294 |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | 30 | --- | 30 |
| Total, AO | 2,902 | 20,342 | 1,539 | 24,783 |

FY 1967 Summary (Categories A & B) Cont'd

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Construction of Facilities** | | | | |
| Ames Research Center | --- | --- | --- | --- |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | --- | --- | --- | --- |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | 360 | --- | --- | 360 |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | --- | --- | --- | --- |
| Marshall Space Flight Center | --- | --- | --- | --- |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | --- | --- | --- |
| Total, CoF | 360 | --- | --- | 360 |
| **SUMMARY ALL APPROPRIATIONS** | | | | |
| Ames Research Center | 2,196 | 1,643 | 161 | 4,000 |
| Electronics Research Center | 200 | 236 | --- | 436 |
| Flight Research Center | 4 | 48 | 55 | 107 |
| Goddard Space Flight Center | 11,077 | 6,003 | 2,232 | 19,312 |
| Headquarters | --- | 175 | 28 | 203 |
| Jet Propulsion Laboratory | 5,972 | 5,762 | 991 | 12,725 |
| Kennedy Space Center | --- | 1,780 | 300 | 2,080 |
| Langley Research Center | 3,455 | 2,755 | 225 | 6,435 |
| Lewis Research Center | --- | 184 | 94 | 278 |
| Manned Spacecraft Center | 2,150 | 20,195 | 719 | 23,064 |
| Marshall Space Flight Center | 28 | 9,742 | 460 | 10,230 |
| Space Nuclear Propulsion Office | --- | 360 | --- | 360 |
| Wallops Station | 369 | 41 | 77 | 487 |
| Total | 25,451 | 48,924 | 5,342 | 79,717 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Analysis of Automatic Data Processing Equipment

FY 1968 - Summary (Categories A & B)

(In Thousands of Dollars)

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Research and Development** | | | | |
| Ames Research Center | 1,450 | 38 | 160 | 1,648 |
| Electronics Research Center | 400 | --- | --- | 400 |
| Flight Research Center | 250 | 56 | 41 | 347 |
| Goddard Space Flight Center | 7,608 | 16 | 2,844 | 10,468 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | 3,138 | 6,221 | 1,189 | 10,548 |
| Kennedy Space Center | 2,048 | 214 | 441 | 2,703 |
| Langley Research Center | --- | 152 | 13 | 165 |
| Lewis Research Center | --- | --- | 12 | 12 |
| Manned Spacecraft Center | 300 | 10,940 | 132 | 11,372 |
| Marshall Space Flight Center | --- | 5,450 | 75 | 5,525 |
| Space Nuclear Propulsion Office | --- | 360 | --- | 360 |
| Wallops Station | --- | 80 | 82 | 162 |
| Total, R&D | 15,194 | 23,527 | 4,989 | 43,710 |
| **Administrative Operations** | | | | |
| Ames Research Center | --- | 1,744 | 56 | 1,800 |
| Electronics Research Center | 645 | 908 | 45 | 1,598 |
| Flight Research Center | 5 | --- | 19 | 24 |
| Goddard Space Flight Center | --- | 7,282 | 344 | 7,626 |
| Headquarters | --- | 131 | 28 | 159 |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | --- | 1,342 | --- | 1,342 |
| Langley Research Center | 4,627 | 3,300 | 402 | 8,329 |
| Lewis Research Center | --- | 77 | 117 | 194 |
| Manned Spacecraft Center | --- | 4,337 | 460 | 4,797 |
| Marshall Space Flight Center | 26 | 3,855 | 402 | 4,283 |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | 40 | --- | 40 |
| Total, AO | 5,303 | 23,016 | 1,873 | 30,192 |

FY 1968 Summary (Categories A & B) Cont'd

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Construction of Facilities** | | | | |
| Ames Research Center | --- | --- | --- | --- |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | --- | --- | --- | --- |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | --- | --- | --- | --- |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | --- | --- | --- | --- |
| Marshall Space Flight Center | --- | --- | --- | --- |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | --- | --- | --- |
| Total, CoF | --- | --- | --- | --- |
| **SUMMARY ALL APPROPRIATIONS** | | | | |
| Ames Research Center | 1,450 | 1,782 | 216 | 3,448 |
| Electronics Research Center | 1,045 | 908 | 45 | 1,998 |
| Flight Research Center | 255 | 56 | 60 | 371 |
| Goddard Space Flight Center | 7,608 | 7,298 | 3,188 | 18,094 |
| Headquarters | --- | 131 | 28 | 159 |
| Jet Propulsion Laboratory | 3,138 | 6,221 | 1,189 | 10,548 |
| Kennedy Space Center | 2,048 | 1,556 | 441 | 4,045 |
| Langley Research Center | 4,627 | 3,452 | 415 | 8,494 |
| Lewis Research Center | --- | 77 | 129 | 206 |
| Manned Spacecraft Center | 300 | 15,277 | 592 | 16,169 |
| Marshall Space Flight Center | 26 | 9,305 | 477 | 9,808 |
| Space Nuclear Propulsion Office | --- | 360 | --- | 360 |
| Wallops Station | --- | 120 | 82 | 202 |
| Total | 20,497 | 46,543 | 6,862 | 73,902 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Analysis of Automatic Data Processing Equipment

FY 1966 Category A (General Purpose Use)

(In Thousands of Dollars)

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Research and Development** | | | | |
| Ames Research Center | --- | 53 | 6 | 59 |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | 59 | --- | 304 | 363 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | 161 | 2,641 | 402 | 3,204 |
| Kennedy Space Center | 136 | 385 | 60 | 581 |
| Langley Research Center | --- | 27 | --- | 27 |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | 13 | 11,335 | --- | 11,348 |
| Marshall Space Flight Center | 1,136 | 5,020 | 19 | 6,175 |
| Space Nuclear Propulsion Office | --- | 168 | --- | 168 |
| Wallops Station | 334 | --- | --- | 334 |
| Total, R&D | 1,839 | 19,629 | 791 | 22,259 |
| **Administrative Operations** | | | | |
| Ames Research Center | 874 | 1,575 | 31 | 2,480 |
| Electronics Research Center | 27 | 15 | 3 | 45 |
| Flight Research Center | 2 | 72 | 23 | 97 |
| Goddard Space Flight Center | 161 | 4,502 | 86 | 4,749 |
| Headquarters | 165 | 90 | 23 | 278 |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | 1 | 947 | --- | 948 |
| Langley Research Center | 5,460 | 2,849 | 52 | 8,361 |
| Lewis Research Center | 2,163 | 321 | 68 | 2,552 |
| Manned Spacecraft Center | 403 | 4,974 | 288 | 5,665 |
| Marshall Space Flight Center | 33 | 3,898 | 396 | 4,327 |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | 63 | 23 | 86 |
| Total, AO | 9,289 | 19,306 | 993 | 29,588 |

FY 1966 Category A (General Purpose Use) Cont'd

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Construction of Facilities** | | | | |
| Ames Research Center | --- | --- | --- | --- |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | --- | --- | --- | --- |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | 3,680 | --- | --- | 3,680 |
| Langley Research Center | --- | --- | --- | --- |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | --- | --- | --- | --- |
| Marshall Space Flight Center | --- | --- | --- | --- |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | --- | --- | --- |
| Total, CoF | 3,680 | --- | --- | 3,680 |
| **SUMMARY ALL APPROPRIATIONS** | | | | |
| Ames Research Center | 874 | 1,628 | 37 | 2,539 |
| Electronics Research Center | 27 | 15 | 3 | 45 |
| Flight Research Center | 2 | 72 | 23 | 97 |
| Goddard Space Flight Center | 220 | 4,502 | 390 | 5,112 |
| Headquarters | 165 | 90 | 23 | 278 |
| Jet Propulsion Laboratory | 161 | 2,641 | 402 | 3,204 |
| Kennedy Space Center | 3,817 | 1,332 | 60 | 5,209 |
| Langley Research Center | 5,460 | 2,876 | 52 | 8,388 |
| Lewis Research Center | 2,163 | 321 | 68 | 2,552 |
| Manned Spacecraft Center | 416 | 16,309 | 288 | 17,013 |
| Marshall Space Flight Center | 1,169 | 8,918 | 415 | 10,502 |
| Space Nuclear Propulsion Office | --- | 168 | --- | 168 |
| Wallops Station | 334 | 63 | 23 | 420 |
| Total | 14,808 | 38,935 | 1,784 | 55,527 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Analysis of Automatic Data Processing Equipment

FY 1967 Category A (General Purpose Use)

(In Thousands of Dollars)

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Research and Development** | | | | |
| Ames Research Center | 51 | 10 | 14 | 75 |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | 897 | --- | 354 | 1,251 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | 380 | 5,162 | 514 | 6,056 |
| Kennedy Space Center | --- | 450 | 300 | 750 |
| Langley Research Center | --- | 152 | --- | 152 |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | --- | 12,973 | --- | 12,973 |
| Marshall Space Flight Center | --- | 5,606 | 52 | 5,658 |
| Space Nuclear Propulsion Office | --- | 360 | --- | 360 |
| Wallops Station | 59 | 11 | 75 | 145 |
| Total, R&D | 1,387 | 24,724 | 1,309 | 27,420 |
| **Administrative Operations** | | | | |
| Ames Research Center | --- | 1,536 | 54 | 1,590 |
| Electronics Research Center | 35 | 236 | --- | 271 |
| Flight Research Center | 4 | --- | 19 | 23 |
| Goddard Space Flight Center | --- | 5,363 | 208 | 5,571 |
| Headquarters | --- | 175 | 28 | 203 |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | --- | 1,330 | --- | 1,330 |
| Langley Research Center | 2,835 | 2,603 | 223 | 5,661 |
| Lewis Research Center | --- | 184 | 91 | 275 |
| Manned Spacecraft Center | --- | 4,397 | 487 | 4,884 |
| Marshall Space Flight Center | 28 | 3,864 | 402 | 4,294 |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | 30 | --- | 30 |
| Total, AO | 2,902 | 19,718 | 1,512 | 24,132 |

FY 1967 Category A (General Purpose Use) Cont'd

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Construction of Facilities** | | | | |
| Ames Research Center | --- | --- | --- | --- |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | --- | --- | --- | --- |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | --- | --- | --- | --- |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | --- | --- | --- | --- |
| Marshall Space Flight Center | --- | --- | --- | --- |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | --- | --- | --- |
| Total, CoF | --- | --- | --- | --- |
| **SUMMARY ALL APPROPRIATIONS** | | | | |
| Ames Research Center | 51 | 1,546 | 68 | 1,665 |
| Electronics Research Center | 35 | 236 | --- | 271 |
| Flight Research Center | 4 | --- | 19 | 23 |
| Goddard Space Flight Center | 897 | 5,363 | 562 | 6,822 |
| Headquarters | --- | 175 | 28 | 203 |
| Jet Propulsion Laboratory | 380 | 5,162 | 514 | 6,056 |
| Kennedy Space Center | --- | 1,780 | 300 | 2,080 |
| Langley Research Center | 2,835 | 2,755 | 223 | 5,813 |
| Lewis Research Center | --- | 184 | 91 | 275 |
| Manned Spacecraft Center | --- | 17,370 | 487 | 17,857 |
| Marshall Space Flight Center | 28 | 9,470 | 454 | 9,952 |
| Space Nuclear Propulsion Office | --- | 360 | --- | 360 |
| Wallops Station | 59 | 41 | 75 | 175 |
| Total | 4,289 | 44,442 | 2,821 | 51,552 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Analysis of Automatic Data Processing Equipment

FY 1968 Category A (General Purpose Use)

(In Thousands of Dollars)

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Research and Development** | | | | |
| Ames Research Center | --- | --- | 16 | 16 |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | 3,000 | --- | 412 | 3,412 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | --- | 5,642 | 495 | 6,137 |
| Kennedy Space Center | 2,048 | 214 | 441 | 2,703 |
| Langley Research Center | --- | 152 | --- | 152 |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | --- | 9,352 | --- | 9,352 |
| Marshall Space Flight Center | --- | 5,174 | 63 | 5,237 |
| Space Nuclear Propulsion Office | --- | 360 | --- | 360 |
| Wallops Station | --- | 80 | 80 | 160 |
| Total, R&D | 5,048 | 20,974 | 1,507 | 27,529 |
| **Administrative Operations** | | | | |
| Ames Research Center | --- | 1,744 | 56 | 1,800 |
| Electronics Research Center | 645 | 908 | 45 | 1,598 |
| Flight Research Center | 5 | --- | 19 | 24 |
| Goddard Space Flight Center | --- | 6,830 | 316 | 7,146 |
| Headquarters | --- | 131 | 28 | 159 |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | --- | 1,342 | --- | 1,342 |
| Langley Research Center | 4,627 | 3,300 | 402 | 8,329 |
| Lewis Research Center | --- | 77 | 117 | 194 |
| Manned Spacecraft Center | --- | 4,337 | 460 | 4,797 |
| Marshall Space Flight Center | 26 | 3,855 | 402 | 4,283 |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | 40 | --- | 40 |
| Total, AO | 5,303 | 22,564 | 1,845 | 29,712 |

FY 1968 Category A (General Purpose Use) Cont'd

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Construction of Facilities** | | | | |
| Ames Research Center | --- | --- | --- | --- |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | --- | --- | --- | --- |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | --- | --- | --- | --- |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | --- | --- | --- | --- |
| Marshall Space Flight Center | --- | --- | --- | --- |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | --- | --- | --- |
| Total, CoF | --- | --- | --- | --- |
| **SUMMARY ALL APPROPRIATIONS** | | | | |
| Ames Research Center | --- | 1,744 | 72 | 1,816 |
| Electronics Research Center | 645 | 908 | 45 | 1,598 |
| Flight Research Center | 5 | --- | 19 | 24 |
| Goddard Space Flight Center | 3,000 | 6,830 | 728 | 10,558 |
| Headquarters | --- | 131 | 28 | 159 |
| Jet Propulsion Laboratory | --- | 5,642 | 495 | 6,137 |
| Kennedy Space Center | 2,048 | 1,556 | 441 | 4,045 |
| Langley Research Center | 4,627 | 3,452 | 402 | 8,481 |
| Lewis Research Center | --- | 77 | 117 | 194 |
| Manned Spacecraft Center | --- | 13,689 | 460 | 14,149 |
| Marshall Space Flight Center | 26 | 9,029 | 465 | 9,520 |
| Space Nuclear Propulsion Office | --- | 360 | --- | 360 |
| Wallops Station | --- | 120 | 80 | 200 |
| Total | 10,351 | 43,538 | 3,352 | 57,241 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Analysis of Automatic Data Processing Equipment

FY 1966 Category B (Special Purpose Use)

(In Thousands of Dollars)

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Research and Development** | | | | |
| Ames Research Center | 340 | 9 | 73 | 422 |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | 161 | 3 | 20 | 184 |
| Goddard Space Flight Center | 7,475 | 16 | 880 | 8,371 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | 4,687 | 110 | 199 | 4,996 |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | --- | --- | --- | --- |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | 6,802 | 1,788 | 179 | 8,769 |
| Marshall Space Flight Center | --- | 227 | 5 | 232 |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | 175 | --- | --- | 175 |
| Total, R&D | 19,640 | 2,153 | 1,356 | 23,149 |
| **Administrative Operations** | | | | |
| Ames Research Center | --- | --- | --- | --- |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | --- | 658 | 28 | 686 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | --- | --- | --- | --- |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | --- | --- | --- | --- |
| Marshall Space Flight Center | --- | --- | --- | --- |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | --- | --- | --- |
| Total, AO | --- | 658 | 28 | 686 |

FY 1966 Category B (Special Purpose Use) Cont'd

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Construction of Facilities** | | | | |
| Ames Research Center | --- | --- | --- | --- |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | 1,208 | --- | --- | 1,208 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | --- | --- | --- | --- |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | --- | --- | --- | --- |
| Marshall Space Flight Center | --- | --- | --- | --- |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | --- | --- | --- |
| Total, CoF | 1,208 | --- | --- | 1,208 |
| **SUMMARY ALL APPROPRIATIONS** | | | | |
| Ames Research Center | 340 | 9 | 73 | 422 |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | 161 | 3 | 20 | 184 |
| Goddard Space Flight Center | 8,683 | 674 | 908 | 10,265 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | 4,687 | 110 | 199 | 4,996 |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | --- | --- | --- | --- |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | 6,802 | 1,788 | 179 | 8,769 |
| Marshall Space Flight Center | --- | 227 | 5 | 232 |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | 175 | --- | --- | 175 |
| Total | 20,848 | 2,811 | 1,384 | 25,043 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Analysis of Automatic Data Processing Equipment

FY 1967 Category B (Special Purpose Use)

(In Thousands of Dollars)

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Research and Development** | | | | |
| Ames Research Center | 2,145 | 97 | 93 | 2,335 |
| Electronics Research Center | 165 | --- | --- | 165 |
| Flight Research Center | --- | 48 | 36 | 84 |
| Goddard Space Flight Center | 10,180 | 16 | 1,643 | 11,839 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | 5,592 | 600 | 477 | 6,669 |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | 260 | --- | 2 | 262 |
| Lewis Research Center | --- | --- | 3 | 3 |
| Manned Spacecraft Center | 2,150 | 2,825 | 232 | 5,207 |
| Marshall Space Flight Center | --- | 272 | 6 | 278 |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | 310 | --- | 2 | 312 |
| Total, R&D | 20,802 | 3,858 | 2,494 | 27,154 |
| **Administrative Operations** | | | | |
| Ames Research Center | --- | --- | --- | --- |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | --- | 624 | 27 | 651 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | --- | --- | --- | --- |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | --- | --- | --- | --- |
| Marshall Space Flight Center | --- | --- | --- | --- |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | --- | --- | --- |
| Total, AO | --- | 624 | 27 | 651 |

FY 1967 Category B (Special Purpose Use) Cont'd

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Construction of Facilities** | | | | |
| Ames Research Center | --- | --- | --- | --- |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | --- | --- | --- | --- |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | 360 | --- | --- | 360 |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | --- | --- | --- | --- |
| Marshall Space Flight Center | --- | --- | --- | --- |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | --- | --- | --- |
| Total, CoF | 360 | --- | --- | 360 |
| **SUMMARY ALL APPROPRIATIONS** | | | | |
| Ames Research Center | 2,145 | 97 | 93 | 2,335 |
| Electronics Research Center | 165 | --- | --- | 165 |
| Flight Research Center | --- | 48 | 36 | 84 |
| Goddard Space Flight Center | 10,180 | 640 | 1,670 | 12,490 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | 5,592 | 600 | 477 | 6,669 |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | 620 | --- | 2 | 622 |
| Lewis Research Center | --- | --- | 3 | 3 |
| Manned Spacecraft Center | 2,150 | 2,825 | 232 | 5,207 |
| Marshall Space Flight Center | --- | 272 | 6 | 278 |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | 310 | --- | 2 | 312 |
| Total | 21,162 | 4,482 | 2,521 | 28,165 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Analysis of Automatic Data Processing Equipment

FY 1968 Category B (Special Purpose Use)

(In Thousands of Dollars)

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Research and Development** | | | | |
| Ames Research Center | 1,450 | 38 | 144 | 1,632 |
| Electronics Research Center | 400 | --- | --- | 400 |
| Flight Research Center | 250 | 56 | 41 | 347 |
| Goddard Space Flight Center | 4,608 | 16 | 2,432 | 7,056 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | 3,138 | 579 | 694 | 4,411 |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | --- | --- | 13 | 13 |
| Lewis Research Center | --- | --- | 12 | 12 |
| Manned Spacecraft Center | 300 | 1,588 | 132 | 2,020 |
| Marshall Space Flight Center | --- | 276 | 12 | 288 |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | --- | 2 | 2 |
| Total, R&D | 10,146 | 2,553 | 3,482 | 16,181 |
| **Administrative Operations** | | | | |
| Ames Research Center | --- | --- | --- | --- |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | --- | 452 | 28 | 480 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | --- | --- | --- | --- |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | --- | --- | --- | --- |
| Marshall Space Flight Center | --- | --- | --- | --- |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | --- | --- | --- |
| Total, AO | --- | 452 | 28 | 480 |

FY 1968 Category B (Special Purpose Use) Cont'd

| | Purchase | Lease | Maintenance | Total |
|---|---|---|---|---|
| **Construction of Facilities** | | | | |
| Ames Research Center | --- | --- | --- | --- |
| Electronics Research Center | --- | --- | --- | --- |
| Flight Research Center | --- | --- | --- | --- |
| Goddard Space Flight Center | --- | --- | --- | --- |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | --- | --- | --- | --- |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | --- | --- | --- | --- |
| Lewis Research Center | --- | --- | --- | --- |
| Manned Spacecraft Center | --- | --- | --- | --- |
| Marshall Space Flight Center | --- | --- | --- | --- |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | --- | --- | --- |
| Total, CoF | --- | --- | --- | --- |
| **SUMMARY ALL APPROPRIATIONS** | | | | |
| Ames Research Center | 1,450 | 38 | 144 | 1,632 |
| Electronics Research Center | 400 | --- | --- | 400 |
| Flight Research Center | 250 | 56 | 41 | 347 |
| Goddard Space Flight Center | 4,608 | 468 | 2,460 | 7,536 |
| Headquarters | --- | --- | --- | --- |
| Jet Propulsion Laboratory | 3,138 | 579 | 694 | 4,411 |
| Kennedy Space Center | --- | --- | --- | --- |
| Langley Research Center | --- | --- | 13 | 13 |
| Lewis Research Center | --- | --- | 12 | 12 |
| Manned Spacecraft Center | 300 | 1,588 | 132 | 2,020 |
| Marshall Space Flight Center | --- | 276 | 12 | 288 |
| Space Nuclear Propulsion Office | --- | --- | --- | --- |
| Wallops Station | --- | --- | 2 | 2 |
| Total | 10,146 | 3,005 | 3,510 | 16,661 |



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

## Inventory of Computers

### EXPLANATORY NOTE

This year's tabulations of computer inventories as of 6/30/66 and 6/30/67 reflect totals somewhat higher than those shown in last year's submission for these dates. Differences are accounted for primarily by the following factors: (1) In the previous submission a direct coupled system containing more than one computer was counted as a single computing system; this year, to assure that all main frames are reflected in the inventory, each individual computer is counted regardless of its position in a larger system. (2) Excluded from the inventory last year were a number of small computers used exclusively for checking out spacecraft systems at contractor operated facilities. These computers have been identified and are included in this submission.

### DEFINITIONS

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

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

Small $450,000 or less.

Purchase refers to equipment that is owned,

Lease to equipment leased and

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

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers
Agency Summary

| Category A (General Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | 7 | 7 | 20 | 34 |
| | Lease | 22 | 25 | 56 | 103 |
| | P/L | 21 | 9 | 9 | 39 |
| | Total | 50 | 41 | 85 | 176 |
| 6/30/67 | Purchase | 11 | 5 | 20 | 36 |
| | Lease | 20 | 18 | 60 | 98 |
| | P/L | 25 | 10 | 10 | 45 |
| | Total | 56 | 33 | 90 | 179 |
| 6/30/68 | Purchase | 13 | 5 | 19 | 37 |
| | Lease | 19 | 8 | 47 | 74 |
| | P/L | 24 | 8 | 7 | 39 |
| | Total | 56 | 21 | 73 | 150 |
| **Category B (Special Purpose)** | | | | | |
| 6/30/66 | Purchase | --- | 8 | 335 | 343 |
| | Lease | --- | 1 | 11 | 12 |
| | P/L | 5 | 10 | 10 | 25 |
| | Total | 5 | 19 | 356 | 380 |
| 6/30/67 | Purchase | --- | 11 | 402 | 413 |
| | Lease | 1 | 3 | 13 | 17 |
| | P/L | 3 | 11 | 10 | 24 |
| | Total | 4 | 25 | 425 | 454 |
| 6/30/68 | Purchase | --- | 16 | 414 | 430 |
| | Lease | 1 | 2 | 10 | 13 |
| | P/L | 3 | 11 | 10 | 24 |
| | Total | 4 | 29 | 434 | 467 |
| **Summary (Categories A and B)** | | | | | |
| 6/30/66 | Purchase | 7 | 15 | 355 | 377 |
| | Lease | 22 | 26 | 67 | 115 |
| | P/L | 26 | 19 | 19 | 64 |
| | Total | 55 | 60 | 441 | 556 |
| 6/30/67 | Purchase | 11 | 16 | 422 | 449 |
| | Lease | 21 | 21 | 73 | 115 |
| | P/L | 28 | 21 | 20 | 69 |
| | Total | 60 | 58 | 515 | 633 |
| 6/30/68 | Purchase | 13 | 21 | 433 | 467 |
| | Lease | 20 | 10 | 57 | 87 |
| | P/L | 27 | 19 | 17 | 63 |
| | Total | 60 | 50 | 507 | 617 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers
Ames Research Center
Moffett Field, Calif.

| Category A (General Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | 1 | 1 | 3 | 5 |
| | Lease | --- | 1 | 8 | 9 |
| | P/L | --- | --- | --- | --- |
| | Total | 1 | 2 | 11 | 14 |
| 6/30/67 | Purchase | 1 | 1 | 4 | 6 |
| | Lease | --- | 1 | 8 | 9 |
| | P/L | --- | --- | --- | --- |
| | Total | 1 | 2 | 12 | 15 |
| 6/30/68 | Purchase | 1 | 1 | 4 | 6 |
| | Lease | 1 | 2 | 8 | 11 |
| | P/L | --- | --- | --- | --- |
| | Total | 2 | 3 | 12 | 17 |
| Category B (Special Purpose) | | | | | |
| 6/30/66 | Purchase | --- | 1 | 6 | 7 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | 1 | 7 | 8 |
| 6/30/67 | Purchase | --- | 3 | 5 | 8 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | 3 | 6 | 9 |
| 6/30/68 | Purchase | --- | 5 | 10 | 15 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | 5 | 11 | 16 |
| Summary (Categories A and B) | | | | | |
| 6/30/66 | Purchase | 1 | 2 | 9 | 12 |
| | Lease | --- | 1 | 9 | 10 |
| | P/L | --- | --- | --- | --- |
| | Total | 1 | 3 | 18 | 22 |
| 6/30/67 | Purchase | 1 | 4 | 9 | 14 |
| | Lease | --- | 1 | 9 | 10 |
| | P/L | --- | --- | --- | --- |
| | Total | 1 | 5 | 18 | 24 |
| 6/30/68 | Purchase | 1 | 6 | 14 | 21 |
| | Lease | 1 | 2 | 9 | 12 |
| | P/L | --- | --- | --- | --- |
| | Total | 2 | 8 | 23 | 33 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers
Electronics Research Center
Cambridge, Mass.

| Category A (General Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | --- | --- | --- | --- |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | --- | --- |
| 6/30/67 | Purchase | --- | --- | --- | --- |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 1 | 1 |
| 6/30/68 | Purchase | --- | --- | --- | --- |
| | Lease | --- | --- | 2 | 2 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 2 | 2 |
| Category B (Special Purpose) | | | | | |
| 6/30/66 | Purchase | --- | --- | --- | --- |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | --- | --- |
| 6/30/67 | Purchase | --- | --- | 1 | 1 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 1 | 1 |
| 6/30/68 | Purchase | --- | 1 | 2 | 3 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | 1 | 2 | 3 |
| Summary (Categories A and B) | | | | | |
| 6/30/66 | Purchase | --- | --- | --- | --- |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | --- | --- |
| 6/30/67 | Purchase | --- | --- | 1 | 1 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 2 | 2 |
| 6/30/68 | Purchase | --- | 1 | 2 | 3 |
| | Lease | --- | --- | 2 | 2 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | 1 | 4 | 5 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers
Flight Research Center
Edwards AFB, Calif.

| Category A (General Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | --- | 1 | --- | 1 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | 1 | --- | 1 |
| 6/30/67 | Purchase | --- | 1 | --- | 1 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | 1 | --- | 1 |
| 6/30/68 | Purchase | 1 | 1 | --- | 2 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | 1 | 1 | --- | 2 |
| **Category B (Special Purpose)** | | | | | |
| 6/30/66 | Purchase | --- | --- | 4 | 4 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 4 | 4 |
| 6/30/67 | Purchase | --- | --- | 4 | 4 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 5 | 5 |
| 6/30/68 | Purchase | --- | --- | 4 | 4 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 5 | 5 |
| **Summary (Categories A and B)** | | | | | |
| 6/30/66 | Purchase | --- | 1 | 4 | 5 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | 1 | 4 | 5 |
| 6/30/67 | Purchase | --- | 1 | 4 | 5 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | 1 | 5 | 6 |
| 6/30/68 | Purchase | 1 | 1 | 4 | 6 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | 1 | 1 | 5 | 7 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers
Goddard Space Flight Center
Greenbelt, Md.

| Category A (General Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | --- | --- | --- | --- |
| | Lease | 1 | 1 | 6 | 8 |
| | P/L | 10 | 2 | 6 | 18 |
| | Total | 11 | 3 | 12 | 26 |
| 6/30/67 | Purchase | --- | --- | --- | --- |
| | Lease | 3 | --- | 10 | 13 |
| | P/L | 11 | 2 | 6 | 19 |
| | Total | 14 | 2 | 16 | 32 |
| 6/30/68 | Purchase | --- | --- | --- | --- |
| | Lease | --- | --- | 11 | 11 |
| | P/L | 12 | 2 | 3 | 17 |
| | Total | 12 | 2 | 14 | 28 |
| Category B (Special Purpose) | | | | | |
| 6/30/66 | Purchase | --- | 4 | 20 | 24 |
| | Lease | --- | --- | 5 | 5 |
| | P/L | --- | 7 | 5 | 12 |
| | Total | --- | 11 | 30 | 41 |
| 6/30/67 | Purchase | --- | 4 | 28 | 32 |
| | Lease | --- | --- | 5 | 5 |
| | P/L | --- | 7 | 5 | 12 |
| | Total | --- | 11 | 38 | 49 |
| 6/30/68 | Purchase | --- | 6 | 29 | 35 |
| | Lease | --- | --- | 2 | 2 |
| | P/L | --- | 7 | 5 | 12 |
| | Total | --- | 13 | 36 | 49 |
| Summary (Categories A and B) | | | | | |
| 6/30/66 | Purchase | --- | 4 | 20 | 24 |
| | Lease | 1 | 1 | 11 | 13 |
| | P/L | 10 | 9 | 11 | 30 |
| | Total | 11 | 14 | 42 | 67 |
| 6/30/67 | Purchase | --- | 4 | 28 | 32 |
| | Lease | 3 | --- | 15 | 18 |
| | P/L | 11 | 9 | 11 | 31 |
| | Total | 14 | 13 | 54 | 81 |
| 6/30/68 | Purchase | --- | 6 | 29 | 35 |
| | Lease | --- | --- | 13 | 13 |
| | P/L | 12 | 9 | 8 | 29 |
| | Total | 12 | 15 | 50 | 77 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers
Goddard Space Flight Center
Institute for Space Studies
New York, N.Y.

| Category A (General Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | --- | --- | --- | --- |
| | Lease | --- | --- | --- | --- |
| | P/L | 1 | --- | --- | 1 |
| | Total | 1 | --- | --- | 1 |
| 6/30/67 | Purchase | --- | --- | --- | --- |
| | Lease | --- | --- | --- | --- |
| | P/L | 1 | --- | --- | 1 |
| | Total | 1 | --- | --- | 1 |
| 6/30/68 | Purchase | --- | --- | --- | --- |
| | Lease | --- | --- | --- | --- |
| | P/L | 1 | --- | --- | 1 |
| | Total | 1 | --- | --- | 1 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers
Goddard Space Flight Center
Tracking Stations

| Category B (Special Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | --- | --- | 80 | 80 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 80 | 80 |
| 6/30/67 | Purchase | --- | --- | 95 | 95 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 95 | 95 |
| 6/30/68 | Purchase | --- | --- | 95 | 95 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 95 | 95 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers
Goddard Space Flight Center
Other Locations

| Category B (Special Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | --- | --- | 14 | 14 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 15 | 15 |
| 6/30/67 | Purchase | --- | --- | 14 | 14 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 15 | 15 |
| 6/30/68 | Purchase | --- | --- | 15 | 15 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 15 | 15 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers
NASA Headquarters
Washington, D. C.

| Category A (General Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | --- | 1 | --- | 1 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | 1 | 1 | 2 |
| 6/30/67 | Purchase | --- | --- | --- | --- |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | 1 | --- | 1 |
| | Total | --- | 1 | --- | 1 |
| 6/30/68 | Purchase | --- | --- | --- | --- |
| | Lease | --- | 1 | --- | 1 |
| | P/L | --- | 1 | --- | 1 |
| | Total | --- | 2 | --- | 2 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers
Jet Propulsion Laboratory
Pasadena, Calif.

| Category A (General Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | --- | --- | 3 | 3 |
| | Lease | 3 | 2 | 7 | 12 |
| | P/L | 5 | 2 | --- | 7 |
| | Total | 8 | 4 | 10 | 22 |
| 6/30/67 | Purchase | --- | --- | 2 | 2 |
| | Lease | 3 | 2 | 9 | 14 |
| | P/L | 7 | 2 | 1 | 10 |
| | Total | 10 | 4 | 12 | 26 |
| 6/30/68 | Purchase | --- | --- | 3 | 3 |
| | Lease | 3 | 2 | 9 | 14 |
| | P/L | 7 | 2 | 1 | 10 |
| | Total | 10 | 4 | 13 | 27 |
| Category B (Special Purpose) | | | | | |
| 6/30/66 | Purchase | --- | --- | 22 | 22 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | 3 | 3 |
| | Total | --- | --- | 25 | 25 |
| 6/30/67 | Purchase | --- | 3 | 27 | 30 |
| | Lease | --- | 2 | 1 | 3 |
| | P/L | --- | 1 | 3 | 4 |
| | Total | --- | 6 | 31 | 37 |
| 6/30/68 | Purchase | --- | 3 | 27 | 30 |
| | Lease | --- | 1 | 2 | 3 |
| | P/L | --- | 2 | 3 | 5 |
| | Total | --- | 6 | 32 | 38 |
| Summary (Categories A and B) | | | | | |
| 6/30/66 | Purchase | --- | --- | 25 | 25 |
| | Lease | 3 | 2 | 7 | 12 |
| | P/L | 5 | 2 | 3 | 10 |
| | Total | 8 | 4 | 35 | 47 |
| 6/30/67 | Purchase | --- | 3 | 29 | 32 |
| | Lease | 3 | 4 | 10 | 17 |
| | P/L | 7 | 3 | 4 | 14 |
| | Total | 10 | 10 | 43 | 63 |
| 6/30/68 | Purchase | --- | 3 | 30 | 33 |
| | Lease | 3 | 3 | 11 | 17 |
| | P/L | 7 | 4 | 4 | 15 |
| | Total | 10 | 10 | 45 | 65 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers
Jet Propulsion Laboratory
Tracking Stations

| Category B (Special Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | --- | --- | 34 | 34 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | 2 | 2 |
| | Total | --- | --- | 36 | 36 |
| 6/30/67 | Purchase | --- | --- | 40 | 40 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | 2 | 2 |
| | Total | --- | --- | 42 | 42 |
| 6/30/68 | Purchase | --- | --- | 41 | 41 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | 2 | 2 |
| | Total | --- | --- | 43 | 43 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers
Kennedy Space Center, NASA
Kennedy Space Center, Fla.

| Category A (General Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | 1 | --- | 3 | 4 |
| | Lease | --- | 5 | --- | 5 |
| | P/L | --- | --- | --- | --- |
| | Total | 1 | 5 | 3 | 9 |
| 6/30/67 | Purchase | 2 | --- | 3 | 5 |
| | Lease | --- | 4 | --- | 4 |
| | P/L | --- | --- | --- | --- |
| | Total | 2 | 4 | 3 | 9 |
| 6/30/68 | Purchase | 2 | --- | 3 | 5 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | 2 | --- | 3 | 5 |
| **Category B (Special Purpose)** | | | | | |
| 6/30/66 | Purchase | --- | --- | 19 | 19 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 19 | 19 |
| 6/30/67 | Purchase | --- | --- | 28 | 28 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 28 | 28 |
| 6/30/68 | Purchase | --- | --- | 28 | 28 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 28 | 28 |
| **Summary (Categories A and B)** | | | | | |
| 6/30/66 | Purchase | 1 | --- | 22 | 23 |
| | Lease | --- | 5 | --- | 5 |
| | P/L | --- | --- | --- | --- |
| | Total | 1 | 5 | 22 | 28 |
| 6/30/67 | Purchase | 2 | --- | 31 | 33 |
| | Lease | --- | 4 | --- | 4 |
| | P/L | --- | --- | --- | --- |
| | Total | 2 | 4 | 31 | 37 |
| 6/30/68 | Purchase | 2 | --- | 31 | 33 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | 2 | --- | 31 | 33 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers

Langley Research Center
Hampton, Va.

| | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| **Category A (General Purpose)** | | | | | |
| 6/30/66 | Purchase | --- | 1 | 1 | 2 |
| | Lease | 3 | 1 | 2 | 6 |
| | P/L | --- | --- | --- | --- |
| | Total | 3 | 2 | 3 | 8 |
| 6/30/67 | Purchase | 2 | 1 | 1 | 4 |
| | Lease | --- | 1 | 2 | 3 |
| | P/L | 1 | --- | --- | 1 |
| | Total | 3 | 2 | 3 | 8 |
| 6/30/68 | Purchase | 3 | 1 | 1 | 5 |
| | Lease | --- | 1 | 1 | 2 |
| | P/L | 1 | --- | --- | 1 |
| | Total | 4 | 2 | 2 | 8 |
| **Category B (Special Purpose)** | | | | | |
| 6/30/66 | Purchase | --- | --- | 1 | 1 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 1 | 1 |
| 6/30/67 | Purchase | --- | --- | 6 | 6 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 6 | 6 |
| 6/30/68 | Purchase | --- | --- | 6 | 6 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 6 | 6 |
| **Summary (Categories A and B)** | | | | | |
| 6/30/66 | Purchase | --- | 1 | 2 | 3 |
| | Lease | 3 | 1 | 2 | 6 |
| | P/L | --- | --- | --- | --- |
| | Total | 3 | 2 | 4 | 9 |
| 6/30/67 | Purchase | 2 | 1 | 7 | 10 |
| | Lease | --- | 1 | 2 | 3 |
| | P/L | 1 | --- | --- | 1 |
| | Total | 3 | 2 | 9 | 14 |
| 6/30/68 | Purchase | 3 | 1 | 7 | 11 |
| | Lease | --- | 1 | 1 | 2 |
| | P/L | 1 | --- | --- | 1 |
| | Total | 4 | 2 | 8 | 14 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers

Lewis Research Center
Cleveland, Ohio

| Category A (General Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | 1 | 2 | 3 | 6 |
| | Lease | --- | 1 | 1 | 2 |
| | P/L | --- | --- | --- | --- |
| | Total | 1 | 3 | 4 | 8 |
| 6/30/67 | Purchase | 2 | 1 | 3 | 6 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | 2 | 1 | 4 | 7 |
| 6/30/68 | Purchase | 2 | 1 | 3 | 6 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | 2 | 1 | 4 | 7 |
| **Category B (Special Purpose)** | | | | | |
| 6/30/66 | Purchase | --- | --- | --- | --- |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | --- | --- |
| 6/30/67 | Purchase | --- | --- | 2 | 2 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 2 | 2 |
| 6/30/68 | Purchase | --- | --- | 2 | 2 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 2 | 2 |
| **Summary (Categories A and B)** | | | | | |
| 6/30/66 | Purchase | 1 | 2 | 3 | 6 |
| | Lease | --- | 1 | 1 | 2 |
| | P/L | --- | --- | --- | --- |
| | Total | 1 | 3 | 4 | 8 |
| 6/30/67 | Purchase | 2 | 1 | 5 | 8 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | 2 | 1 | 6 | 9 |
| 6/30/68 | Purchase | 2 | 1 | 5 | 8 |
| | Lease | --- | --- | 1 | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | 2 | 1 | 6 | 9 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers

Manned Spacecraft Center
Houston, Texas

| | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| **Category A (General Purpose)** | | | | | |
| 6/30/66 | Purchase | 4 | 1 | --- | 5 |
| | Lease | 11 | 3 | 10 | 24 |
| | P/L | 1 | 2 | --- | 3 |
| | Total | 16 | 6 | 10 | 32 |
| 6/30/67 | Purchase | 4 | 1 | --- | 5 |
| | Lease | 8 | --- | 4 | 12 |
| | P/L | 1 | 2 | --- | 3 |
| | Total | 13 | 3 | 4 | 20 |
| 6/30/68 | Purchase | 4 | 1 | --- | 5 |
| | Lease | 9 | --- | 4 | 13 |
| | P/L | 1 | 2 | --- | 3 |
| | Total | 14 | 3 | 4 | 21 |
| **Category B (Special Purpose)** | | | | | |
| 6/30/66 | Purchase | --- | 3 | 49 | 52 |
| | Lease | --- | --- | 4 | 4 |
| | P/L | 5 | 1 | --- | 6 |
| | Total | 5 | 4 | 53 | 62 |
| 6/30/67 | Purchase | --- | 1 | 61 | 62 |
| | Lease | 1 | 1 | 4 | 6 |
| | P/L | 3 | 1 | --- | 4 |
| | Total | 4 | 3 | 65 | 72 |
| 6/30/68 | Purchase | --- | 1 | 64 | 65 |
| | Lease | 1 | 1 | 4 | 6 |
| | P/L | 3 | --- | --- | 3 |
| | Total | 4 | 2 | 68 | 74 |
| **Summary (Categories A and B)** | | | | | |
| 6/30/66 | Purchase | 4 | 4 | 49 | 57 |
| | Lease | 11 | 3 | 14 | 28 |
| | P/L | 6 | 3 | --- | 9 |
| | Total | 21 | 10 | 63 | 94 |
| 6/30/67 | Purchase | 4 | 2 | 61 | 67 |
| | Lease | 9 | 1 | 8 | 18 |
| | P/L | 4 | 3 | --- | 7 |
| | Total | 17 | 6 | 69 | 92 |
| 6/30/68 | Purchase | 4 | 2 | 64 | 70 |
| | Lease | 10 | 1 | 8 | 19 |
| | P/L | 4 | 2 | --- | 6 |
| | Total | 18 | 5 | 72 | 95 |



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers

Marshall Space Flight Center
Huntsville, Alabama

| Category A (General Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | --- | --- | 6 | 6 |
| | Lease | 1 | 8 | 17 | 26 |
| | P/L | 2 | 2 | 3 | 7 |
| | Total | 3 | 10 | 26 | 39 |
| 6/30/67 | Purchase | --- | --- | 6 | 6 |
| | Lease | 2 | 8 | 20 | 30 |
| | P/L | 2 | 2 | 3 | 7 |
| | Total | 4 | 10 | 29 | 43 |
| 6/30/68 | Purchase | --- | --- | 4 | 4 |
| | Lease | 3 | --- | 8 | 11 |
| | P/L | --- | --- | 3 | 3 |
| | Total | 3 | --- | 15 | 18 |
| Category B (Special Purpose) | | | | | |
| 6/30/66 | Purchase | --- | --- | 81 | 81 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | 2 | --- | 2 |
| | Total | --- | 2 | 81 | 83 |
| 6/30/67 | Purchase | --- | --- | 85 | 85 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | 2 | --- | 2 |
| | Total | --- | 2 | 85 | 87 |
| 6/30/68 | Purchase | --- | --- | 85 | 85 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | 2 | --- | 2 |
| | Total | --- | 2 | 85 | 87 |
| Summary (Categories A and B) | | | | | |
| 6/30/66 | Purchase | --- | --- | 87 | 87 |
| | Lease | 1 | 8 | 17 | 26 |
| | P/L | 2 | 4 | 3 | 9 |
| | Total | 3 | 12 | 107 | 122 |
| 6/30/67 | Purchase | --- | --- | 91 | 91 |
| | Lease | 2 | 8 | 20 | 30 |
| | P/L | 2 | 4 | 3 | 9 |
| | Total | 4 | 12 | 114 | 130 |
| 6/30/68 | Purchase | --- | --- | 89 | 89 |
| | Lease | 3 | --- | 8 | 11 |
| | P/L | --- | 2 | 3 | 5 |
| | Total | 3 | 2 | 100 | 105 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers

Marshall Space Flight Center

Michoud Assembly Facility

New Orleans, La.

| Category A (General Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | --- | --- | 1 | 1 |
| | Lease | 3 | 2 | 4 | 9 |
| | P/L | 2 | --- | --- | 2 |
| | Total | 5 | 2 | 5 | 12 |
| 6/30/67 | Purchase | --- | --- | 1 | 1 |
| | Lease | 4 | 1 | 5 | 10 |
| | P/L | 2 | --- | --- | 2 |
| | Total | 6 | 1 | 6 | 13 |
| 6/30/68 | Purchase | --- | --- | 1 | 1 |
| | Lease | 3 | 1 | 3 | 7 |
| | P/L | 2 | --- | --- | 2 |
| | Total | 5 | 1 | 4 | 10 |
| **Category B (Special Purpose)** | | | | | |
| 6/30/66 | Purchase | --- | --- | 3 | 3 |
| | Lease | --- | 1 | --- | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | 1 | 3 | 4 |
| 6/30/67 | Purchase | --- | --- | 3 | 3 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 3 | 3 |
| 6/30/68 | Purchase | --- | --- | 3 | 3 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 3 | 3 |
| **Summary (Categories A and B)** | | | | | |
| 6/30/66 | Purchase | --- | --- | 4 | 4 |
| | Lease | 3 | 3 | 4 | 10 |
| | P/L | 2 | --- | --- | 2 |
| | Total | 5 | 3 | 8 | 16 |
| 6/30/67 | Purchase | --- | --- | 4 | 4 |
| | Lease | 4 | 1 | 5 | 10 |
| | P/L | 2 | --- | --- | 2 |
| | Total | 6 | 1 | 9 | 16 |
| 6/30/68 | Purchase | --- | --- | 4 | 4 |
| | Lease | 3 | 1 | 3 | 7 |
| | P/L | 2 | --- | --- | 2 |
| | Total | 5 | 1 | 7 | 13 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers

Space Nuclear Propulsion Office

Jackass Flats, Nevada

| Category A (General Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | --- | --- | --- | --- |
| | Lease | --- | 1 | --- | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | 1 | --- | 1 |
| 6/30/67 | Purchase | --- | --- | --- | --- |
| | Lease | --- | 1 | --- | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | 1 | --- | 1 |
| 6/30/68 | Purchase | --- | --- | --- | --- |
| | Lease | --- | 1 | --- | 1 |
| | P/L | --- | --- | --- | --- |
| | Total | --- | 1 | --- | 1 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

End of Year Inventory of Computers

Wallops Station

Wallops Island, Va.

| Category A (General Purpose) | | Large | Medium | Small | Total |
|---|---|---|---|---|---|
| 6/30/66 | Purchase | --- | --- | --- | --- |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | 1 | --- | 1 |
| | Total | --- | 1 | --- | 1 |
| 6/30/67 | Purchase | --- | --- | --- | --- |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | 1 | --- | 1 |
| | Total | --- | 1 | --- | 1 |
| 6/30/68 | Purchase | --- | --- | --- | --- |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | 1 | --- | 1 |
| | Total | --- | 1 | --- | 1 |
| Category B (Special Purpose) | | | | | |
| 6/30/66 | Purchase | --- | --- | 2 | 2 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 2 | 2 |
| 6/30/67 | Purchase | --- | --- | 3 | 3 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 3 | 3 |
| 6/30/68 | Purchase | --- | --- | 3 | 3 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | --- | --- | --- |
| | Total | --- | --- | 3 | 3 |
| Summary (Categories A and B) | | | | | |
| 6/30/66 | Purchase | --- | --- | 2 | 2 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | 1 | --- | 1 |
| | Total | --- | 1 | 2 | 3 |
| 6/30/67 | Purchase | --- | --- | 3 | 3 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | 1 | --- | 1 |
| | Total | --- | 1 | 3 | 4 |
| 6/30/68 | Purchase | --- | --- | 3 | 3 |
| | Lease | --- | --- | --- | --- |
| | P/L | --- | 1 | --- | 1 |
| | Total | --- | 1 | 3 | 4 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

AMES RESEARCH CENTER

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| **Computer Cost (In thousands of dollars):** | | | |
| Purchase | 1,214 | 2,196 | 1,450 |
| Lease | 1,637 | 1,643 | 1,782 |
| Maintenance | 110 | 161 | 216 |
| Total | 2,961 | 4,000 | 3,448 |
| **Number of Computers (End of Year):** | | | |
| Purchased | 12 | 14 | 21 |
| Leased | 10 | 10 | 12 |
| Total | 22 | 24 | 33 |
| **Number of Personnel:** | | | |
| Civil Service | 65 | 64 | 68 |
| Contracting Firm | 59 | 73 | 90 |

Contractor Identification

| Name of Firm | Service Performed |
|---|---|
| Computer Science Corp. | Scientific Programming and Analysis; Administrative Applications Programming |
| Massey Temporary Services | Programming and Operation |
| Computer Usage Corp. | Computer Operators |
| Electronic Associates, Inc. | Maintenance |
| Honeywell, Inc. | Maintenance |
| IBM | Maintenance and Programming |
| Scientific Data Systems | Maintenance |
| Aero, Inc. | Programming |
| Informatics | Programming |

## AMES RESEARCH CENTER

### FY 1966

ARC utilizes ADP equipment for wind tunnel test data reduction and analysis, for scientific and engineering studies, and for administrative applications. New ADP requirements result from new and advanced theoretical studies in Space Vehicle Systems, Electronics Systems, Aeronautics, and Bioscience. The IBM 7094/40 DCS, including four remote access 1440 units, provides support for most of the Scientific and Engineering requirements. The H 800/200 system is used for reduction of experimental data from Bioscience and other research labs, data from wind tunnel work, and data from Pioneer, OGO, and AIMP. This system is indirectly connected on-line with several of the wind tunnels to provide quick look during test runs as well as improved efficiency for bulk-data reduction; in addition, the H 800 is shared by the U. S. Naval Air Station. Administrative support activities utilize the IBM 1401 system and the 7094 DCS system.

### FY 1967

Data reduction requirements reflect a 10 to 12% increase in FY 1967 resulting from reactivation of several wind tunnel test facilities, and from requirements of flight projects including Pioneer, Biosatellite and OSO. Additional increases will result as the Bioscience program progresses, and as additional experimental work in the area of sonic-boom phenomena is undertaken. Increased requirements for Scientific and Engineering computation result from research studies in Aeronautics, Electronics Systems, Space Vehicle Structure Analysis, and Bioscience. The two major computer systems at Ames are scheduled to be improved and expanded to provide additional on-line computing and data acquisition capability, including on-line data processing for two wind tunnels running simultaneously.

### FY 1968

The data reduction workload will continue to increase gradually as improved and more sophisticated data collection techniques are developed. Research related to aeronautics will be extended to include more advanced techniques and is expected to work existing ADP systems to their limits.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

ELECTRONICS RESEARCH CENTER

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| **Computer Cost (In thousands of dollars):** | | | |
| Purchase | 27 | 200 | 1,045 |
| Lease | 15 | 236 | 908 |
| Maintenance | 3 | --- | 45 |
| Total | 45 | 436 | 1,998 |
| **Number of Computers (End of Year):** | | | |
| Purchased | --- | 1 | 3 |
| Leased | --- | 1 | 2 |
| Total | --- | 2 | 5 |
| **Number of Personnel:** | | | |
| Civil Service | 9 | 21 | 27 |
| Contracting Firm | 11 | 37 | 76 |

Contractor Identification

| Name of Firm | Service Performed |
|---|---|
| Wolf R&D, Inc. | Numerical Analysis |
| Computer Applications, Inc. | Programming |
| Research Calculations, Inc. | Programming |

## ELECTRONICS RESEARCH CENTER

### FY 1966

ERC organizes and manages a program of basic and applied space electronics research as well as providing a focal point for national space electronics research. ADP applications are directed primarily to the solution of a broad range of scientific and engineering problems typical of those encountered in electronics guidance and reliability studies, such as trajectory analysis, power spectral analysis, and large matrix inversion problems. ERC also requires ADP equipment for support of extensive program management. Later development is expected to include simulation, requiring hybrid equipment configurations. During FY 1966 ERC utilized facilities of other government agencies in the area, commercial facilities, and some remote time-shared services.

### FY 1967

Requirements for Scientific and Engineering type processing continue, and data reduction requirements are increasing as the various research labs progress in experimental testing phases. The growing variety of requirements for ADP equipment at ERC results in a need for complex large scale equipment. Some scientific applications require equipment with very large word size and large bulk memory. Present requirements will continue to be met on a variety of systems in the Boston area including some computer time on very large and complex systems.

### FY 1968

An analysis of current and expected future requirements indicates a need for a high degree of flexibility in the design of the Center's computing facility. The need for a modular design applies particularly to the peripheral equipment and remote access devices located in the various labs throughout the Center. There will also be a continuing need for a very large and complex central processing facility.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

FLIGHT RESEARCH CENTER

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| **Computer Cost (In thousands of dollars):** | | | |
| Purchase | 163 | 4 | 255 |
| Lease | 75 | 48 | 56 |
| Maintenance | 43 | 55 | 60 |
| Total | 281 | 107 | 371 |
| **Number of Computers (End of Year):** | | | |
| Purchased | 5 | 5 | 6 |
| Leased | --- | 1 | 1 |
| Total | 5 | 6 | 7 |
| **Number of Personnel:** | | | |
| Civil Service | 19 | 19 | 19 |
| Contracting Firm | 9 | 12 | 14 |

Contractor Identification

| Name of Firm | Service Performed |
|---|---|
| General Electric | Computer Operations, Key Punching, Data Preparation, and Maintenance |
| Telecomputing Services, Inc. | Biomedical Programming and Analysis |
| IBM | Maintenance |

## FLIGHT RESEARCH CENTER

### FY 1966

FRC utilizes ADP equipment for general aeronautical research programs in conjunction with testing phases of the Lifting Body program, X-15 Ramjet Propulsion, X-15 Delta Wing, Supersonic Transport, and Hypersonic Research Aircraft. The airborne instrumentation systems of flight research vehicles, as well as ground based test facilities, are being converted to incorporate improved data collection methods; and large quantities of biological data come from monitoring pilot reaction during flight. New and improved computer programs are being developed to efficiently utilize these increased volumes of data. New requirements include provisions for automatic edit of large volumes of data, more detailed analysis, and format control for data plotting as well as data storage. FRC is investigating methods for describing transfer functions of human operators in an effort to develop unified handling qualities criteria ratings. The Center has completed installation of an IBM 360/40 to accommodate all general purpose computing and the central ADP facility is in use three full shifts per day. This is expected to increase to full saturation by FY 1968.

### FY 1967

New requirements in the area of flight simulation will be a major factor in planning for an expanded ADP system. Interim steps will be taken to meet these requirements by utilizing ADP equipment on a lease basis, with specially designed input/output interface equipment. Current planning includes upgrading the IBM 360/40 to a more powerful central processor, and increased flexibility for input/output equipment. This would incorporate advanced design and techniques to include flight simulation on the central computer.

### FY 1968

Anticipated new requirements will result from additional improvements in data acquisition and installation of new high precision radar tracking facilities. Other applications included in feasibility planning stages would provide real-time interconnection of the computer with biological laboratory instrumentation.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

GODDARD SPACE FLIGHT CENTER

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| **Computer Cost (In thousands of dollars):** | | | |
| Purchase | 8,903 | 11,077 | 7,608 |
| Lease | 5,176 | 6,003 | 7,298 |
| Maintenance | 1,298 | 2,232 | 3,188 |
| Total | 15,377 | 19,312 | 18,094 |
| **Number of Computers (End of Year):** | | | |
| Purchased | 118 | 141 | 145 |
| Leased | 14 | 19 | 13 |
| Purchased/Leased | 31 | 32 | 30 |
| Total | 163 | 192 | 188 |
| **Number of Personnel:** | | | |
| Civil Service | 399 | 413 | 419 |
| Contracting Firm | 822 | 974 | 1,006 |

Contractor Identification

| Name of Firm | Service Performed |
|---|---|
| Aero Geo Astro | Data Reduction and Data Analysis |
| CEIR | Programming |
| Computer Applications | Programming, Operation and Maintenance |
| Computer Service Corp. | Programming |
| Dynalectron (1966 only) | Data Processing |
| IBM | Programming, Operation, Maintenance and Mathematical Analysis |
| The Martin Company | Programming |
| Sperry Rand Corp. | Programming and Analysis |
| System Development Corp. | Programming and Analysis |
| Telecomputing Services Inc. | Data Processing |
| Westinghouse | Programming |
| Wolf R&D Corp. | Programming |

## GODDARD SPACE FLIGHT CENTER

### FY 1966

In carrying out its prime responsibility for supporting the NASA unmanned satellite program, and in providing tracking and communications support to the manned space program, GSFC is a major user of computers. FY 1966 marked the arrival of the first of the third generation IBM computer systems purchased in FY 1965. Two major elements of the system were received: the interim IBM 360/75J was installed at the Goddard Institute for Space Studies in New York City, and an IBM 360/65H was installed at Goddard's Greenbelt complex. Several smaller computers were also acquired on a lease basis to provide support to the major systems. FY 1966 also saw the beginning of the up-dating of the satellite telemetry data reduction system when the first of two Univac 1108 replacements for Univac 1107's was received.

### FY 1967

During FY 1967 the major system up-dating started in FY 1965 to meet the projected growth in support requirements will continue. Major deliveries will include the second IBM 360/65 for the central computing facilities at GSFC Greenbelt, and a second Univac 1108 which will complete the up-dating of the satellite telemetry data reduction system. Again, several small leased computers to support the major systems will be acquired. During FY 1967 a number of small computers are being added as direct flight project support components. The majority of these small computers will be installed at tracking sites to expand the capability of these facilities to meet flight project support requirements.

### FY 1968

FY 1968 will see the completion of the conversion of the GSFC major computing facilities to the third generation systems purchased in FY 1965. The final system IBM 360/95 will be installed at the Institute for Space Studies, replacing the interim IBM 360/75J. At Greenbelt, the remaining five large IBM 360 system computers will be installed. A number of large scale second generation computers and their associated small support computers will be released as the third generation systems become operational. As a result, this year will see the start of a downward trend in the total number of computers at GSFC.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

HEADQUARTERS

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| **Computer Cost (In thousands of dollars):** | | | |
| Purchase | 165 | --- | --- |
| Lease | 90 | 175 | 131 |
| Maintenance | 23 | 28 | 28 |
| Total | 278 | 203 | 159 |
| **Number of Computers (End of Year):** | | | |
| Purchased | 1 | --- | --- |
| Leased | 1 | --- | 1 |
| Purchased/Leased | --- | 1 | 1 |
| Total | 2 | 1 | 2 |
| **Number of Personnel:** | | | |
| Civil Service | 12 | 12 | 11 |
| Contracting Firm | 31 | 31 | 40 |

Contractor Identification

| Name of Firm | Service Performed |
|---|---|
| Documentation, Inc. | Programming and Operations |

## NASA HEADQUARTERS

### FY 1966

Early in FY 1966 NASA Headquarters purchased an IBM 1410 and released an IBM 1401 to the Office of Economic Opportunity through the GSA disposal service program. The increased capacity of the IBM 1410 was necessary to accommodate the greatly expanding demands for timely data needed for management decision making. General scientific calculations for the manned space flight program, including Gemini engineering analysis and mission planning, were performed on an IBM 1620.

### FY 1967

A comprehensive reappraisal has been made of all administrative applications with the objective of optimizing machine utilization. As a result, additional storage and increased printing capacity are being added to the IBM 1410 system to provide a more balanced configuration. The phasing out of the Gemini program provided a logical point at which to review the functions served by the IBM 1620. As a result of this review, the IBM 1620 is scheduled for release in FY 1967. The scientific workload will be divided between the Headquarters IBM 1410 and a leased remote terminal linked to a large Washington area computer, at a considerably reduced cost.

### FY 1968

The projected increase in administrative workload cannot be handled by the IBM 1410. A new computer is therefore planned for installation by the last quarter of FY 1968, following a complete review of Headquarters' computation requirements. Preliminary indications show a need for better accessibility and increased accuracy of data bank information, integratation of related data into single data banks, and increased discipline of total information systems from source data to end product. Future scientific ADP requirements will be met largely by remote terminals linked to major scientific computer systems in the Washington area.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

## JET PROPULSION LABORATORY

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| **Computer Cost (In thousands of dollars):** | | | |
| Purchase | 4,848 | 5,972 | 3,138 |
| Lease | 2,751 | 5,762 | 6,221 |
| Maintenance | 601 | 991 | 1,189 |
| Total | 8,200 | 12,725 | 10,548 |
| **Number of Computers (End of Year):** | | | |
| Purchased | 59 | 72 | 74 |
| Leased | 12 | 17 | 17 |
| Purchased/Leased | 12 | 16 | 17 |
| Total | 83 | 105 | 108 |
| **Number of Personnel:** | | | |
| JPL Staff | 189 | 223 | 244 |
| Contracting Firm | 171 | 236 | 234 |

**Contractor Identification**

| Name of Firm | Service Performed |
|---|---|
| Aerojet General Corp. (1966 only) | Off-Lab. Computer Service |
| Bendix Field Engineering Corp. | Operation |
| Computer Applications, Inc. | Programming and Analysis |
| Computer Services, Inc. | Programming |
| Consultants and Designers, Inc. | Programming |
| Informatics | Programming and Analysis |
| IBM | Programming and Analysis, Operation and Maintenance |
| Planning Research, Inc. | Programming and Analysis |
| RCA | Operation and Maintenance |
| Service Bureau Corp. (1966 only) | Off-Lab. Computer Service |
| Superior Service Bureau | Keypunching |
| VIP Engineering, Inc. | Programming |

## JET PROPULSION LABORATORY

### FY 1966

JPL is the principal center for research and development related to deep space exploration, and provides support for deep space flights. To accomplish this mission, extensive use is made of electronic data processing equipment. The major action that occurred during FY 1966 was the acquisition of a third computing system consisting of three machines by the Space Flight Operations Facility (SFOF). In addition, the administrative computing facility was updated through the acquisition of a medium size third generation computer and two small support computers.

### FY 1967

This year the expansion of the Space Flight Operations Facility will be completed. A fourth computer string will be added through the acquisition of an excess IBM 7094 from the Manned Spacecraft Center and the leasing of the necessary support components. A number of small general purpose computers will also be added to provide direct support of the deep space projects. The majority of these computers will be installed at the tracking sites or in the laboratory as support to the tracking function.

### FY 1968

Third generation replacement equipment for the Scientific Computing Facility of the laboratory will be installed in FY 1968. This system will provide data processing support for all research and development efforts, all mission design and analysis, and post flight data reduction. The introduction of this third generation system will provide the laboratory with an increase in the total computer capability in the scientific areas while at the same time effecting a reduction in the total cost of this ADP support.



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

KENNEDY SPACE CENTER

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| **Computer Cost (In thousands of dollars):** | | | |
| Purchase | 3,817 | --- | 2,048 |
| Lease | 1,332 | 1,780 | 1,556 |
| Maintenance | 60 | 300 | 441 |
| Total | 5,209 | 2,080 | 4,045 |
| **Number of Computers (End of Year):** | | | |
| Purchased | 23 | 33 | 33 |
| Leased | 5 | 4 | --- |
| Total | 28 | 37 | 33 |
| **Number of Personnel:** | | | |
| Civil Service | 52 | 58 | 58 |
| Contracting Firm | 369 | 501 | 474 |

Contractor Identification

| Name of Firm | Service Performed |
|---|---|
| Computer Applications, Inc. | Administrative Applications Programming and Operations |
| Federal Electric Co. | Scientific Applications Programming and Operations |

## KENNEDY SPACE CENTER

### FY 1966

ADP equipment at KSC is used for scientific and engineering computation, automatic checkout work, data reduction and mission control, and administrative applications. The general purpose computer equipment at KSC is operated "on-line" as part of the count down and launch control system for a significant part of its total operating time, since all major vehicle projects are supported. The special purpose checkout computers must be supported by general purpose machines for assembling checkout programs, checkout evaluation, and tabulating results. In the administrative area, financial management, supply accounting, automatic checkout support, vehicle configuration control, and contractor support make up the bulk of the workload. During FY 1966 both IBM 1410's were upgraded to 7010's to handle the increased volume of work in the administrative area.

### FY 1967

To prevent unneccessary cost increases, all general purpose computation at KSC will be consolidated on the GE 635 computers. This has been delayed by late delivery of system software and by rapidly increasing commercial workload, but is expected to be completed by the end of FY 1968. Expansion of the present GE 635 system and the lease of a second processor has been approved and will be implemented during FY 1967. Other equipment actions during FY 1967 include release of the GE 235 and 415 systems and release of one of the IBM 7010's if the workload can be transferred to the GE 635.

### FY 1968

Further consolidation of both business and scientific applications on the GE 635 systems is planned commensurate with the machines' ability to handle the specialized ADP requirements such as on-line and mass storage functions. Additional computing resources do not at this time appear necessary for the Apollo Applications Program. However, the future support role of the KSC Computation Office in this program has not yet been defined.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

LANGLEY RESEARCH CENTER

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| **Computer Cost (In thousands of dollars):** | | | |
| Purchase | 5,460 | 3,455 | 4,627 |
| Lease | 2,876 | 2,755 | 3,452 |
| Maintenance | 52 | 225 | 415 |
| Total | 8,388 | 6,435 | 8,494 |
| **Number of Computers (End of Year):** | | | |
| Purchased | 3 | 10 | 11 |
| Leased | 6 | 3 | 2 |
| Purchased/Leased | --- | 1 | 1 |
| Total | 9 | 14 | 14 |
| **Number of Personnel:** | | | |
| Civil Service | 129 | 134 | 140 |
| Contracting Firm | 35 | 62 | 113 |

Contractor Identification

| Name of Firm | Service Performed |
|---|---|
| Hampton Institute | Read-out and Data Preparation |
| Hayes International Corp. | Keypunching |
| IBM | Maintenance |
| Unselected | Programming |

## LANGLEY RESEARCH CENTER

### FY 1966

ADP requirements at Langley are primarily for support of the Space Flight Program and the Aeronautical Research Program. Increased demands are being placed on Analytical and Engineering computations, particularly for increased computation speeds, larger bulk memories, and greater precision. Increased requirements include analysis of composite structures and studies of dynamic systems involving control and environment as applicable to launch vehicles and spacecraft of the Saturn, Titan, and Lunar Lander type; and, Langley must convert from analog to digital simulation to meet requirements for research on projects such as Lunar Orbiter. Langley has completed feasibility studies and has scheduled installation of new third generation CDC equipment as a part of this conversion. Scientific and Engineering requirements are presently on the IBM 7094/40 DCS systems, including 16 remote terminals located in research labs and at other strategic points throughout the Center. Data reduction requirements are primarily for conversion of experimental data from wind tunnels and other ground test facilities as well as flight test. Increased requirements are for larger, more flexible memory to accommodate larger data files, and increased flexibility of input/output. ADP equipment at Langley is currently scheduled approximately three shifts per day with some operating around-the-clock. Utilization during FY 1966 was approximately a 90% increase over the previous year.

### FY 1967

Two of the three phases of the third generation CDC 6400/6600/6800 integrated computer complex will be installed. The new generation equipment will allow Langley to gradually combine all general purpose applications into a single integrated operation. Release of present equipment will follow as the workload is shifted over to the new generation system. Langley is continuing to install IBM 1050 system remote terminal equipment in various lab facilities and it is expected that this will continue through FY 1967. The need for peripheral equipment is constantly changing as program techniques and computers are changed. It is anticipated that minor additions of this type of equipment will continue to be made.

### FY 1968

The third phase of new generation equipment is scheduled for installation this fiscal year, and will allow Langley to expand facilities to include digital simulation, which is required to meet the need for greater accuracy, increased flexibility, and more sophisticated function generators. These requirements relate directly to Lunar Orbit and Landing Approach and to Space and Launch Vehicle control problems. Other applications include glide slope and air traffic control studies (FAA) and air combat studies for DOD.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

LEWIS RESEARCH CENTER

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| **Computer Cost (In thousands of dollars):** | | | |
| Purchase | 2,163 | --- | --- |
| Lease | 321 | 184 | 77 |
| Maintenance | 68 | 94 | 129 |
| Total | 2,552 | 278 | 206 |
| **Number of Computers (End of Year):** | | | |
| Purchased | 6 | 8 | 8 |
| Leased | 2 | 1 | 1 |
| Total | 8 | 9 | 9 |
| **Number of Personnel:** | | | |
| Civil Service | 154 | 148 | 148 |
| Contracting Firm | --- | --- | --- |

**Contractor Identification**

| Name of Firm | Service Performed |
|---|---|
| NONE | |

## LEWIS RESEARCH CENTER

### FY 1966

Lewis Research Center utilizes ADP equipment primarily for Scientific and Engineering work as related to the Center's primary function, research and development of techniques for advanced propulsion and space power generation. Major new ADP requirements result from improved, or new, research facilities which include more sophisticated data acquisition devices. These increasing requirements are consistent with a rapidly evolving state of the art for investigating fundamental energy conversion processes, and for development of more efficient conversion techniques. During FY 1966 steps were taken to transfer the growing data reduction workload from the Univac 1103 to the IBM 7094/44 DCS on an interim basis. The anticipated installation of the IBM 360/67 was delayed, resulting in around-the-clock use of the DCS system.

### FY 1967

Scientific and Engineering work includes basic as well as applied research. Applications range from basic heat transfer calculations to trajectory calculations and other elements of mission analysis. As an example, engine design requires mission oriented input to predict performance during all flight phases. The 7094/44 DCS is expected to continue meeting this requirement through FY 1968. Data reduction includes test results from wind tunnels, space environment facilities, and thermal reactors. Other specialized experimental facilities include rocket static thrust stands, and a full scale non-nuclear NERVA test stand for the study of engine control dynamics. The IBM 360/67 computer system is being installed to be used primarily for data reduction. During the transition period, a large percentage of the data reduction workload is scheduled on the 7094 DCS system. The LeRC Fiscal Division uses an IBM 1401 for administrative support services to the entire Center. This is supplemented by the IBM 1620 located at the Plum Brook station.

### FY 1968

LeRC will continue basic and applied research studies in space power and electrical propulsion systems, chemical propulsion, and nuclear rockets. ADP requirements indicate a need for a more modular type design to allow installation of remote facilities. This refers primarily to test data acquisition from the large variety of testing facilities but will include a need for the display-interrogate type remote consoles.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

MANNED SPACECRAFT CENTER

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| **Computer Cost (In thousands of dollars):** | | | |
| Purchase | 7,218 | 2,150 | 300 |
| Lease | 18,097 | 20,195 | 15,277 |
| Maintenance | 467 | 719 | 592 |
| Total | 25,782 | 23,064 | 16,169 |
| **Number of Computers (End of Year):** | | | |
| Purchased | 57 | 67 | 70 |
| Leased | 28 | 18 | 19 |
| Purchased/Leased | 9 | 7 | 6 |
| Total | 94 | 92 | 95 |
| **Number of Personnel:** | | | |
| Civil Service | 192 | 206 | 207 |
| Contracting Firm | 1,241 | 1,360 | 1,300 |

Contractor Identification

| Name of Firm | Service Performed |
|---|---|
| IBM | RTCC System Design, Programming and Operations |
| Philco | RTCC System Design and Programming |
| Lockheed | General Purpose Computation, Programming and Operations |

## MANNED SPACECRAFT CENTER

### FY 1966

At the Manned Spacecraft Center the Computation and Analysis Division (CAD) is responsible for general purpose scientific computation, data reduction and commercial data processing; the Flight Operations Directorate (FOD) manages the operation of the Real Time Computer Complex (RTCC) which is the computing and data processing facility controlling all manned spacecraft missions; and the Information Systems Division is responsible for most of the special purpose equipment. The culmination of the Gemini program coincident with Apollo development caused a doubling of computation requirements in 1966 as compared to 1965 workload.

### FY 1967

Four major equipment actions are planned during FY 1967. Late in FY 1966 replacement of the IBM 7094/7044 and the IBM 7040 was approved. A competitive selection resulted in chosing Univac 1108 systems scheduled for delivery to CAD starting in mid FY 1967. The second equipment action planned is the upgrading of the CDC 3600 used for Guidance and Control Applications to a CDC 3800. The IBM 7094's used to support Mission Planning and Analysis and for contractor support are saturated and must be augmented during FY 1967. (Plans to effect this augmentation call for three peripheral processors linked to the large central computers through the Univac 418 communications processor. IBM 360/30 processors presently installed can act as remote terminals in addition to handling peripheral functions pending a competitive procurement of terminal equipment.) Within FOD the conversion from IBM 7094's to IBM 360's which started in FY 1966 was completed in FY 1967. All 7094's will be phased out by March 1967, following installation of five 360/75's. Several smaller 360 computers leased during the interim conversion phase will be released.

### FY 1968

At this time, no major equipment actions are scheduled for MSC during FY 1968 unless there are significant changes in the overall MSC program responsibilities. It may be necessary to augment the CAD Univac 1108 computer systems if the general purpose computation requirements increase substantially or if additional responsibilities are transferred to MSC.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

MARSHALL SPACE FLIGHT CENTER

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| **Computer Cost (In thousands of dollars):** | | | |
| Purchase | 1,169 | 28 | 26 |
| Lease | 9,145 | 9,742 | 9,305 |
| Maintenance | 420 | 460 | 477 |
| Total | 10,734 | 10,230 | 9,808 |
| **Number of Computers (End of Year):** | | | |
| Purchased | 91 | 95 | 93 |
| Leased | 36 | 40 | 18 |
| Purchased/Leased | 11 | 11 | 7 |
| Total | 138 | 146 | 118 |
| **Number of Personnel:** | | | |
| Civil Service | 185 | 189 | 189 |
| Contracting Firm | 1,142 | 1,236 | 1,313 |

Contractor Identification

| Name of Firm | Service Performed |
|---|---|
| **Huntsville** | |
| Computer Science Corp. | Computer Operations and Programming |
| **Slidell** | |
| Ling-Temco-Vought | Programming and Operations |
| Boeing | Programming and Operations |
| Chrysler | Programming and Operations |
| Mason-Rust | Programming and Operations |
| General Electric | Programming and Operations |
| North American Aviation | Programming and Operations |

## MARSHALL SPACE FLIGHT CENTER

### FY 1966

MSFC computation requirements are served by large central computer complexes at Huntsville and at Slidell, La., in addition to a variety of smaller computers located in the MSFC research laboratories. During FY 1966 increasing workload in the administrative area required upgrading of two IBM 1410's at Huntsville to IBM 7010's. Also during FY 1966 the decision was made to centralize all computations in the Huntsville area into the central complex; and increased contractor requirements forced the planned replacement of present equipment at Slidell. A combined procurement was initiated which resulted in selection of three Univac 1108's to be installed at Huntsville and two to be installed at Slidell.

### FY 1967

The plan to replace most decentralized scientific computers at Huntsville with remote terminals and combine the scientific and commercial workload at the central computer facility will require several years to implement. Since some of the peripheral and decentralized machines will become economic liabilities prior to the time when they could be replaced by third generation equipment, plans now call for an interim replacement of four IBM 1620's and three IBM 1401's with machines of greater capability at substantially less cost during FY 1967. At Huntsville, installation of the third generation systems is scheduled in three phases with the first phase planned for late FY 1967 and with final implementation in late FY 1968. At Slidell, the conversion started with the installation of a Univac 1108 in October 1966. Other computer actions planned at MSFC/Slidell during FY 1967 include conversion of an IBM 7094/40 DCS from lease to purchase; and release of two H 800's, an H 200, an IBM 7094 and an IBM 1401.

### FY 1968

During FY 1968 most of the decentralized general purpose computers at Huntsville can be released as they are replaced by terminals linked to the central facility. Approximately 20 central processors are involved. Additional expansion of the facilities will be required for launch support and real-time flight support functions. New programs, however, are not expected to have sufficient impact on requirements to justify additional computers. At Slidell, the remaining Honeywell and IBM computers are planned for release during FY 1968 as the conversion to Univac third generation systems is completed.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

SPACE NUCLEAR PROPULSION OFFICE

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| **Computer Cost (In thousands of dollars):** | | | |
| Purchase | --- | --- | --- |
| Lease | 168 | 360 | 360 |
| Maintenance | --- | --- | --- |
| Total | 168 | 360 | 360 |
| **Number of Computers (End of Year):** | | | |
| Purchased | --- | --- | --- |
| Leased | 1 | 1 | 1 |
| Total | 1 | 1 | 1 |
| **Number of Personnel:** | | | |
| Civil Service | --- | --- | --- |
| Contracting Firm | 13 | 6 | 7 |

Contractor Identification

| Name of Firm | Service Performed |
|---|---|
| Pan American World Airways, Inc. | Programming, Analysis and Operations |

## SPACE NUCLEAR PROPULSION OFFICE

### FY 1966

The Space Nuclear Propulsion Office (SNPO) Nuclear Rocket Development Station (NRDS), Nevada, uses ADP equipment for data reduction from engine test stands, and engineering analysis of test results. The major test projects are PHOEBUS - testing of advanced nuclear rocket reactors; and NERVA - testing rocket reactors and engines. ADP requirements are steadily increasing as work progresses toward full scale engine systems development phases. Administrative support includes monitoring data and control channels to generate work orders required for status modifications and to maintain the channel data logs. Work orders and miscellaneous instruction reports are issued daily, semi-weekly, and weekly. Cost accounting and inventory control are currently a part of the ADP business applications and require weekly, semi-monthly, monthly and quarterly reports. The NRDS uses a CDC 3200 computer for ADP applications.

### FY 1967

ADP requirements will continue to increase, particularly for data reduction and analysis from engine systems testing phases. Test data are recorded directly on specially designed magnetic digital tape for input to the CDC 3200 computer. The Center is evaluating methods for improving data acquisition in other areas, particularly in the area of optical readers.

### FY 1968

ADP requirements are expected to remain fairly steady during continued test and analysis of engine systems. New ADP developments will center primarily around improved and more sophisticated data collection devices for direct input to the central processor. Additional requirements will include some type of display-interrogation for quick look, as well as improved utilization of the central computer.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF REQUIREMENTS

WALLOPS STATION

| | FY 1966 | FY 1967 | FY 1968 |
|---|---|---|---|
| **Computer Cost (In thousands of dollars):** | | | |
| Purchase | 509 | 369 | --- |
| Lease | 63 | 41 | 120 |
| Maintenance | 23 | 77 | 82 |
| Total | 595 | 487 | 202 |
| **Number of Computers (End of Year):** | | | |
| Purchased | 2 | 3 | 3 |
| Leased | --- | --- | --- |
| Purchased/Leased | 1 | 1 | 1 |
| Total | 3 | 4 | 4 |
| **Number of Personnel:** | | | |
| Civil Service | 14 | 15 | 15 |
| Contracting Firm | 18 | 24 | 33 |

Contractor Identification

| Name of Firm | Service Performed |
|---|---|
| General Electric | Programming |
| Philco | Programming |
| Technitrol Engineering, Inc. | Operation and Data Reduction |
| Undetermined (in 1968) | Operation and Programming |

## WALLOPS STATION

### FY 1966

Wallops Station provides support to a wide variety of programs in the fields of scientific research, vehicle testing, and testing of flight hardware. The station also provides launching facilities for sounding rockets and certain of the smaller satellites. To accomplish these tasks, a small inventory of computers is required. The major computing effort at the station is provided by a central computing complex. During FY 1966 this facility was modernized through the replacement of the existing system with a third generation GE 625. A small general purpose computer was also procured to provide full time support to the OWL satellite project.

### FY 1967

During FY 1967 a small general purpose computer will be procured for integration into the station's Mobile Range System. Other ADP expenditures will provide components for expansion of the capabilities of existing systems. Since the GE 625 has certain leased peripherals, some leasing funds must be provided.

### FY 1968

No computer purchases are scheduled for FY 1968. It is contemplated that an additional processing unit for the GE 625 will be procured as a leased item. This unit will provide the system with a greater data reduction capability to meet increased requirements arising from the station's growing launch program.



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