

NASA

National Aeronautics and
Space Administration

Budget Estimates

FISCAL YEAR 1989

Volume III

Research and Program Management

Special Analyses

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1989 ESTIMATES

VOLUME III

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RESEARCH AND
PROGRAM
MANAGEMENT

SUMMARY
INFORMATION

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1989 ESTIMATES

GENERAL STATEMENT

The Research and Program Management appropriation funds the performance and management of research, technology and test activities at NASA installations, and the planning, management and support of contractor research and development tasks necessary to meet the Nation's ongoing objectives in aeronautical and space research. The objectives of the activities funded by the Research and Program Management appropriation are to (1) provide the civil service staff with the technical and management skills to conduct the full range of programs for which NASA is responsible, (2) provide base maintenance of facilities and manage its use in support of research and development programs, and (3) provide effective and efficient technical and administrative support for the research and development programs. For 1989, an appropriation of \$1,915,000,000 is requested.

The 1989 Research and Program Management appropriation request provides funding for the 22,950 permanent and temporary civil service workyears (FTE) at eight major installations and Headquarters. This civil service workforce is NASA's most important resource and is vital to future space and aeronautics research activities. At the direction of the Committees on Appropriation, NASA, beginning in 1988, has realigned the R&D/SFCDC and R&PM appropriation structures. In the realigned R&PM appropriation, about fifty nine percent provides for the salaries and related costs of the civil service workforce. Three percent is for travel, critical to manage successfully the agency's in-house and contracted programs. The remaining amount of the Research and Program Management appropriation provides for the research, test and operational facility support, and for related goods and services necessary to operate efficiently and effectively the NASA installations and to accomplish NASA's approved missions.

NASA field centers report to the Program Associate Administrator responsible for the major portion of their technical programs. The principal roles assigned to each installation, based on demonstrated capabilities and capacities to meet NASA's overall program goals, are as follows:

Office of Space Flight:

Johnson Space Center: Management of the Space Shuttle program, including orbiter production and operation; selection and training of astronauts and mission specialists; Space Transportation System Operations including mission planning, operational procedures and flight control; and management of the Space Station Truss system, airlocks and nodes, subsystems development, including propulsion and EVA, and operations planning and definition.

Kennedy Space Center: Launch of Space Shuttle flights; management of the ground operational phase of the Space Transportation System; the preparation and launch of payloads on the Space Shuttle and expendable launch vehicles, and Space Station operational readiness planning.

Marshall Space Flight Center: Management of the Space Shuttle main engine, solid rocket booster and external tank projects; management of NASA's activities on the Spacelab project; management of large automated spacecraft projects such as the Hubble Space Telescope; conduct and development of experiments in materials processing in space; and management of the Space Station habitation, logistics and laboratory modules.

National Space Technology Laboratories: Space Shuttle engine testing; Earth resources research and technology transfer; and provision of support service functions for other Government agencies located on site.

Office of Space Science and Applications

Goddard Space Flight Center: Development and Operation of Earth orbital flight experiments and automated spacecraft to conduct scientific investigations and demonstrate practical applications; management of tracking and data acquisition activities; management of the Delta launch vehicle program; management and launch of sounding rockets and balloons; operation of an instrumented flight range for aeronautical and space research; and development of the Space Station platforms and payload accommodations. The Wallops Flight Facility is an operational element and component installation of the Goddard Space Flight Center.

Office of Aeronautics and Space Technology:

Ames Research Center: Conduct of activities involving experimental and theoretical aerodynamics research, computational fluid dynamics, aeronautical flight research and testing, rotorcraft technology, short and vertical takeoff and landing technology, technology for transatmospheric vehicles, planetary probe research, life sciences, human factors, autonomous systems, guidance and control, and operation of an alternate landing site for the Space Shuttle operational missions. The Dryden Flight Research Facility, an operational element and component installation of Ames located in the Mojave Desert, is the site of advanced flight testing and shuttle landings.

Langley Research Center: Conduct of subsonic aircraft research and technology, emphasizing fuel conservation, safety and environmental effects; hypersonic propulsion; experimental and theoretical aerodynamics; environmental quality monitoring by remote sensing; advanced space systems technology; and research in the areas of structures and materials, guidance and controls, and airframe/propulsion integration of the transatmospheric research and technology program.

Lewis Research Center: Conduct of aeronautical and space propulsion research and technology, including propulsion for the transatmospheric research and technology program; space communications research and technology; space energy systems research and technology; development of the space station power system; and management of expendable launch vehicle programs.

The 1989 budget provides the necessary resources to apply these in-house capabilities to program activities. Detailed data on funding requirements are provided in the section on each installation. A summary description of, and the funding required by functional category, include:

1. Personnel and Related Costs (\$1,131,008,000): Includes salaries and benefits, the government's contribution to personnel benefits for NASA permanent and temporary civil service employees (including the government's cost of the Federal Employees Retirement System (FERS) and the Civil Service Retirement System (CSRS)), and for personnel of other Government agencies detailed to NASA. In 1989, the cost of an additional 525 FTE is included. The additional FTE will complete the staffing requirements for STS recovery and strengthen further the NASA IG staff. This category also includes other personnel related costs, such as moving expenses (excluding the associated travel of people), recruiting and personnel investigation services provided by the Office of Personnel Management, and the training of NASA civil service employees.

2. Travel (\$51,000,000): Includes the cost of transportation, per diem, and related travel expenses of civil service employees who travel for the direction, coordination and management of NASA program activities including overseas launch and tracking sites; for contract management; for flight mission support; for meetings and technical seminars and symposia; and for permanent and temporary relocations.

3. Operation of Installation (\$732,992,000): Provides a broad range of services, supplies, and equipment in support of each center's institutional activities. These are divided into three major subfunctional areas: Facilities Services, covering the cost of rental of real property, maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; Technical Services, covering the cost of automatic data processing for management activities, and the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations, covering the cost of administrative communications, printing, transportation, medical, supply, and related services. The realignment of appropriation structures in 1988 affected the Operation of Installation portion of R&PM. An analysis of the restructuring is contained in the final section of this book. The amounts by major subcategory are as follows:

- A. Facilities Services (\$302,588,000): Includes rental of real property; the cost of maintenance, repair and related activities for facilities and equipment; custodial services; minor modifications and alterations; and utilities services.
- B. Technical Services (\$183,598,000): Includes the cost of general purpose automatic data processing for management activities (including development of agencywide automated systems); education and informational programs; other essential technical services.
- C. Management and Operations (\$246,446,000): Includes the cost of administrative communications; printing and reproduction; administrative supplies; general purpose materials and equipment; transportation of equipment and supplies (including payments to interagency motor pools); medical services and other support.

SUMMARY OF THE BUDGET PLAN BY FUNCTION

	<u>1987</u>	<u>1988</u>		<u>1989</u>
	<u>Actual</u>	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
		(Thousands of Dollars)		
I. Personnel and Related Costs.....	1,009,098	1,111,631	1,036,958	1,131,008
11. Travel.....	36,410	43,312	42,800	51,000
III. Operation of Installation.....	406,004	685,495	663,242	732,992
A. Facilities Services.....	(210,827)	(273,944)	(272,121)	(302,588)
B. Technical Services.....	(81,249)	(177,988)	(165,212)	(183,958)
C. Management and Operations....	<u>(113,928)</u>	<u>(233,563)</u>	<u>(225,909)</u>	<u>(246,446)</u>
Total.....	<u>1,451,512</u>	<u>1,840,438*</u>	<u>1,743,000</u>	<u>1,915,000</u>

* Includes appropriation realignment implemented in 1988 to adjust for institutional activities funded in the R&D and SFCDC appropriations.

SUMMARY OF CHANGES FROM THE 1988 BUDGET TO THE 1988 CURRENT ESTIMATE

The 1988 Budget request of \$1,598 million has been revised to \$1,864.9 million to reflect requirements changes. The current R&PM plan of \$1743.0 million results from the following actions:

1988 Budget Request.....	1,598.0
Pay Raises.....	19.6
Appropriation Realignment.....	242.4
DOD Transfer (ALS)	<u>4.9</u>
Agency 1988 Requirement.....	1,864.9
Required Reductions.....	<u>121.9</u>
1988 Program Plan.....	<u>1,743.0</u>

The appropriation reduction of \$102.3 million coupled with the full absorption of \$19.6 in 1988 pay raises and the added requirement in R&PM (\$4.9 million) related to the transfer of ALS work from DOD results in a net change in 1988 of \$121.9 million.

BASIS OF THE 1989 ESTIMATE

The 1989 Budget estimate of \$1,915,000,000, an increase of \$214.0 million over the current 1988 R&PM plan, provides for: a civil service ceiling of 22,950 workyears (an increase of 525 FTE from 1988), the funds needed to restore 1988 reductions, the full year cost of the 1988 pay raises, security/protection for the Space Transportation Systems as a national resource; conduct of definitional review/studies for the OMB required "centralized" Financial and Accounting System; establishment of a NASA Project Management Institute; a minimum level of travel to support Agency missions and programs; support service contractor effort at the anticipated wage-rates; utility usage consistent with programmatic requirements at projected rates; and supplies, materials, equipment and other minor contracts and services at anticipated price levels consistent with the planned resumption of Space Shuttle Flights.

The Research and Program Management appropriation request for 1989, by functional category is summarized below.

1. Personnel and Related Costs (\$1.131.008.000): The 1989 estimate for Personnel and Related Costs is \$94.0 million higher than 1988. Of the increase, \$42.0 million is related to the 1988 reductions (shown in Center justifications as permanent compensation and retirement), \$6.1 million is for the full year cost of 1988 pay increases, \$23.8 million for the compensation, benefits and supporting costs for the 525 additional FTE, establishment of a project management institute (\$2.0 million) and the balance (\$20.1 million) is for changes in reimbursements received, career development costs and other changes in salaries and benefits paid. The additional 525 FTE will complete the staffing requirements for STS recovery and strengthen further The NASA IG staff. (Note: The full civil service staffing increase needed to manage the Space Station adequately and to revitalize the NASA institution fully will be subject of further review with OMB in the spring of 1988.)

2. Travel (\$51.000.000): Because the vast majority of NASA funds are spent for activity in the private sector (over 85%), travel for both programmatic and management purposes is integral to the effective and economical accomplishment of program objectives. In addition, because NASA's civil service workforce is so heavily technical (over 50 percent of NASA's permanent personnel are degreed scientists and engineers) travel to scientific and technical meetings, seminars and symposia is important for the interchange of

information and maintenance of their technical currency. In 1989, the growth in travel over 1988 is associated with the added 525 FTE (\$3.0 million) and the expected rise in the general cost of transportation, per diem and miscellaneous travel expenses, as well as the anticipated demands of project and other management travel.

3. Operation of Installation (\$732,992,000): The 1989 plan provides for anticipated changes in the price levels of support service contractor wage rates and utility rates, the alteration in the funding plans from reimbursable launch vehicles activities, the change in price levels for supplies, materials, and equipment, and minor changes in the levels of support provided as center requirements change and Space Shuttle flights resume. In addition, funds are requested to support the 525 additional FTE planned for in 1989, the security improvements for STS and the start of the NASA part of a governmental "centralized" financial and accounting system.

- A. Facilities Services (\$302,588,000): The 1989 estimate, an increase of \$30.5 million over the 1988 current estimate, covers the anticipated rate and price increases for utilities support contractor wage rates, supplies, materials, equipment and minor contractual effort, minor changes to support levels, principally needed as Space Shuttle flights resume and support to increased civil service staffing and the security improvements for STS.
- B. Technical Services (\$183,958,000): The \$18.7 million increase in 1989 covers anticipated support service contractor wage-rates, the anticipated cost of supplies, materials, equipment and other contractual efforts, support to increased civil service staffing and the "centralized" Financial and Accounting Systems.
- C. Management and Operations (\$246,446,000): The \$20.5 million increase in this subcategory is the result of the support to increased civil service staffing, increased costs of supplies, materials, equipment and minor contractual effort, the anticipated change in support service contractor wage-rates, and the changes in levels of support required, driven chiefly by the resumption of Space Shuttle flights.

In summary, the 1989 budget requirement of \$1,915,000,000 is to provide for 22,950 full-time equivalent civil service workyears and to support the activities at eight NASA installations and Headquarters, consistent with the Research and Development, Space Flight, Control and Data Communications, and Construction of Facilities program plans.

DETAIL OF CONTENTS BY FUNCTION

I. PERSONNEL AND RELATED COSTS

A. COMPENSATION AND BENEFITS:

1. Compensation:

- a. Permanent Positions: This part of Personnel and Related Costs covers the salaries of the full-time permanent civil service workforce and is the largest piece of this functional category.
- b. Other Than Full-Time Permanent Positions: This category includes the salaries of NASA's non-permanent workforce. Programs such as students participating in cooperative training, summer employment, youth opportunity, and temporary clerical support are covered in that is category.
- c. Reimbursable Detailees: In accordance with existing agreements, NASA reimburses the parent Federal organization for the salaries and related costs of persons detailed to NASA.
- d. Overtime and Other Compensation: Overtime, holiday, post and night differential, and hazardous duty pay are included in this category. Also included are incentive awards for outstanding achievement and superior performance.

2. Benefits: In addition to compensation, NASA, as authorized and required by law, makes the employer's contribution to personnel benefits. These benefits include contributions to the Civil Service Retirement Fund, the Federal Employees Retirement System, employees' life and health insurance, payments to the Medicare fund for permanent employees, and social security contributions for non-permanent personnel. Payments to the civil service retirement fund for re-employed annuitants and for severance pay to former employees involuntarily separated through no fault of their own are also included.

B. SUPPORTING COSTS:

1. Transfer of Personnel: Provided under this category are relocation costs required by law, such as the expenses of selling and buying a home, and the movement and storage of household goods.
2. Office of Personnel Management Services: The Office of Personnel Management is reimbursed for activities such as security investigations on new hires, recruitment advertising, and career-maturity surveys.
3. Personnel Training: Training is provided within the framework of the Government Employees Training Act of 1958. Part of the training costs consists of courses offered by other Government agencies, and the remainder provides for training through nongovernment sources.

11. TRAVEL

A. Program Travel:

The largest part of travel is for direction, coordination and management of program activities including international programs and activities. The complexity of the programs and the geographical distribution of NASA installations and contractors necessitate the need for this category of travel. As projects reach the flight stage, support is required for prelaunch activities, including overseas travel to launch and tracking sites. The amount of travel required for flight projects is significant as it is directly related to the number of systems and subsystems, the number of design reviews, and the number and complexity of the launches and associated ground operations.

B. Scientific and Technical Development Travel:

Travel to scientific and technical meetings and seminars permits employees engaged in research and development to participate in both Government sponsored and nongovernment sponsored activities. This participation allows personnel to benefit from exposure to technological advances which arise outside NASA, as well as allowing personnel to present both accomplishments and problems to their associates and provides for the dissemination of technical results to the United States community. Many of the Government sponsored meetings are working panels convened to solve certain problems for the benefit of the Government.

C. Management and Operations Travel:

Management and operations travel provides for the direction and coordination of general management matters and travel by officials to review the status of programs. It includes travel by functional managers in such areas as personnel, financial management and procurement. This category also includes the cost of travel in and around the Installations; travel of unpaid members of research advisory committees; and initial duty station, permanent change of assignment, and other family travel expenses. Payments to interagency motor pools are included in the Operation of Installation function (Management and Operations subfunction).

111. OPERATION OF INSTALLATION

Operation of Installation provides a broad range of services, supplies, and equipment in support of the centers' institutional activities. These are divided into three major subfunctional areas: Facilities Services (the cost of renting real property, maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities); Technical Services (the cost of automatic data processing for management activities, and the cost of educational and information programs and technical shops supporting institutional activities); and Management and Operations (the cost of administrative communications, printing, transportation, medical, supply, and related services). The content of the following subfunctions has been adjusted to reflect the realignment of the R&PM appropriation. A description of each major subfunction follows:

A. Facilities Services:

1. Rental of Real Property: Rental of real property includes the rental of building space directly by NASA or through the General Services Administration to meet offsite office, warehousing, and other requirements which cannot otherwise be provided in existing buildings at the NASA Installation. Most of the funding is required for rental of the NASA Headquarters complex of buildings in the District of Columbia, and nearby Maryland and Virginia that are either Government-owned or leased. NASA must provide rental payments to the General Services Administration in accordance with P.L. 92-313 for these facilities.
2. Maintenance and Related Activities: Maintenance and related activities include the recurring day-to-day maintenance of facilities (grounds, buildings, structures, etc.) and equipment accomplished by non-Civil Service personnel. This involves the mowing and care of grassy areas, care of trees and shrubs, elevators, cranes, pressure vessel inspections, painting and protective coatings, general buildings maintenance, and the maintenance of installed mechanical, electrical, and other systems. In addition, this item includes feasibility studies, project design, construction supervision, inspection, and other institutional facility engineering functions. Included also are any applicable costs associated with recurring facility work as well as materials, hardware, and equipment used in facility maintenance activities, whether accomplished by civil service personnel or contractors. In the cost of equipment, related maintenance and other services are reflected for office, shop, laboratory and other facilities equipment as well as administrative internal communications and television monitoring equipment.

3. Custodial Services: Custodial services include janitorial and building cleaning services, pest control, fire protection services, security services including badging and identification, lock and safe repair, trash and refuse handling, window blinds and light fixture cleaning, and laundry and dry cleaning of facility related items.
4. Utilities Services: Utilities services include the purchase of utilities such as electricity, natural gas, fuel oil, coal, steam, propane, and other fuel commodities as well as water and sewage treatment services. Also included are the related maintenance and operating costs of the utility plants and systems.

B. Technical Services:

1. Automatic Data Processing:

- a. Equipment: This category provides for the lease, purchase and maintenance of general purpose data processing equipment which supports institutional operations at each installation. Excluded is equipment dedicated to specific research or operational systems which is funded from the Research and Development or the Space Flight, Control and Data Communications appropriations.
- b. Operations: Operations services include programming, computer operations and related services for institutional applications including payroll, financial management, security, maintenance, personnel, logistics, and procurement records and reports.

2. Scientific and Technical Information and Educational Programs:

- a. Libraries: The technical libraries are established to provide installation staff with **books**, periodicals, technical reports and other scientific documentation.
- b. Education and Information Programs: The educational and informational programs provide for the documentation and dissemination of information about the Agency's programs to the general public, the educational community at the elementary and secondary levels, and the mass communications media. Assistance to the mass communications media includes the assembly and

exposition of newsworthy material in support of requests in the form of press kits, news releases, television and radio information tapes and clips, and feature material.

- c. Support Services: Support services include safety, and the production of general photographic services, graphics, and audio-visual materials.

C. Management and Operations:

1. Administrative Communications: Included in this category are costs not dedicated to a specific program or project, and cover leased lines, long distance tolls (including FTS charges), teletype services, and local telephone service.
2. Printing and Reproduction: Included in this category are the costs for duplicating, blueprinting, microfilming, and other photographic reproductions. Also included in this category are Government Printing Office printing costs, contractual printing and the related composition and binding operations.
3. Transportation: Transportation services include the operation and maintenance of all general purpose motor vehicles used by both civil service and support contractor personnel and the operation of the NASA administrative aircraft fleet. The cost of movement of supplies and equipment by commercial carriers and payments to interagency motor pools are also in this category.
4. Installation Common Services: Installation common services include support activities at each installation such as: occupational medicine and environmental health; mail service; supply management; patent services; administrative equipment; office supplies and materials; and postage.

DISTRIBUTION OF PERMANENT CIVIL SERVICE WORKYEARS BY INSTALLATION

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
Johnson Space Center.....	3.254	3.366	3.340	3.460
Kennedy Space Center.....	2.056	2.057	2.131	2.324
Marshall Space Flight Center.....	3.290	3.394	3.364	3.461
National Space Technology Laboratories..	128	138	139	159
Goddard Space Flight Center.....	3.624	3.576	3.578	3.584
Ames Research Center.....	2.064	2.059	2.068	2.068
Langley Research Center.....	2.809	2.812	2.812	2.812
Lewis Research Center.....	2.652	2.638	2.647	2.646
Headquarters.....	1.287	1.512	1,489	1.559
Inspector General.....	<u>108</u>	<u>126</u>	<u>126</u>	<u>151</u>
Subtotal. Full-Time Permanent Workyears.....	21.272	21.678	21.694	22.224
Other Than Full-Time Permanent Workyears.....	<u>729</u>	<u>747</u>	<u>731</u>	<u>726</u>
Subtotal. Ceiling Controlled FTE.....	<u>22.001</u>	<u>22.425</u>	<u>22.425</u>	<u>22.950</u>

SUMMARY OF BUDGET PLAN BY INSTALLATION

(Thousands of Dollars)

	<u>1987</u>	<u>1988</u>	<u>1988</u>	<u>1989</u>
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
Johnson Space Center.....	227,912	300,869	276,896	301,526
Kennedy Space Center.....	200,247	243,068	234,319	270,475
Marshall Space Flight Center.....	212,046	247,039	231,114	249,104
National Space Technology Laboratories..	12,020	21,257	20,699	23,348
Goddard Space Flight Center.....	213,852	255,831	236,741	256,823
Ames Research Center.....	133,618	169,677	167,994	179,398
Langley Research Center.....	154,337	187,673	174,629	185,255
Lewis Research Center.....	151,749	192,344	178,337	191,453
Headquarters.....	139,394	214,731	214,812	248,171
Inspector General.....	<u>6,337</u>	<u>7,949</u>	<u>7459</u>	<u>9.447</u>
 Total, Research and Program Management.....	 <u>1.451.512</u>	 <u>1.840.438*</u>	 <u>1.743.000</u>	 <u>1.915.000</u>

* Includes appropriation realignment implemented in 1988 to adjust for institutional activities funded in the R&D and SFCD appropriations.

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM
TOTAL NASA

	1987 ACTUAL	1988		1989 BUDGET ESTIMATE
		REVISED ESTIMATE	CURRENT ESTIMATE	
SPACE STATION.....	1,819	2,779	2,095	2,095
SPACE FLIGHT PROGRAMS.....	5,343	4,883	5,420	5,920
SPACE TRANSPORTATION CAPABILITY DEV. SPACE SHUTTLE.....	1,353 3,990	1,172 3,711	1,368 4,052	1,389 4,531
SPACE SCIENCE AND APPLICATIONS.....	3,980	3,754	3,745	3,720
PHYSICS AND ASTRONOMY.....	2,120	1,943	1,962	1,933
LIFE SCIENCES.....	241	246	248	248
PLANETARY EXPLORATION.....	203	180	191	190
SPACE APPLICATIONS.....	1,416	1,385	1,344	1,349
AERONAUTICS AND SPACE TECHNOLOGY.....	4,704	4,812	4,899	4,092
AERONAUTICAL RESEARCH AND TECHNOLOGY SPACE RESEARCH AND TECHNOLOGY.....	3,121 1,334	3,192 1,296	3,153 1,433	3,124 1,455
TRANSATMOSPHERIC RESEARCH & TECH....	249	324	313	313
COMMERCIAL PROGRAMS.....	134	129	151	150
SAFETY, RELIABILITY & QUALITY ASSURANCE.	46	60	60	60
TRACKING AND DATA PROGRAMS.....	687	668	695	684
SUBTOTAL DIRECT.....	16,713	17,085	17,065	17,521
CENTER MANAGEMENT AND OPERATIONS.....	4,559	4,593	4,629	4,703
SUBTOTAL (FULL-TIME PERMANENTS)....	21,272	21,678	21,694	22,224
OTHER CONTROLLED FTE'S..... (PMI's/CO-OPS/OTFTP's)	729	747	731	726
GRAND TOTAL (FULL-TIME EQUIVALENTS)	22,001	22,425	22,425	22,950

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND PROGRAM MANAGEMENT - FY 1989 ESTIMATES
DISTRIBUTION OF BUDGET PLAN BY FUNCTION BY INSTALLATION

FUNCTION	TOTAL NASA	JOHNSON SPACE CENTER	KENNEDY SPACE CENTER	MARSHALL ACE FLIGHT CENTER	NATIONAL SPACE TECHNOLOGY LABORATORIES	GODDARD SPACE FLIGHT CENTER	AMES RESEARCH CENTER	LANGLEY RESEARCH CENTER	LEWIS RESEARCH CENTER	HEADQUARTERS	INSPECTOR GENERAL
PERSONNEL AND RELATED COST											
1987 ACTUAL	1,009,098	163,480	94,494	154,619	5,812	165,125	100,407	121,617	116,530	81,223	5,191
1988 REVISED	1,111,631	178,707	106,673	172,856	6,885	179,868	106,863	130,087	129,174	93,357	7,161
1988 CURRENT	1,036,958	165,555	101,522	157,878	6,597	166,186	100,785	121,348	119,257	90,968	6,862
1989 ESTIMATE	1,131,008	180,476	115,907	171,331	8,041	179,592	108,006	129,281	127,546	102,027	8,801
TRAVEL											
1987 ACTUAL	36,410	5,848	2,792	6,189	264	4,967	3,331	3,232	2,903	6,638	246
1988 REVISED	43,312	6,835	3,464	7,326	355	5,575	3,915	3,833	3,256	8,385	368
1988 CURRENT	42,800	6,414	3,303	7,125	330	5,705	3,884	3,809	3,414	8,499	317
1989 ESTIMATE	51,000	8,331	5,338	8,196	457	6,200	4,335	4,198	3,767	9,833	345
OPERATION OF INSTALLATION											
1987 ACTUAL	406,004	58,584	02,961	51,238	5,944	43,760	29,880	29,488	32,316	51,533	300
1988 REVISED	685,495	115,327	32,931	66,857	14,017	70,388	58,899	53,753	59,914	112,989	420
1988 CURRENT	663,242	104,927	29,494	66,111	13,772	64,850	63,325	49,472	55,666	115,345	280
1989 ESTIMATE	732,992	112,719	149,230	69,577	14,850	71,031	67,057	51,776	60,140	136,311	301
TOTAL											
1987 ACTUAL	1,451,512	227,912	200,247	212,046	12,020	213,852	133,618	154,337	151,749	139,394	6,337
1988 REVISED	1,840,438	300,869	243,068	247,039	21,257	255,831	169,677	187,673	192,344	214,731	7,949
1988 CURRENT	1,743,000	276,896	234,319	231,114	20,699	236,741	167,994	174,629	178,337	214,812	7,459
1989 ESTIMATE	1,915,000	301,526	270,475	249,104	23,348	256,823	179,398	185,255	191,453	248,171	9,447

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
PROPOSED APPROPRIATION LANGUAGE

RESEARCH AND PROGRAM MANAGEMENT

For necessary expenses of research in Government laboratories, management of programs and other activities of the National Aeronautics and Space Administration, not otherwise provided for, including uniforms or allowances therefor, as authorized by law (5 U.S.C. 5901-5902); awards; lease, hire, purchase of one aircraft for replacement only (for which partial payment may be made by exchange of at least one existing administrative aircraft and such other existing aircraft as may be considered appropriate), maintenance and operation of administrative aircraft; purchase (not to exceed thirty-three for replacement only) and hire of passenger motor vehicles; and maintenance and repair of real and personal property, and not in excess of \$100,000 per project for construction of new facilities and additions to existing facilities, repairs, and rehabilitation and modification of facilities; [~~\$1,495,680,000~~] ~~\$1,915,000,000~~. *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: *Provided further*, That not to exceed \$35,000 of the foregoing amount shall be available for scientific consultations or extraordinary expense, to be expended upon the approval or authority of the Administrator and his determination shall be final and conclusive: *Provided further*, That apportionments granted pursuant to this Act for the appropriations to the National Aeronautics and Space Administration shall reflect the moving of up to \$245,000,000 (on an annual basis) in institutional costs from the "Research and development" and "Space flight, control and data communications" accounts to the "Research and program management" account]. (*Department of Housing and Urban Development-Independent Agencies Appropriation Act, 1988; additional authorizing legislation to be proposed.*)

OBJECT CLASSIFICATION
(Thousands of Dollars)

	1987 ACTUAL	1988 ESTIMATE	1989 ESTIMATE	
	-----	-----	-----	
Direct obligations:				
Personnel compensation:				
11.1	Full-time permanent.....	839,426	885,259	914,732
11.3	Other than full-time permanent.....	15,173	16,632	16,917
11.5	Other personnel compensation.....	14,796	17,715	18,664
11.8	Special personal services payments..	6,341	6,409	6,817
		-----	-----	-----
11.9	Total personnel compensation.....	875,736	926,015	957,130
		=====	=====	=====
12.1	Personnel benefits: Civilian.....	115,962	135,098	152,095
13.0	Benefits for former personnel.....	639	329	335
21.0	Travel and transportation of persons..	36,410	42,800	51,000
21.0	Payments to interagency motor pools...	1,471	1,514	2,376
22.0	Transportation of things.....	4,845	6,250	6,317
23.1	Rental payments to GSA.....	11,191	17,146	18,926
23.2	Rental payments to others.....	503	608	632
23.3	Communications, utilities and miscellaneous charges.....	99,026	148,333	145,092
24.0	Printing and reproduction.....	3,120	15,429	18,079
25.0	Other services.....	267,074	377,493	478,604
26.0	Supplies and materials.....	22,404	40,810	42,750
31.0	Equipment.....	10,537	30,745	41,212
32.0	Lands and structures.....	1,780	0	0
41.0	Grants, subsidies, and contributions..	814	430	452
		-----	-----	-----
99.0	Subtotal, direct obligations.....	1,451,512	1,743,000	1,915,000
99.0	Reimbursable obligations.....	42,518	40,000	40,000
		-----	-----	-----
99.9	TOTAL OBLIGATIONS.....	1,494,030	1,783,000	1,955,000
		=====	=====	=====

INSTALLATION
JUSTIFICATION

JOHNSON
SPACE CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1989 ESTIMATES

LYNDON B. JOHNSON SPACE CENTER

DESCRIPTION

The Lyndon B. Johnson Space Center (JSC) is located approximately 20 miles rsoutheast of downtown Houston, Texas. Total NASA owned land at the Houston site consists of 1,620 acres. The Center also utilizes an additional 54,080 acres at the White Sands Test Facility, Las Cruces, New Mexico. The total capital investment of the JSC, including fixed assets in progress and contractor-held facilities at various locations and the White Sands Test Facility, as of September 30, 1987 was \$766,360,000.

CENTER ROLES AND MISSIONS

JSC was established in November 1961, in response to the need in NASA for a Center to manage the design, development and manufacture of manned spacecraft; for selection and training of astronaut crews; and the conduct of manned space flight missions. This need continued as the Nation proceeded toward more ambitious undertakings such as the Apollo program, the Skylab program, the Apollo-Soyuz Test Project, the Space Shuttle program, and currently the Space Station program. To meet this responsibility, JSC has developed unique areas of recognized technical excellence within the civil service staff and facilities of superior merit, which constitute a National resource. The principal and supporting roles are:

Principal Roles:

Space Station - A major work package development center for specific Space Station elements, including the truss structure, airlocks and nodes as well as several subsystems including propulsion and EVA.

Space Shuttle Production and Operations Capability - modification of the orbiter for safe return to flight, system modifications and improvements, production of the replacement orbiter, and support to NASA Headquarters for management of the Shuttle system including: Shuttle configuration management; Shuttle system engineering and integration; and detailed program planning, direction, and scheduling; and development, acquisition and/or modifications of support aircraft for astronaut training and Shuttle flight operations.

STS Operations - operational planning, crew selection and training, medical operations, STS flight control, experiment/payload flight control for attached payloads and STS utilization planning/payload accommodation studies,

Environmental and Crew Support Svstems - develop and demonstrate Environmental Control and Life Support Systems (ECLSS) and Extravehicular Activity (EVA) systems suitable for STS and advanced needs.

Environmental Effects Analysis - manage efforts to develop the data base and conduct analyses to ascertain any environmental impact of STS operations.

Supporting Technolow Advanced Developments - development of prototypes, long lead time systems and new procedures and software for advanced systems.

Advanced Missions - manage studies to define advanced transportation and orbital systems.

Spacelab Development - crew training in conjunction with flight hardware, and development and operation of simulators.

Payload Integration - involved with integrating the Inertial Upper Stage, the Transfer Orbital Stage, and the Payload Assist Module with the orbiter.

Pavload Operations - provides analytical tasks, special analysis or modification of hardware for payloads to be flown on the Shuttle.

Manned Vehicles - development of manned space vehicles and associated supporting technology, including:

Life Science

Medical Research - establish human baseline data, investigate and develop countermeasures to solve space medicine problems, and develop information techniques and equipment to support medical operation and medical experiments.

Food Svstems Technology - develop nutritional requirements and food preparation and packaging systems in support of human space flight.

Spacelab Payload - develop Spacelab life sciences research capability through common use of clinical and research equipment; define and develop in-flight biomedical experiments.

Supporting Roles:

Lunar and Planetary Geosciences - develop and maintain technical discipline base for lunar and planetary geosciences and planetary material handling techniques.

Technoloey Experiments in Space - manage the Orbiter experiments program; define and develop experiments in areas consistent with other JSC space roles.

Remote Sensing - design, develop, and test flight instruments used to measure various phenomena on or above the Earth from space. Includes development of techniques to process, understand, and apply the data obtained.

DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM
JOHNSON SPACE CENTER

	1988		1989 BUDGET ESTIMATE
	1987 ACTUAL	REVISED ESTIMATE	
SPACE STATION.....	625	900	663
SPACE FLIGHT PROGRAMS.....	2,009	1,869	2,164
SPACE TRANSPORTATION CAPABILITY DEV.	622	450	525
SPACE SHUTTLE.....	1,387	1,419	1,639
SPACE SCIENCE AND APPLICATIONS.....	139	124	136
PHYSICS AND ASTRONOMY.....	20	16	23
LIFE SCIENCES.....	66	67	70
PLANETARY EXPLORATION.....	41	29	32
SPACE APPLICATIONS.....	12	12	11
AERONAUTICS AND SPACE TECHNOLOGY.....	29	28	34
SPACE RESEARCH AND TECHNOLOGY.....	29	28	34
COMMERCIAL PROGRAMS.....	12	4	12
SUBTOTAL DIRECT.....	2,814	2,925	3,008
CENTER MANAGEMENT AND OPERATIONS.....	440	441	452
SUBTOTAL (FULL-TIME PERMANENTS) ...	3,254	3,366	3,460
OTHER CONTROLLED FTE'S..... (PMI's/CO-OPS/OTFTP's)	116	106	104
GRAND TOTAL (FULL-TIME EQUIVALENTS)	3,370	3,472	3,564

PROGRAM DESCRIPTION

Permanent Civil
Service Workyears

RESEARCH AND DEVELOPMENT

SPACE STATION.....

663

As one of NASA's four major development centers for the Space Station program, JSC is responsible for the design, development, test, and certification of specific elements, systems, and subsystems necessary to meet the baseline configuration capability. With the start of JSC's development funding, the staffing for FY 1989 provides for the management of initial development activities through the Preliminary Design Review.

Specific JSC Space Station project responsibilities are the integrated truss assembly, mobile transporter, airlocks, resource nodes, and STS-to-Space Station attachment system.

The JSC Space Station project is also assigned system responsibility for the propulsion system; the data management system; the external thermal control system; the communications and tracking system (except internal audio and video); the guidance, navigation, and control system, EVA systems and software.

In addition, JSC provides technical management of the design and development of the manned systems hardware in the Marshall Space Flight Center development contract, and provides support for environmentally controlled life support systems testing.

SPACE FLIGHT PROGRAMS.....

2.164

SPACE TRANSPORTATION CAPABILITY DEVELOPMENT.....

525

The support of the Spacelab development effort includes establishing and controlling the Shuttle interface with the Spacelab for overall safety requirements for the Shuttle/Spacelab, and support to the Marshall Space Flight Center in the performance of its assigned responsibilities. JSC is responsible for crew mission training in conjunction with flight hardware and the development and operation of Shuttle/Spacelab simulators and trainers.

Payload integration activities involve both the upper stages project and the tethered satellite system. For the upper stages, duties include the efforts necessary to integrate the interface between the Orbiter and the payload. JSC is involved with integrating the Inertial Upper Stage, the Transfer Orbit Stage, and the Payload Assist Module. JSC provides the support of payload-unique integration requirements for the Tethered Satellite System.

The Engineering and Technical Base (ETB) provides the base capability necessary to support ongoing and future efforts. The ETB supports a one-shift operation of the JSC laboratories and a two-shift operation of the Central Computer Facility.

Payload operations and support equipment provides optional services for payloads. These efforts involve performing analytical tasks for the payloads that require special analysis, and the building and modification of hardware for unique payloads, hardware that supports specific classes of payloads, or hardware that provides interfaces between the payload and the Orbiter.

The advanced programs activities at JSC are planned and administered to support current and future Agency programs. Major activities at JSC are designed to promote more efficient operations of the STS and emphasis has been placed on developing and enhancing satellite services. Support to the development of upper stages and the integration of payloads have been and will continue to be major tasks. Supporting technology activities are conducted to advance the use of artificial intelligence and its applications to Space Station and to the real time mission control and training facilities. Studies to define the orbital debris environment and measures to deal with it continue.

Permanent Civil
Service Workyears

SPACE SHUTTLE.....

1,639

The 1989 staffing provides for continuation of the Shuttle production activities to support a schedule consistent with the major program milestones. It also provides development, integration, and operations support for the Mission Control Center and the Shuttle Mission Simulator.

Activities consistent with operation of the orbiter fleet and procurement of necessary flight and ground support equipment will be continued. Also included are those activities necessary to manage the building of the replacement orbiter. The National Space Transportation System (NSTS) Program Office of JSC has the responsibility to support NASA Headquarters in the day- to-day management of the NSTS Program. This includes detailed program planning, direction, scheduling, and STS system configuration management. Overall management of the production of the Orbiter system is also provided. This includes management of various elements of the total Orbiter system (e.g., structures, propulsion, power, avionics, etc.) and to lower elements within the systems. JSC is responsible for a large quantity of supporting equipment. Examples of such equipment are: extra-vehicular mobility unit, closed circuit television, survival radio sets, dosimetry, crew equipment, photographic camera systems, and bioinstrumentation.

To integrate all vehicle systems into an efficient operating system, many detailed interfaces and functional performance features must be identified and defined. Specific interface control documents are identified and established, including both flight systems and flight to ground systems. General capability and performance criteria are established for special areas of consideration such as electromagnetic compatibility and lightning protection. Systems operations require the preparation of systems performance data and operations information.

Since the orbiter represents an integrated complex of technical and engineering disciplines, specific subtasks have been assigned to a variety of technical organizations at JSC. Included in these tasks are: providing technical expertise in the orbiter life support systems; performing engineering analysis and performance evaluation for communication and tracking systems ground testing; providing expertise in guidance, navigation, control, instrumentation and electrical power distribution; management and operation of orbital maneuvering system components, reaction control engine performance, and reaction control system engine valve detection techniques; analysis of vehicle attachment and separation systems; analysis of total Shuttle systems, Shuttle/payload interface, crew station evaluation, and engineering analysis to determine overall vehicle performance characteristics in the area of aerodynamic performance, flight characteristics, performance, and dynamics including aeroelasticity.

The successful flight and operations performance of the Space Shuttle is dependent on the proper functioning of integrated electronic equipment. Collectively, these are termed the integrated avionics system. Avionics provides the Shuttle pilots and crew with the total assessment and command capability

necessary to manage, fly, operate and land the vehicle. Because of the critical nature of this system, very close attention is given to the identification of performance requirements and integrated performance.

A variety of avionic elements are included within the Space Shuttle system, each of which requires the attention of a group of technical experts. These elements include: guidance, navigation and control, data processing, communication and tracking, instrumentation, displays and control, solid rocket booster interface, electrical power distribution and control, and external tank instrumentation interface.

The space transportation operations staffing provides for Shuttle operational flight program management including vehicle system integration; Mission Control Center (MCC) operations; replenishment of crew equipment, crew equipment processing, and crew training; flight mission planning and operations; and procurement of Orbiter hardware.

Mission flight support includes a wide variety of planning activities ranging from operational concepts and techniques to detailed systems operational procedures and checklists. Tasks include preparation of development system and software handbooks, flight rules, detailed crew activity plans and procedures, development of MCC and network systems requirements, and operations input to the planning for the selection and operation of Shuttle payloads.

Operation flight design includes: the identification of operational requirements for the design of systems; and the development of nominal and contingency flight profiles for all Shuttle missions. This includes conceptual level profile development and analysis, beginning about two years before the flight, and operational profile development and analysis, accomplished immediately prior to the flight. The software activities for operational flights also include the continued development, definition, and verification support of the guidance, targeting, and navigation systems software requirements of the Orbiter and MCC. Software changes for Orbiter improvements will upgrade vehicle capabilities and performance.

Specific flight planning activity encompasses the flight design, flight analysis, and software preparation activities. The flight design tasks include supporting the crew training simulations and development of flight techniques. Flight design products include conceptual flight profiles and operational flight profiles which are issued for each flight. The software activities include the development, formulation, and verification support for the guidance, targeting, and navigation systems

software requirements in the Orbiter and MCC. In addition, the flight dependent data co-located in the erasable memory (mission-to-mission changes) is developed from the flight design process for incorporation into the Orbiter software and MCC systems.

Avionics and software testing and checkout in the Electronics Systems Test Laboratory and the Shuttle Avionics Integration Laboratory will continue. The purpose of these laboratories is to ensure verification of the functional performance of the Shuttle Integrated Avionics Systems, and continue validation of the system design, and verify compatibility of the various radio frequency communication links.

Orbiter avionics software development will provide payload support, which will include general capabilities for Spacelab and Upper Stages, with flexibility available to implement specific payload requirements as optional services.

Reconfiguration tools (hardware and software systems) to permit support of the flight rates are being implemented in the Shuttle Mission Simulator complex and procedures training facility. The capability for near-continuous training of a number of flight crews for different types of missions with different payload requirements and on different Orbiters requires management and utilization of a very high volume of data. Automated tools are essential to support this pace of training. In addition, simulator system upgrades are regularly being made to keep up with changes to the orbiter.

Furthermore, there is provision for rapid handling of mission-to-mission software changes (flight dependent data in erasable memory) and associated verification on a "near production line" basis in order to achieve greater mission rates. To accommodate the production-line type of work, emphasis is being placed on software tools and the associated automatic data processing equipment hardware to support the Software Production Facility.

SPACE SCIENCE AND APPLICATIONS

136

PHYSICS AND ASTRONOMY

23

JSC has the role of mission manager for the Spacelab flights, and of providing mission support. This includes the integration of all physics and astronomy experiments that are placed in the Spacelab modules, pallets, and in the mid-deck. In some cases, JSC also designs and develops the individual experiments to be used on the missions.

LIFE SCIENCES

70

The Center has the lead role in evaluating human physiological changes associated with the space environment and providing effective countermeasures to assure crew health and optimal performance, e.g., the space adaption syndrome activity which focuses on investigating the potential problems the Space Shuttle crew have in adjusting to the weightless environment of space. These experiments are also designed to utilize the space environment to accomplish medical and biological research. The Center will have mission management responsibility for dedicated life sciences missions.

The medical activities provide for in-flight contingencies involving on-board health services, training for the crew, ground-based support, and evaluation of proposed crew members. The objectives are supportive of the Center's responsibility for assuring the Space Shuttle crew health and safety, both during flight and on the ground. The accomplishment of these objectives requires a well-defined and continuing program that incorporates medical research, operations, laboratory support, and clinical medicine.

The bioengineering activities include dedicated Life Sciences Spacelab experiments and real-time human experiments. To this end, science experiments have been selected, and experiment hardware development has been initiated. JSC has mission management responsibility for the life sciences payloads, which includes systems management and engineering of the payload equipment and operation of the payload during flights.

PLANETARY EXPLORATION..... 32

The Center supports the Agency's planetary exploration program in the area of geosciences where a strong, active research group is required to support potential future programs, provide curatorial support, assist in information dissemination and interact with outside scientists. To provide this support, the research group pursues research on the compositions, structures and evolutionary histories of the solid bodies of the solar system. The Center has an ongoing program of analysis of planetary materials and of remote sensing data, a theoretical studies program and a program which is involved in the development of remote sensing instrumentation. The definition of geoscience requirements for future planetary flight missions involves extensive interaction with the planetary science community.

SPACE APPLICATIONS..... 11

Space applications flight project responsibilities at JSC center around Shuttle payload instrument development. Responding to airborne measurement requirements, JSC is also developing and implementing an aircraft sensors plan involving testing, maintenance, and operation of a wide variety of report sensors to provide data to investigators. JSC is assigned mission management responsibilities for the earthward-looking remote sensing missions SRL-1 and SRL-2. This includes the mission planning, real-time mission control, mission requirements definition, and experiment integration.

SPACE RESEARCH AND TECHNOLOGY..... 34

JSC is completing the study of a family of technologies for the Space Station era and for improved STS operations, and is initiating a new family of technologies to support possible future missions such as and a Lunar Base or Manned Mars Mission. The technologies include: improvement of man-machine interactions in space, advanced thermal concepts, evaluation of ADA language in NASA flight systems, environmentally controlled life support systems efficiencies, development of docking/berthing systems required for large

space systems, data system architectural designs, methodologies to improve cost effectiveness of guidance, navigation and control systems and techniques to make use of extraterrestrial materials. Experiments compatible with STS operational capabilities are being developed to obtain research and technology data in flight regimes applicable to advanced transportation systems. This effort also includes automation and robotics, which is part of the Civil Space Technology Initiative program.

Permanent Civil
Service Workyears

COMMERCIAL PROGRAMS 11

The objectives of the Commercial Use of Space Program are to establish close working relations with the private sector and academia to encourage investment in space technology and the use of such technology to facilitate private sector space activities through access to government capabilities, to encourage private sector investment that is independent of NASA funding and to develop a commercial space policy and insure consistent NASA-wide implementation. This effort established an organizational focal point to foster commercial use and access to space.

The Technology Utilization program identifies, acquires and disseminates results of NASA research and development information through a variety of technology transfer mechanisms to strengthen the national economy and industrial productivity. In order to accelerate and facilitate the application of NASA-related technology to meet technical needs in the industrial and public sectors, the program increasingly focuses participation by all NASA and contractor scientific and engineering personnel.

CENTER MANAGEMENT AND OPERATIONS SUPPORT..... 452

Center Management and Operations Support is provided to all JSC organizations. The civil service personnel involved in this support include the following:

Director and Staff - The Center Director, Deputy Director and immediate staff, e.g, Legal, Personnel, Equal Opportunity, Technical Planning, and Public Affairs.

Manaaement Support - Personnel providing information and control service supporting **all** levels of Center management, both program and functional. Specific functions include resources and financial management, program control, contracting and procurement, property management, and management systems and analysis.

Operations Support - Personnel managing and providing for the operation and maintenance of institutional facilities, buildings, systems, and equipment, including those who provide technical services such as automatic data processing, reliability and quality assurance, medical care, and photographic support.

SUMMARY OF RESOURCES REOUIREMENTS

Funding Plan by Function

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u> <u>Estimate</u> (Thousands	<u>Current</u> <u>Estimate</u> of Dollars)	<u>Budget</u> <u>Estimate</u>
I. Personnel and Related Costs.....	163,480	178,707	165,555	180,476
11. Travel.....	5,848	6,835	6,414	8,331
111. Operation of Installation.....	58,584	115,327	104,927	112,719
A. Facilities Services.....	(29,623)	(39,613)	(39,407)	(41,803)
B. Technical Services.....	(10,921)	(32,732)	(24,665)	(27,576)
C. Management and Operations.....	<u>(18,040)</u>	<u>(42,982)</u>	<u>(40,855)</u>	<u>(43,340)</u>
 Total, fund requirements.....	<u>227.912</u>	<u>300.869</u>	<u>276.896</u>	<u>301.526</u>

	1987	<u>1988</u>		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
I. <u>PERSONNEL AND RELATED COSTS</u>	<u>163,480</u>	<u>178,707</u>	<u>165,555</u>	<u>180,476</u>
<u>Summary of Fund Reaquirements</u>				
A. <u>ComDensation and Benefits</u>				
1. <u>ComDensation</u>				
a. Full-time permanent.....	133,663	137,953	132,932	143,726
b. Other than full-time				
permanent.....	2,261	2,268	2,044	2,113
c. Reimbursable detailees.....	5,152	5,660	5,071	5,211
d. Overtime and other				
compensation.....	<u>2,153</u>	<u>2,399</u>	<u>2,669</u>	<u>2,785</u>
Subtotal, Compensation.....	143,229	148,280	142,716	153,835
2. <u>Benefits</u>	<u>17,763</u>	<u>27,556</u>	<u>20,381</u>	<u>23,457</u>
Subtotal, Compensation and				
Benefits.....	160,992	175,836	163,097	177,292
B. <u>Supporting Costs</u>				
1. Transfer of personnel.....	972	1,333	746	938
2. Personnel training.....	<u>1,516</u>	<u>1,538</u>	<u>1,712</u>	<u>2,246</u>
Subtotal, Supporting Costs.....	2,488	2,871	2,458	3,184
Total, Personnel and Related				
costs	<u>163,480</u>	<u>178,707</u>	<u>165,555</u>	<u>180,476</u>

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	<u>Budget Estimate</u>
A. <u>Compensation and Benefits</u>	<u>160.992</u>	<u>175.836</u>	<u>163.097</u>	<u>177,292</u>
<u>1. Compensation</u>	<u>143.229</u>	<u>148,280</u>	<u>142.716</u>	<u>153,835</u>
a, Full-time permanent.....	133,663	137,953	132,932	143,726

The decrease in the 1988 Current Estimate from the 1988 Revised Estimate is due to re-estimates for the FERS retirement System and reductions in the Military Detailees, partially offset by the 1988 pay raise; and JSC's share of the \$42.0 million general reduction needed to reach 1988 authorized levels. The 1989 Estimate includes funding for additional civil service workforce, a full year of the 1988 pay raise and restoration of 1988 reductions.

Basis of Cost for Full-time Workyears

In 1989, the cost of full-time workyears will be \$143,726,000, an increase of \$10.8 million from 1988. The change is calculated as follows:

Cost of full-time permanent workyears in 1988.....	132,932
Cost increases in 1989.....	13,999
Restoration of 1988 general reduction.....	6,098
Within grade and career advances:	
Full year cost of 1988 increases.....	1,769
Partial year cost of 1989 actions.....	1,584
Additional FTE	3,548
Full year cost of the 1988 payraise.....	1,000
Cost decreases in 1989.....	-3,205
Full year effect of 1988 turnover savings.....	-331
Partial year effect of 1989 turnover savings.....	-1,845
Two less paid days.....	-1,029
Cost of full-time permanent workyears in 1989.....	<u>143,726</u>

	1987	1988		1989
	<u>Actual</u>	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
		(Thousands of Dollars)		
b. Other than full-time permanent				
1. Cost.....	2,261	2,268	2,044	2,113
2. Workyears.....	165	152	150	150

The distribution of 1988 workyears is as follows:

Distribution of Other than Full-Time Workyears

<u>Program</u>	<u>Workyears</u>
Development programs.....	79
Summer programs.....	9
Other temporary programs.....	16
Youth Opportunity Programs.....	<u>46</u>
Total.....	<u>150</u>

The decrease from the 1988 Revised Estimate to the 1988 Current Estimate and is primarily the result of the mix between temporary and permanent workyears, due to decreases in the development programs (Co-ops and PMI's), and an increase in the summer programs resulting in an overall decrease of two workyears. The 1989 Estimate is at the same as 1988.

c. Reimbursable detailees.....	5,152	5,660	5,071	5,211
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The military personnel detailed to the Johnson Space Center on a reimbursable basis are individuals experienced in manned space flight and related fields. Each individual performs a function essential and critical to current and future programs. The decrease from the 1988 Revised Estimate to the 1988 Current Estimate is due to a reduction in the number of detailees. 1989 reflects the same level as 1988.

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
d. Overtime and other compensation....	2,153	2,399	2,699	2,785

(Thousands of Dollars)

Overtime in 1988 will be used primarily in preparation for resumption of Shuttle flights; e.g., crew training, trajectory optimization, data reduction and integration activities, and related support activities. The increase from the 1988 Revised Estimate to the 1988 Current Estimate is due to greater than anticipated return to flight activities. The 1989 Budget Estimate reflects the same level of effort as FY 1988.

2. <u>Benefits</u>	<u>17.763</u>	<u>27.556</u>	<u>20.381</u>	<u>23.457</u>
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The following are the amounts of contribution by category:

Retirement Fund and Thrift Plan..	10,420	20,110	11,714	14,440
Employee Life Insurance.....	267	295	277	305
Employee Health Insurance.....	3,700	3,572	3,577	3,707
Workmen's Compensation.....	675	705	700	740
FICA.....	1,153	1,168	2,419	2,486
Medicare.....	1,521	1,658	1,658	1,743
Other Benefits.....	<u>27</u>	<u>48</u>	<u>36</u>	<u>36</u>
Total.....	<u>17.763</u>	<u>27.556</u>	<u>20.381</u>	<u>23.457</u>

The decrease from the 1988 Revised Estimate to the 1988 Current Estimates are due primarily to a reduction in the cost of employees switching to the new Federal Employees Retirement System and the concomitant retirement change related to the reduction in permanent compensation on the \$42.0 million general reduction. The increase in 1989 is due to the full year effect of the FERS and additions to the civil service workforce at JSC.

	1987	1988		1989
	<u>Actual</u>	Revised	Current	Budget
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
B. <u>Supporting Costs</u>	<u>2.488</u>	<u>2.871</u>	<u>2.458</u>	<u>3.184</u>
1. <u>Transfer of Personnel</u>	<u>972</u>	<u>1.333</u>	<u>746</u>	<u>938</u>
2. <u>Personnel Training</u>	<u>1.516</u>	<u>1.538</u>	<u>1.712</u>	<u>2.246</u>

The transfer of personnel includes movement of household goods, subsistence and temporary expenses, real estate and miscellaneous moving expenses related to change of duty stations. The decrease from the 1988 Revised Estimate to the 1988 Current Estimate reflects a decrease in the number of new employees eligible for these benefits. 1989 includes support for the additional Civil Service Workforce.

The purpose of the JSC training program is to continue to develop the skills and knowledge of civil service employees in order to maintain a state-of-the-art technology to more efficiently support JSC roles and missions. The change from the 1988 Revised Estimate to the 1988 Current Estimate reflects an increase in the level of training, as well as an increase in projected tuition and other costs. The 1989 Budget Estimate reflects the same level of effort as 1988 with an increase for additional Civil Service Workforce.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u> (Thousands of Dollars)	<u>Current</u> <u>Estimate</u>	
I. TRAVEL	<u>5,848</u>	<u>6,835</u>	<u>6,414</u>	<u>8,331</u>

Summary of Fund Reaquirements

A. Program Travel.....	4,601	5,471	5,127	6,895
B. Scientific and Technical Development Travel.....	307	539	337	355
C. Management and Operations Travel.	<u>940</u>	<u>825</u>	<u>950</u>	<u>1,081</u>
Total, Travel.....	<u>5,848</u>	<u>6,835</u>	<u>6,414</u>	<u>8,331</u>

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>

(Thousands of Dollars)

Explanation of Fund Requirements

A. <u>Program Travel</u>	<u>4.601</u>	<u>5.471</u>	<u>5.127</u>	<u>6.895</u>
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Program Travel is specifically required for the accomplishment of the Center's mission and accounts for approximately 77 percent of the travel budget for 1989. The decrease from the 1988 Revised Estimate to the 1988 Current Estimate is based on 1987 actuals. The 1988 travel supports the planned increase of support to production of a replacement Orbiter, an increase in Space Station support, and travel associated with the return-to-flight status activity. In addition to supporting Shuttle production and Space Station, the 1989 travel is required to support operations activity including launch, mission support, coordination of engineering and technical activities, support of payload technical integration, and travel to support increased civil service workforce.

B. <u>Scientific and Technical Development Travel</u>	<u>307</u>	<u>539</u>	<u>337</u>	<u>355</u>
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Scientific and technical development travel permits employees to participate in meetings and technical seminars with other representatives of the aerospace community. The decrease from the FY 1988 Revised Estimate to the FY 1988 Current Estimate is based on FY 1987 actuals. The FY 1989 estimate reflects the same level of travel as FY 1988. A relatively stable level of support is anticipated with changes for 1988 and 1989 occurring only to reflect changes in travel costs for per diem and transportation.

C. <u>Management and Operations Travel</u>	<u>940</u>	<u>825</u>	<u>950</u>	<u>1.081</u>
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Management and operations travel is used for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management, and procurement activities; travel of the Center's top management to NASA Headquarters and other NASA Centers; and local transportation. The increase from the 1988 Revised Estimate to the 1988 Current Estimate is based on 1987 actuals. The 1989 estimate reflects the same level of travel as 1988.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u> (Thousands of Dollars)	<u>Current</u> <u>Estimate</u>	
111. <u>OPERATION OF INSTALLATION.....</u>	<u>58.584</u>	<u>115.327</u>	<u>104.927</u>	<u>112.719</u>
<u>Summary of Fund Reaquirements</u>				
A. Facilities Services.....	29,623	39,613	39,407	41,803
B. Technical Services.....	10,921	32,732	24,665	27,576
C. Management and Operations...	<u>18.040</u>	<u>42.982</u>	<u>40.855</u>	<u>43.340</u>
Total, Operation of Installation	<u>58.584</u>	<u>115.327</u>	<u>'104.927</u>	<u>112.719</u>

Explanation of Fund Reaquirements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Center's institutional activities. These are divided into three major functional areas: Facilities Services, the cost of maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; Technical Services, the cost of automatic data processing for management activities, and the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations, the cost of administrative communications, printing, transportation, medical, supply, and related services.

The decrease from the 1988 Revised Estimate to the 1988 Current Estimate reflects reductions and deferrals of ADP purchases and other equipment purchases due to budget reductions. The increase from the 1988 Current to the 1989 Estimate is restoration of some deferred purchases and upgrades to the financial systems, continuation of the NASA Personnel Payroll System as well as support to additional civil service workforce.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u>
		<u>Revised</u> <u>Estimate</u>	<u>Current</u> <u>Estimate</u>	<u>Budget</u> <u>Estimate</u>
(Thousands of Dollars)				
A. <u>FACILITIES SERVICES</u>	<u>29.623</u>	<u>39.613</u>	<u>39.407</u>	<u>41.803</u>

This physical plant supports an average daily on-site population of approximately 11,300 personnel plus additional personnel located at nearby facilities and Ellington Air Force Base. These Budget Estimates also include resources associated with the physical plant requirements of the White Sands Test Facility and for facilities used at Ellington Air Force Base.

Summary of Fund Reuirements

1. Rental of Real Property.....	0	523	523	547
2. Maintenance and Related Services..	12,988	14,854	12,475	14,008
3. Custodial Services.....	8,155	5,700	9,801	9,916
4. Utility Services.....	<u>8.480</u>	<u>18.536</u>	<u>16.608</u>	<u>17.332</u>
Total, Facilities Service.....	<u>29.623</u>	<u>39.613</u>	<u>39.407</u>	<u>41.803</u>

Explanation of Fund Reuirements

1. Rental of Real Property.....	<u>0</u>	<u>523</u>	<u>523</u>	<u>547</u>
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Provides for the rental of buildings offsite of JSC for source evaluation boards, rental of hanger space at El Paso, Texas International Airport for the T-38 and Shuttle training vehicles, and rental of warehouse storage in Bell, California for tooling and assembly for the Shuttle. The 1989 estimate provides for same level of effort as 1988.

		1987	1988		1989
		<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
(Thousands of Dollars)					
2. Maintenance and Related Services.....	<u>12.988</u>	<u>14.854</u>	<u>12.475</u>	<u>14.008</u>	

This activity involves routine maintenance and facilities support for JSC at Houston, as well as White Sands Test Facility and Ellington Air Force Base, and includes such activities as support for utility systems; administrative facility alterations and painting; ground maintenance; and other facility and system design and modification tasks. The decrease in the 1988 Current Estimate from the 1988 Revised Estimate is due to realignment of some plant operation work from the Maintenance and Related function to the Custodial function. The increase from the 1988 Current Estimate to the 1989 Estimate reflects the restoration of some minor construction projects and adds funding to support additional civil service workforce.

3. Custodial Services.....	<u>8.155</u>	<u>5.700</u>	<u>9.801</u>	<u>9.916</u>	
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This activity involves support contractor effort at JSC to provide security guard services such as protection of government facilities, equipment, and classified information and badging for all on-site personnel and official visitors; janitorial services (including highly specialized clean-room services); and fire protection services such as maintenance of alarms and fixed fire fighting equipment, and industrial safety and inspection. The increase from the Current Estimate to the 1988 Revised Estimate is due to realignment of some plant operation work from the Maintenance and Related function to the Custodial function and reflects negotiated labor rates. The increase in the 1989 Estimate includes the same level of support as 1988 with an increase for escalation.

4. Utility Services.....	<u>8.480</u>	<u>18.536</u>	<u>16.608</u>	<u>17.332</u>	
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This category includes purchased utilities and support contractor effort for the operation and maintenance of the utility distribution system. The 1987 actuals are costs associated with the purchase of utilities only, while the 1988 and 1989 estimates reflect the purchase of utilities plus the operation

and maintenance of the utility systems. The decrease from the 1988 Revised Estimate to the 1988 Current Estimate is due to lower consumption of utilities and rates not as high as anticipated. The increase in 1989 reflects increased activity related to increased flight rate.

		<u>1988</u>		
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
B. <u>TECHNICAL SERVICES</u>	<u>10.921</u>	<u>32.732</u>	<u>24.665</u>	<u>27.576</u>

Summary of Fund Requirements

1. Automatic Data Processing.....	<u>4.763</u>	<u>23.072</u>	<u>15.024</u>	<u>18.560</u>
2. Scientific and Technical Information.....	<u>3.125</u>	<u>4.431</u>	<u>4.228</u>	<u>4.464</u>
3. Shop and Support Services.....	<u>3.033</u>	<u>5.229</u>	<u>5.413</u>	<u>4.552</u>
Total, Technical Services.....	<u>10.921</u>	<u>32.732</u>	<u>24.665</u>	<u>27.576</u>

Explanation of Fund Reaquirements

1. Automatic Data Processing.....	<u>4.763</u>	<u>23.072</u>	<u>15.024</u>	<u>18.560</u>
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This activity provides support to all JSC administrative ADP functions; included within this area are institutional portions of lease and maintenance costs of hardware systems within the Central Computer Facility, as well as contractor effort for computer programming, operations, keypunch, and other support personnel. The ADP systems supported include institutional management, finance and accounting, procurement, contract status and tracking, personnel management, payroll, and utility tracking. The decrease from the FY 1988 Revised Estimate to the N 1988 Current Estimate is due to the movement of ADP upgrades to the Management and Operations area. The decrease in the 1988 Current Estimate from the 1988 Revised Estimate is due to reduction and deferral of ADP purchases due to budget reductions. The increase from the 1988 Current Estimate to the 1989 Estimate is restoration of some deferred purchases and upgrades to the financial systems as well as support to additional civil service workforce.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u>	<u>Current</u> <u>Estimate</u>	
		(Thousands of Dollars)		
2. Scientific and Technical Information.....	<u>3.125</u>	<u>4.431</u>	<u>4.228</u>	<u>4.464</u>

This activity provides for a public affairs educational and informational program and support to the Center in provision of various scientific and technical information services. Included in the public affairs program are: motion picture production from script to screen; film clip preparation; exhibit management and refurbishment; visitor orientation tours; lecturing; mail answering services; and other public affairs activities. The decrease from the 1988 Revised Estimate to the 1988 Current Estimate is based on the 1987 actuals. The increase from the 1988 Current Estimate to the 1989 Budget Estimate reflects the same level of effort as 1988.

3. Shop and Support Services.....	<u>3.033</u>	<u>5.229</u>	<u>5.413</u>	<u>4.552</u>
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These funds provide for a support contractor who provides JSC graphics and photographic services. Graphic materials are prepared for use in presentations and senior management reviews. Various kinds of films are processed and reproductions and reprints made. The increase from the 1988 Revised Estimates to the 1988 Current Estimate is due to refinement of the previous estimates. The decrease from the 1988 Budget Estimate to the 1989 Budget Estimate reflects a reduction in the level of support provided.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u> (Thousands of Dollars)	<u>Current</u> <u>Estimate</u>	
c . <u>MANAGEMENT AND OPERATIONS</u>	<u>18.040</u>	<u>42.982</u>	<u>40.855</u>	<u>43.340</u>
1. Administrative Communications..	4,007	14,003	13,191	13,205
2. Printing and Reproduction.....	352	2,310	2,016	2,258
3. Transportation.....	2,402	7,080	4,978	5,253
4. Installation Common Services...	<u>11.279</u>	<u>19.589</u>	<u>20.670</u>	<u>22.624</u>
Total, Management and Operations	<u>18.040</u>	<u>42.982</u>	<u>40.855</u>	<u>43.340</u>

Explanation of Fund Requirements

1. Administrative Communications... 4,007 14,003 13,191 13,205

Communications support for JSC and WSTF consists of local and long distance telephone service and other communication services. Local service includes Centrex lines and telephones at JSC and WSTF. Long distance service includes the cost for FTS, commercial toll calls, and a small number of dedicated voice circuits. Other communications services include teletype and wire news services; the operation and maintenance of a closed circuit TV system; and local radio networks for fire, security and custodial uses. The decrease from the 1988 Revised Estimate to the FY 1988 Current Estimate is due to refinement of the estimates. The increase from 1988 Current Estimate to the 1989 Budget Estimate is due to support services contractor wage rates.

2. Printing and Reproduction..... 352 2,310 2,016 2,258

Printing services are provided by on-site and off-site facilities. The on-site printing plant, operated by JSC personnel, produces approximately 69 million units each year. In addition to this on-site printing plant, JSC also purchases printing from private firms through Government Printing Office contracts, about **66,000,000** units each year. Purchased printing is overflow requirements that cannot be handled on-site, and printing which requires capabilities not available at the on-site plant. The decrease from the 1988 Revised Estimate to the 1988 Current Estimate is based on 1987 actuals. The 1989 Budget Estimate reflects the same level of effort as 1988.

		1987	1988		1989
		<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
			<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
			(Thousands of Dollars)		
3. Transportation.....	<u>2.402</u>	<u>7.080</u>	<u>4,978</u>	<u>5.253</u>	

Transportation includes administrative aircraft maintenance and fuel costs, lease of passenger vehicles and trucks, including GSA drivers and dispatchers and maintenance of vehicles. The decrease from the 1988 Revised Estimate to the 1988 Current Estimate is due to a re-evaluation of the estimates based on 1987 actuals and review of new requirements. The increase from the 1988 Current Estimate to the 1989 Budget Estimate is due to a planned engine maintenance on the administrative aircraft.

4. Installation Common Services....	<u>J.1.279</u>	<u>19,589</u>	<u>20.670</u>	<u>22.624</u>	
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These services support center management and staff activities, provide medical services, and cover various installation support services. Center management and staff functions include legal, personnel, procurement, and EEO activities. Medical services provided include occupational medicine and environmental health, consisting of the operation of the JSC on-site clinic; emergency assistance at Ellington Field; providing physicals for JSC personnel at Downey, California; medical consultation and crew test support; industrial hygiene; radiological health; and an environmental health laboratory. Installation support services include administrative supplies, materials and equipment at the Center and at WSTF; JSC share of operating costs at Ellington Field and miscellaneous administrative support. The increase from the 1988 Revised Estimate to the 1988 Current Estimate reflects 1987 experience. The increase from the 1988 Current Estimate to the 1989 Budget Estimate is due to support service contractor labor rates already negotiated, full year funding of support services contracts and funding to support additional civil service workforce.

Staffing Summary		
	FY-88	FY-89
SES	47	48
GS/GM-15	296	294
GS/GM-14	630	629
All other GS/GM	2492	2617
Wage Grade	7	7
TOTAL	3371	3467

Director Deputy Director Assistant Director		
	FY-88	FY-89
SES	7	6
GS/GM-15	2	2
GS/GM-14	1	1
All other GS/GM	0	0
Wage Grade	0	0
TOTAL	10	9

Office of
Inspector General
JSC

Human Resources Office		
	FY-88	FY-89
SES	1	1
GS/GM-15	1	1
GS/GM-14	4	4
All other GS/GM	62	62
Wage Grade	0	0
TOTAL	69	69

Equal Opportunity Programs Office		
	FY-88	FY-89
SES	0	0
GS/GM-15	0	0
GS/GM-14	1	1
All other GS/GM	6	6
Wage Grade	0	0
TOTAL	7	7

Legal Office		
	FY-88	FY-89
SES	1	1
GS/GM-15	1	2
GS/GM-14	6	5
All other GS/GM	7	7
Wage Grade	0	0
TOTAL	15	15

Public Affairs Office		
	FY-88	FY-89
SES	1	1
GS/GM-15	1	1
GS/GM-14	2	2
All other GS/GM	24	24
Wage Grade	0	0
TOTAL	28	28

New Initiatives Office		
	FY-88	FY-89
SES	2	2
GS/GM-15	4	4
GS/GM-14	11	11
All other GS/GM	42	42
Wage Grade	0	0
TOTAL	59	59

White Sands Test Facility		
	FY-88	FY-89
SES	1	1
GS/GM-15	1	1
GS/GM-14	8	8
All other GS/GM	40	40
Wage Grade	0	0
TOTAL	50	50

Director Engineering		
	FY-88	FY-89
SES	5	5
GS/GM-15	66	66
GS/GM-14	110	110
All other GS/GM	486	517
Wage Grade	0	0
TOTAL	667	698

Space Station Projects Office		
	FY-88	FY-89
SES	3	3
GS/GM-15	16	16
GS/GM-14	34	34
All other GS/GM	48	48
Wage Grade	0	0
TOTAL	98	98

Orbiter and GFE Projects Office		
	FY-88	FY-89
SES	2	2
GS/GM-15	20	20
GS/GM-14	47	47
All other GS/GM	60	65
Wage Grade	0	0
TOTAL	129	134

National Space Transportation Systems Office		
	FY-88	FY-89
SES	0	0
GS/GM-15	29	29
GS/GM-14	60	60
All other GS/GM	96	117
Wage Grade	0	0
TOTAL	185	206

Director Safety, Reliability, And Quality Assurance		
	FY-88	FY-89
SES	2	2
GS/GM-15	18	18
GS/GM-14	15	16
All other GS/GM	136	152
Wage Grade	0	0
TOTAL	171	187

Director Flight Crew Operations		
	FY-88	FY-89
SES	3	3
GS/GM-15	28	28
GS/GM-14	20	20
All other GS/GM	109	109
Wage Grade	0	0
TOTAL	160	160

Director Mission Operations		
	FY-88	FY-89
SES	7	7
GS/GM-15	35	36
GS/GM-14	64	64
All other GS/GM	377	402
Wage Grade	0	0
TOTAL	483	509

Director Mission Support		
	FY-88	FY-89
SES	7	7
GS/GM-15	30	30
GS/GM-14	60	60
All other GS/GM	229	248
Wage Grade	0	0
TOTAL	312	328

Director Space and Life Sciences		
	FY-88	FY-89
SES	4	4
GS/GM-15	30	30
GS/GM-14	40	40
All other GS/GM	160	160
Wage Grade	0	0
TOTAL	234	234

Director Administration and Program Support		
	FY-88	FY-89
SES	3	3
GS/GM-15	15	16
GS/GM-14	36	36
All other GS/GM	320	330
Wage Grade	0	0
TOTAL	374	385

Director Center Operations		
	FY-88	FY-89
SES	2	2
GS/GM-15	6	6
GS/GM-14	15	16
All other GS/GM	297	297
Wage Grade	7	7
TOTAL	323	328

KENNEDY
SPACE CENTER

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RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1989 ESTIMATES

JOHN F. KENNEDY SPACE CENTER

DESCRIPTION

The John F. Kennedy Space Center (KSC) is located 50 miles east of Orlando, Florida. The total land and water area occupied by the installation is 139,305 acres. NASA owns 82,943 acres of that total. The remainder is comprised of the Banana River Causeway Easement (271 acres), the Indian River Causeway Easement (296 acres), and Florida-owned submerged lands with Deed of Dedication (55,795 acres).

Space Shuttle flights began at KSC in 1981. Expendable launch vehicle operations are conducted at both the Air Force's Eastern Space and Missile Center, at Cape Canaveral Air Force Station, Florida, and the Western Space and Missile Center at Vandenberg Air Force Base, California, which is located six miles west of Lompoc, California. Activities at Vandenberg are accomplished within a host-tenant agreement with the Air Force.

The NASA capital investment at KSC, Cape Canaveral Air Force Station, and Vandenberg Air Force Base, including fixed assets in progress and contractor-held facilities as of September 30, 1987, was \$1,854,775,000.

CENTER ROLES AND MISSIONS

The Launch Operations Center was established at Cape Canaveral, Florida, in July 1962 to serve as the primary NASA center for the test, checkout, and launch of space vehicles. In late 1963, it was named the John F. Kennedy Space Center and in 1964 the Center was relocated to Merritt Island. This site was chosen because of its unique geographical characteristics, climate, local growth capability, accessibility, and

availability. The Center has since become the major free world launch site with a unique civil service staff of unparalleled expertise in the test, checkout and launch of space vehicles and in the design of associated ground support equipment. The technical facilities developed at KSC represent a recognized national resource. The principal roles of the Center are:

Space Transportation System (STS) Ground Operations • includes Space Shuttle launch preparation, launch, landing and refurbishment; Spacelab and Spacelab payloads ground processing; payload/experiment integration and processing; upper stages ground processing; orbiter logistics; and operation and maintenance of ground support equipment.

Space Station • Space Station effort at KSC will consist of activities utilization, system engineering and integration, operational readiness, and delegated ground support equipment (GSE) program management functions for Headquarters.

Expendable Launch Vehicle Operations • includes launch preparation, checkout and launch for the current inventory of launch vehicles on a reimbursable basis. This will evolve into commercial and mixed fleet operations as policies are developed, agreements made, and new launch directives implemented.

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM
KENNEDY SPACE CENTER

	1987 ACTUAL	1988		1989 BUDGET ESTIMATE
		REVISED ESTIMATE	CURRENT ESTIMATE	
SPACE STATION.....	107	288	159	159
SPACE FLIGHT PROGRAMS.....	1,374	1,176	1,377	1,577
SPACE TRANSPORTATION CAPABILITY DEV. SPACE SHUTTLE.....	150 1,224	150 1,026	147 1,230	152 1,425
SPACE SCIENCE AND APPLICATIONS.....	81	92	79	72
PHYSICS AND ASTRONOMY.....	62	75	61	54
LIFE SCIENCES.....	19	17	18	18
COMMERCIAL PROGRAMS.....	16	14	17	17
SUBTOTAL DIRECT.....	1,578	1,570	1,632	1,825
CENTER MANAGEMENT AND OPERATIONS.....	478	487	499	499
SUBTOTAL (FULL-TIME PERMANENTS).	2,056	2,057	2,131	2,324
OTHER CONTROLLED FTE'S..... (PMI's/CO-OPS/OTFTP's)	87	80	64	64
GRAND TOTAL (FULL-TIME EQUIVALENTS)	2,143	2,137	2,195	2,388

PROGRAM DESCRIPTION

Permanent Civil
Service Workyears

RESEARCH AND DEVELOPMENT

SPACE STATION..... 159

Space Station effort will consist of activities in the areas of utilization, system engineering and integration, operational readiness studies, and delegated ground support equipment program management.

SPACE FLIGHT PROGRAMS 1562

SPACE TRANSPORTATION CAPABILITY DEVELOPMENT 152

The upper stages currently consist of the Inertial Upper Stage, Transfer Orbit Stage, and the Payload Assist Module (PAM). These upper stages are expendable, propulsive stages intended for use in the deployment of Space Shuttle transported payloads to high energy orbits not attainable by the Space Shuttle alone.

The PAM has been developed, checked out and mated to a payload by the commercial developer, McDonnell Douglas. The Center has responsibility for integration of the PAM and its payload into the Shuttle payload bay.

The Center's role in the Spacelab program is similar to that for the Space Shuttle; that is, KSC is responsible for launch site development and for ground operations leading to the launch. KSC has responsibility for verifying that the Spacelab flight and ground systems are compatible with the Spacelab, with each other, and with safety requirements.

KSC will provide facilities and support to the various customers during processing of their payloads. KSC, in concert with other NASA organizations must analyze potential payload users' requirements and activities. Based on experience gained during the Expendable Launch Vehicle program and thus far in the Shuttle program, KSC will monitor payload activity from conception; participate in design reviews to ensure compatibility with KSC facilities; and provide support coordination during the payload checkout and launch at KSC.

SPACE FLIGHT CONTROL & DATA COMMUNICATIONS..... 1425

The design, modification or acquisition, installation and checkout of equipment and facilities to be used in support of launch requirements will continue. This includes equipment provided by KSC contractors, as well as equipment to be supplied by development contractors as part of their flight vehicle responsibilities.

The first Space Shuttle landed at KSC in February 1984. Although installation and checkout of initial operational systems are complete and the ground support equipment installed, there are ongoing new requirements, such as the orbiter maintenance and refurbishment facility for orbiter checkout and storage, and modifications to existing systems, including the Launch Processing System. In addition, KSC ground support equipment and associated subsystems which have been in place since the mid-1970's must be upgraded/replaced due to obsolescence and to take advantage of advancing state of the art. These include replacement of the Launch Processing System in order to meet the increasing flight rate as well as major subsystems on the launch pads and other ground processing facilities.

Support will continue for launch construction activities, Launch Complex **39** modifications, and other modifications to facilities or equipment to meet Space Shuttle requirements.

The operations role includes the test and checkout of each flight element as it arrives for flight; the integration of elements (orbiter, external tank, solid rocket boosters and their subsystems) into the Space Shuttle vehicle, and the integrated testing of the stacked configuration, propellant loading, and launch. Subsequent to landing, the orbiter is refurbished by KSC in preparation for the next mission. KSC is responsible for retrieval and disassembly of the expended solid rocket boosters. The Center will also continue the refurbishment of selected existing support equipment for reuse in the Space Shuttle system. KSC is responsible for the operation and maintenance of worldwide contingency and secondary landing sites and for ferrying the orbiter back to KSC.

The Center is responsible for the launch preparation, checkout, support coordination during the payload checkout, and launch of the current inventory of expendable launch vehicles. Launches at both the Eastern Space and Missile Center and Vandenberg Air Force Base are the responsibility of KSC.

Permanent Civil
Service Workyears

SPACE SCIENCE AND APPLICATIONS

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PHYSICS AND ASTRONOMY.....

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KSC is responsible for planning and coordinating the integration of the Spacelab experiment with the Spacelab hardware system (Level IV integration). Interfaces are established and maintained with the NASA discipline program offices, the principal investigators, and appropriate engineering groups to assure that scientific objectives of the mission are met.

LIFE SCIENCES.....

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KSC will continue its support role in the definition, development and integration of biomedical experiments on the Space Shuttle for life sciences research. Included is the responsibility for providing and managing a Life Sciences Principal Investigator Support Facility and assisting in the conduct of life sciences synchronous ground control experiments and procedures required for these payloads. Experiments are designed to use the environment of space to accomplish medical and biological research.

COMMERCIAL PROGRAMS.....

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The objectives of the Commercial Use of Space program are to establish close working relations with the private sector and academia to encourage investment in space technology and the use of such technology to facilitate private sector space activities through access to government capabilities, to encourage private sector investment that is independent of NASA funding and to develop a commercial space policy and insure consistent NASA-wide implementation. This effort established an organizational focal point to foster commercial use and access to space.

The Technology Utilization program identifies, acquires and disseminates the results of NASA research and development in useful forms and through a variety of technology transfer mechanisms to strengthen the national economy and industrial productivity. In order to accelerate and facilitate the application of NASA-related technology to meet technical needs in the industrial and public sectors, the program increasingly focuses participation by all NASA and contractor scientific and engineering personnel.

CENTER MANAGEMENT AND OPERATIONS SUPPORT.....

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Center Management and Operations Support provides support to all Kennedy Center organizations. The civil service personnel involved are:

Director and Staff · The Center Director, Deputy Director, and the immediate staff, e.g., Legal, Patent Counsel, Equal Opportunity, and Public Affairs.

Management Support · Personnel providing information and control services supporting **all** levels of center management, both program and functional. Specific functions include resources and financial management, program control, contracting and procurement, property management, personnel management, and management systems and analysis.

Operations Support · Personnel providing **for** the operational and maintenance of institutional facilities, buildings, systems and equipment, including those who manage or provide technical services such as automatic data processing, supply and transportation, reproduction services, some medical care, and photographic support.

SUMMARY OF RESOURCES REQUIREMENTS

FUNDING PLAN BY FUNCTION

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	<u>Budget Estimate</u>
I. Personnel and Related Costs	94,494	106,673	101,522	115,907
II. Travel	2,792	3,464	3,303	5,338
III Operation of Installation	102,961	132,931	129,494	149,230
A. Facilities Services	(61,512)	(73,912)	(75,323)	(87,017)
B. Technical Services	(13,739)	(18,018)	(16,328)	(17,891)
C. Management and Operations	<u>(27,710)</u>	<u>(41,001)</u>	<u>(37,843)</u>	<u>(44,322)</u>
Total, Fund Requirements	<u>200,247</u>	<u>243,068</u>	<u>234,319</u>	<u>270,475</u>

RESOURCES REQUIREMENTS BY FUNCTION

	<u>1987</u>	<u>1988</u>		<u>1989</u>
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
I. <u>PERSONNEL AND RELATED COSTS</u>	<u>94.494</u>	<u>106.673</u>	<u>101.522</u>	<u>115.907</u>
	<u>Summary of Fund Reuirements</u>			
A. <u>ComDensation and Benefits</u>	92,191	104,199	99,734	113,555
1. <u>ComDensation</u>				
a. Permanent Positions.....	77,840	82,207	81,967	91,775
b. Other than full-time permanent.....	1,905	1,524	1,761	1,844
c. Reimbursable detailees....	155	186	80	122
d. Overtime and other compensation.....	<u>1.632</u>	<u>3.830</u>	<u>3.109</u>	<u>3.585</u>
Subtotal, Compensation....	81,532	87,747	86,917	97,326
2. <u>Benefits</u>	<u>10.659</u>	<u>16.452</u>	<u>12.817</u>	<u>16.229</u>
Subtotal, Compensation and Benefits.....	<u>92.191</u>	<u>104.199</u>	<u>99.734</u>	<u>113.555</u>
B. <u>Supporting Costs</u>				
1. Transfer of personnel.....	899	1,014	328	506
2. Personnel training.....	<u>1.404</u>	<u>1.460</u>	<u>1,460</u>	<u>1,846</u>
Subtotal, Supporting costs.....	<u>2.303</u>	<u>2.474</u>	<u>1.788</u>	<u>2,352</u>
Total, Personnel and Related costs.....	<u>94.494</u>	<u>106.673</u>	<u>101,522</u>	<u>115,907</u>

	<u>Explanation of Fund Reuirements</u>			1989 Budget <u>Estimate</u>
	1987 <u>Actual</u>	1988 Revised <u>Estimate</u> (Thousands of Dollars)	1988 Current <u>Estimate</u>	
A. <u>ComDensation and Benefits</u>	<u>92.191</u>	<u>104.199</u>	<u>99.734</u>	<u>113.555</u>
1. <u>ComDensation</u>	<u>81.532</u>	<u>87.742</u>	<u>86.917</u>	<u>97.326</u>
a. Full-time Permanent.....	<u>77.840</u>	<u>82.207</u>	<u>81.967</u>	<u>91.775</u>

The decreases in the 1988 Current Estimate from the 1988 Revised Esitmate are due to re-estimates for the FERS retirement System, and reductions in overtime, offset by the the 1988 pay raise and KSC's share of the \$42.0 million general reduction needed to reach 1988 authorized levels. The 1989 Estimate includes funding for additional civil service workforce and restorations of the 1988 reductions.

Basis of Cost for Civil Service Workvears

In 1989, the cost of permanent positions will be \$91,775.000The change is calculated as follows:

Cost of full-time permanent workyears in 1988	81,967
Cost increases in 1989	13,655
Restoration of 1988 general reductions.....	3,760
Within grade and career advances:	
Full year cost of 1988 actions.....	1,156
Partial year cost of 1989 actions.....	1,526
Additional	5,706
Full year cost of the 1988 payraise.....	1,147
Cost decreases in 1989.....	• 3,847
Full year cost of the 1988 actions.....	-2,175
Partial year effect of 1989 turnover savings.....	-980
Two less paid days.....	-658
Change in reimbursements34
Cost of full-time permanent workyears in 1989	<u>91.775</u>

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
b. Other than full-time permanent positions				
(1) Cost.....	1,905	1,524	1,761	1,844
(2) Workyears.....	111	111	94	94

The distribution of 1989 workyears is as follows:

<u>Program</u>	<u>Distribution of Other than Full-Time Permanent Workyears</u>		<u>Workyears</u>
Other temporary programs.....			62
Youth Opportunity Programs.....			<u>32</u>
Total.....			<u>94</u>

The program is planned to be reduced in 1988 for redistribution of FTE's to full-time permanent positions. The program will have a realignment of skill mix and higher skilled employees will be hired in 1989.

c. Reimbursable detailees.....	155	186	80	122
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The military personnel detailed to Kennedy Space Center on a reimbursable basis is in the Security Office. The change in the 1988 Current Estimate over the 1988 Revised Estimate is due to disapproval of requests for additional detailees. The 1988 estimate includes the partial year cost of two detailees and the 1989 Estimate includes the full year cost.

d. Overtime and other compensation.....	1,632	3,830	3,109	3,585
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This item includes primarily overtime, holiday pay, night differential, Sunday premium and incentive awards. The decrease from 1988 Revised Estimate to 1988 Current Estimate is due to standdown and change in return-to-flight schedule, The increase in 1989 is caused by the increased Shuttle flight rate.

	1987	<u>1988</u>		1989
	<u>Actual</u>	<u>Revised</u> <u>Estimate</u>	<u>Current</u> <u>Estimate</u>	<u>Budget</u> <u>Estimate</u>
		(Thousands of Dollars)		
2. <u>Benefits</u>	<u>10.659</u>	<u>16.452</u>	<u>12.817</u>	<u>16.229</u>
The following are the amounts of contribution by category:				
Retirement Fund.....	6,276	12,238	7,088	9,801
Employee Life Insurance.....	178	203	198	230
Employee Health Insurance.....	2,324	2,133	2,400	2,606
Workmen's Compensation.....	281	308	347	382
FICA.....	492	390	1,462	1,780
Medicare.....	1,003	1,092	1,212	1,315
Other Benefits OPM Annuity & Unemp Comp.....	<u>105</u>	<u>88</u>	<u>110</u>	<u>115</u>
Total.....	<u>10.659</u>	<u>16.452</u>	<u>12.817</u>	<u>16.229</u>

The decrease in the 1988 Current Estimate from the 1988 Revised Estimate is due to a re-estimate of the Civil Service Retirement, offset by increases in Employee Health Insurance, and FICA and the concomitant retirement changes related to the reduction in permanent compensation for the \$42.0 million general reduction. The 1989 Estimate includes funding for additional civil service workforce.

	1987	1988		1989
	<u>Actual</u>	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
		(Thousands of Dollars)		
B. <u>Supporting Costs</u>	<u>2,303</u>	<u>2,474</u>	<u>1,788</u>	<u>2,352</u>
1. Transfer of personnel.....	899	1,014	328	506

Transfer of personnel includes actual expenses involved in the movement and storage of employee's household goods. The decrease in 1988 Current Estimate reflects less relocation activity because of lower than anticipated PCS costs. 1989 reflects an increase in the number of relocations due to additional civil service workforce.

2. Personnel training.....	1,404	1,460	1,460	1,846
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The increase in 1989 Budget Estimate from the 1988 Current Estimate is due to KSC's training needs related to a large number of new employees hired in 1987, new hires in 1988 and additional civil service workforce in 1989.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u> (Thousands of Dollars)	<u>Current</u> <u>Estimate</u>	
11. TRAVEL.....	<u>2.792</u>	<u>3.464</u>	<u>3,303</u>	<u>5,338</u>
<u>Summary of Fund Requirements</u>				
A. Program Travel.....	1,683	2,732	2,441	4,403
B. Scientific and Technical Development Travel.....	113	61	86	94
C. Management and Operations Travel.....	<u>996</u>	<u>671</u>	<u>776</u>	<u>841</u>
Total, Travel.....	<u>2.792</u>	<u>3.464</u>	<u>3,303</u>	<u>5,338</u>
<u>Explanation of Fund Requirements</u>				
A. <u>Program Travel</u>	<u>1.683</u>	<u>2.732</u>	<u>2.441</u>	<u>4,403</u>

Program travel is directly related to the accomplishment of KSC's mission and accounts for approximately 75 percent of the Center's travel budget. Program travel reflects the continued involvement in launch site operations; the design, manufacturing, and testing of ground system equipment, and construction of facilities; and the activation of systems manufactured at off-site locations.

The current estimate for program travel increase from the 1988 Revised Estimate is due to return-to-flight requirements. Associated with return-to-flight requirements are Delta certification reviews of all orbiter and ground systems, Payload design reviews, and Spacelab recertification testing. Foreign travel is planned for reviews in Germany for ROSAT, in Japan for GEOTAIL and Spacelab J, and in Italy for LAGEOS-2. Also, OV-105 (new orbiter) design reviews, support for Advanced Launch Systems studies, and Shuttle C ground operations and facilities impact study activities.

The decrease from the 1988 Revised to the 1988 Current Estimate is due to less travel requirements because of delay in flight schedule.

The increase in 1989 is additional launch and landing support for increased Shuttle flight rate, and continued OV-105 design reviews, Space Station program requirement reviews, Ground Data Management Systems reviews, design reviews on Space Station Processing Facility and associated equipment, and travel for additional civil service workforce.

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised	Current	Budget
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
B. <u>Scientific and Technical Development</u>				
<u>Travel</u>	<u>113</u>	<u>61</u>	<u>86</u>	<u>94</u>

Scientific and Technical Development Travel permits employees to participate in meetings and technical seminars with other representatives of the aerospace community. This participation allows personnel to benefit from exposure to technological advances outside KSC, as well as to present both accomplishments and problems to associates. Many of the meetings are working panels convened to solve certain problems for the benefit of the government. The increase from the 1988 Revised Estimate to the 1988 Current Estimate reflects this continued support to scientific and technological studies. The increase in 1989 reflects continued support to scientific and technological studies, and anticipated price levels.

C. <u>Management and ODerations Travel</u> ...	<u>996</u>	<u>671</u>	<u>776</u>	<u>841</u>
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Management and Operations Travel is used for the direction and coordination of general management matters. It includes travel concerning such areas as personnel, financial management, and procurement activities; travel of the Center's top management to NASA Headquarters, and other NASA Centers; and local transportation. Local travel includes personal travel in and around the official station of the employer, including tolls, parking fees, and taxis. Non-NASA travel includes transportation of persons, per diem and other incidental expenses for all non-NASA employees, such as unpaid advisory committee members and preemployment interviews for NASA SES positions. The increase from the 1988 Revised Estimate to the 1988

Current Estimate reflects new SR&QA (Safety, Reliability and Quality Assurance) administrative requirements for management reviews, conferences, and studies; also new SR&QA hands on personnel and professional training. The increase in 1989 Budget Estimate reflects continued training requirements, and anticipated cost per trip increases.

	<u>1987</u> <u>Actual</u>	<u>1988</u> Revised <u>Estimate</u> (Thousands of Dollars)	Current <u>Estimate</u>	1989 Budget <u>Estimate</u>
111. <u>OPERATION OF INSTALLATION</u>	<u>102.961</u>	<u>132.931</u>	<u>129.494</u>	<u>149.230</u>

Summary of Fund Reuirements

A. Facilities Services.....	61,512	73,912	75,323	87,017
B. Technical Services.....	13,739	18,018	16,328	17,891
C. Management and Operations.....	<u>27.710</u>	<u>41.001</u>	<u>37.843</u>	<u>44.322</u>
Total, Operation of Installation..	<u>102.961</u>	<u>132.931</u>	<u>129.494</u>	<u>149.230</u>

Explanation of Fund Reaurement

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Center's institutional activities. These are divided into three major functional areas: Facilities Services, the cost of renting real property, maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; Technical Services, the cost of automatic data processing for management activities, and the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations, the cost of communications, printing, transportation, medical, supply, and related services.

The decreases in the Operation of Installation from the 1988 Revised Estimate to the 1988 Current Estimate is due primarily to overall reduction and deferral of equipment due to budget reductions. The increase from the 1988 Current Estimate to the 1989 Budget Estimate results from the full year funding of support service contracts, expected price levels and support for additional civil service workforce.

	1987	<u>1988</u>		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		(Thousands of Dollars)		<u>Estimate</u>
		<u>Estimate</u>	<u>Estimate</u>	
A. <u>FACILITIES SERVICES</u>	<u>61.512</u>	<u>73.912</u>	<u>75.323</u>	<u>87.017</u>

Summary of Fund Reauirements

1. <u>Rental of Real Property</u>	0	0	5	6
2. <u>Maintenance and Related Services</u>	10,172	16,021	19,158	21,932
3. <u>Custodial Services</u>	26,089	29,474	28,630	36,891
4. <u>Utility Services</u>	<u>25.251</u>	<u>28.417</u>	<u>27.530</u>	<u>28.188</u>
Total, Facilities Services....	<u>61.512</u>	<u>73.912</u>	<u>75.323</u>	<u>87.017</u>

Explanation of Fund Reauirements

1. <u>Rental of Real Property</u>	<u>0</u>	<u>0</u>	<u>5</u>	<u>6</u>
2. <u>Maintenance and Related Services</u>	<u>10.172</u>	<u>16.021</u>	<u>19.158</u>	<u>21.932</u>

This activity involves the necessary management, supervisory, engineering, operation and maintenance required to plan, initiate, and perform services on institutional facilities, systems, and equipment. It includes ground maintenance; the development and implementation of a maintenance program for all institutional government furnished and contractor acquired systems, facilities, and equipment; the operations and maintenance at the Kennedy Vandenberg Resident Office at Vandenberg Air Force Base, CA. It provides monitoring of all construction contracts, maintains construction management documentation files, and conducts necessary functions during pre-contract award phase. The support contractor provides various engineering facility management tasks such as cost estimating, master planning and space utilization. These items include cost engineering capabilities to collect, maintain and review conceptual, preliminary and detail cost estimates; provide engineering support and applicable data/documentation to perform the KSC facility master planning function; and provide support for maintenance of the physical space management system and the facilities space control documents. Also, the support contractor will provide environmental engineering work which include the following: Processing of environmental management documentation; master planning in support of Center facility development, siting, and configuration management; and the reporting and correction of pollution incidents and accidents, and the elimination of recurring problems having environmental consequences.

The increase in the 1988 Revised Estimate to the 1988 Current Estimate is for increased manpower and services support; growth and population increases at the Center for new and modified facilities, new procedures, testing and documentation support, and specification updates due to 51-L impacts; increased compliance with federal and state regulations, and functional transfers from research and development for various engineering facility management tasks which are described in the above test. Also, there was an additional sales tax on subcontracted work which was enacted by the State of Florida. The increase in 1989 is due to the full year funding of support service contracts at expected contractor wage rates and support for additional civil service workforce.

	1987	<u>1988</u>		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
3. <u>Custodial Services</u>	<u>26.089</u>	<u>29.474</u>	<u>28.630</u>	<u>36.891</u>

This category includes janitorial services, fire protection, and security. Funding provides janitorial services to highly specialized clean room areas and orbiter support equipment; fire protection services such as conducting drills, fire inspections of facilities and equipment, standby support during

operational tests, and fighting fires. Security protection of personnel and property involves: support of hazardous tests and operations; badging of all on-site personnel and official visitors; safeguarding flight hardware and other items of high intrinsic value; protection of classified information; and maintaining area surveillance and traffic control. Other activities in this category consist of pest control services, laundry services, and supplies and equipment used by the support contractor performing the function. The decrease from the 1988 Revised Estimate to the 1988 Current Estimate is due to refinement of estimates. The increase in 1989 results from the full year funding of support service contracts at expected price and wage levels and funding for the National Resource Protection instituted to protect flight program assets.

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
		(Thousands of Dollars)		
4. <u>Utility Services</u>	<u>25.251</u>	<u>28.417</u>	<u>27.530</u>	<u>28.188</u>

The major utility is electrical energy purchased from Florida Power and Light Company through an Air Force contract. Fuel oil is purchased from a local supplier. Water services are purchased from the City of Cocoa and sewage treatment is accomplished on-site. Utility plant supervision and operations and maintenance of the utility distribution systems are provided by a support contractor and by the Air Force. The support contractor will implement and manage energy conservation projects, programs, audits and inspections on facilities to insure conformance of energy conservation policy and to identify new energy initiatives in such areas as modifications, operational changes, energy studies and awareness. At the Kennedy Resident Office at Vandenberg Air Force Base, CA, utilities are purchased through the United States Air Force.

The decrease from the 1988 Revised Estimates to the 1988 Current Estimate reflects lower consumption due to a reduced flight rate offset by increased utility rates.

The increase from the 1988 Current Estimate to the 1989 Budget Estimate is for anticipated support contractor wage rates, projected purchased utility rates and projected utility and manpower consumption for operation and maintenance of new facilities and increased STS flight rate.

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
B. <u>TECHNICAL SERVICES</u>	<u>13,739</u>	<u>18,018</u>	<u>16,328</u>	<u>17,891</u>

Summary of Fund Requirements

1. <u>Automatic Data Processing</u>	<u>10,393</u>	<u>11,496</u>	<u>9,200</u>	<u>12,031</u>
2. <u>Scientific and Technical</u> <u>Information</u>	<u>1,241</u>	<u>1,384</u>	<u>1,391</u>	<u>1,459</u>
3. <u>Shop and Support Services</u>	<u>2,105</u>	<u>5,138</u>	<u>5,737</u>	<u>4,401</u>
Total, Technical Services....	<u>13,739</u>	<u>18,018</u>	<u>16,328</u>	<u>17,891</u>

Explanation of Fund Requirements

1. <u>Automatic Data Processing</u>	<u>10,393</u>	<u>11,496</u>	<u>9,200</u>	<u>12,031</u>
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The Base Operations contractor provides programming services for payroll, general accounting, resources and financial management reports, supply, procurement, preventive maintenance, contract surveillance, personnel, security, and related institutional management information. The contractor provides for the development and maintenance of general management ADP programs which include the lease, purchase, and maintenance of ADP equipment, and programming and operations services. Also, the support contractor provides for an Engineering Management Integration System and an Integrated Management Information System. A contract to design, develop, and install an Office Automation System (OAS) will provide an integrated system for information exchange between KSC organizational elements. The OAS will include word processing, electronic mail, and projects and data management capabilities.

The decrease from the 1988 Revised Estimate to the 1988 Current Estimate is due to the overall reduction and deferral of equipment purchases. The increase from the 1988 Current Estimate to the 1989 Budget

Estimate results from the full year funding of support service contracts, restoration of some equipment replacement and repair and provides support for additional civil service workforce.

	<u>1987</u>	<u>1988</u>		<u>1989</u>
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
2. <u>Scientific and Technical</u>				
<u>Information</u>	<u>1.241</u>	<u>1.384</u>	<u>1.391</u>	<u>1.459</u>

This funding provides for operation of a technical library at KSC and for technical and administrative documentation services, including support to the public affairs educational and information program.

The base operations contractor operates the library facilities, which provide technical and management books and periodicals plus the military, federal, and professional society specifications and standards. The contractor also operates a STS and Spacelab documents repository which catalogs, classifies, and indexes documents and provides document reference and distribution services. Public Affairs support provides for the gathering and dissemination of information about the agency's program to the mass communications media, the general public, and the educational community at the elementary and secondary levels. The increase from the 1988 Revised Estimate to the 1988 Current Estimate is due to escalation. The 1989 Estimate increase reflects continuing services at anticipated price levels for needed goods and services.

3. <u>Support Services</u>	<u>2.105</u>	<u>5.138</u>	<u>5.737</u>	<u>4.401</u>
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These funds provide for the Eastern Space and Missile Center photographic services for NASA's Public Affairs Office and any other institutional support. These funds also provide for the institutional part of the mishap reporting system. The support contractor also provides the necessary management of a comprehensive safety program. This includes the establishment and development of both short and long-range work plans, emergency plans and schedules in support of KSC base operations. The support

contractor provides graphic services, technical writing, illustration support, ordering, storing, issuing forms/publications, and providing support for presentations. The support contractor will provide Operational Maintenance Documentation (OMD's) for pre-STS activities. Also, the support contractor will maintain, lease and purchase the associated supplies and equipment for this function.

The increase from the 1988 Revised Estimate to the 1988 Current Estimate is due to accelerated Operational Maintenance Documentation (OMD's) activity required for return to flight readiness. The decrease in the 1989 estimate is due to demand for OMD's returning to a normal level offset by anticipated support contractor wage rates.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u> (Thousands of Dollars)	<u>Current</u> <u>Estimate</u>	
C. <u>MANAGEMENT AND OPERATIONS</u>	<u>27.710</u>	<u>41.001</u>	<u>37.843</u>	<u>44.322</u>
<u>Summary of Fund Reaquirements</u>				
1. <u>Administrative Communications</u> ...	<u>2.612</u>	<u>7.141</u>	<u>6.600</u>	<u>6.719</u>
2. <u>Printing and Reproduction</u>	<u>601</u>	<u>6,289</u>	<u>6.477</u>	<u>8,216</u>
3. <u>Transportation</u>	<u>4.446</u>	<u>4.605</u>	<u>5.121</u>	<u>5.627</u>
4. <u>Installation Common Services</u>	<u>20.051</u>	<u>22.966</u>	<u>19.645</u>	<u>23,760</u>
Total, Management and Operations.....	<u>27.710</u>	<u>41.001</u>	<u>37.843</u>	<u>44,322</u>

Explanation of Fund Reauirements

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
1. <u>Administrative Communications...</u>	2.612	7.141	6.600	6.719

These funds provide for the costs of local telephone service, Federal Telecommunications System (FTS), long distance tolls, and special communication services in support of all NASA civil service and contractor personnel located at KSC, ESMC, and VAFB. NASA contractors and other institutions who conduct official business with KSC are widely dispersed throughout the United States. KSC utilizes FTS and other leased lines to minimize costs. Special services include teletype, wire news services and lease and maintenance of various small electrical/electronic systems such as printers which support major communications systems. The base operations contractor will perform liaison activities for administrative communications systems and equipment which are installed and maintained by others and used by various contractor and government organizations at KSC and ESMC. The contractor also is responsible for performing operation and maintenance activities for other administrative communications systems and equipment and for operation of communications centers at KSC and ESMC.

The reduction from the 1988 Revised Estimate to the 1988 Current Estimate is for projected decreases in FTS rates and calls due to return to flight processing. The increase from the 1988 Current Estimate to the 1989 Budget Estimate reflects anticipated rate changes offset by a one-time buy in 1988 of a secure voice system in compliance with National Resources Protection Policy NCSC.22.

2. <u>Printing and Revrodution.....</u>	601	6.289	6.477	8.216
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This category includes printing, reproduction and micrographics services which are provided by the support contractor, the Government Printing Office (GPO) and minor commercial firms contracted by GPO. This work includes constantly updating Operation Maintenance Instructions (OMI's) for return-to-flight; preparing viewgraphs, halftones, and offset plates; trim, bind, collate, drill, cut, and staple finished

products; reduce documentation to micrographic products; producing the house organ, the telephone directory, and Public Affairs brochures and launch support material; and providing lease and maintenance for office copiers at KSC, ESMC and VAFB. Also, the contractor provides the supplies and equipment associated with this function.

The increase from the 1988 Revised Budget to the 1988 Current Estimate is for increased manpower and services needed to support weekend turnaround of updating Operation Maintenance Instructions for return to flight documentation support. The increase in 1989 is due to anticipated rate changes, increased consumption of printing services due to increased STS operations, and equipment upgrades of obsolete equipment

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised	Current	Budget
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
3. <u>TransDortation</u>	<u>4.446</u>	<u>4.605</u>	<u>5.121</u>	<u>5.627</u>

Funding covers the transportation management function performed by the base operations contractor, which includes coordination, check, inspection, and document control of all shipments, delivery of in-bound shipments, and the operation of heavy transportation equipment. The maintenance of KSC's administrative aircraft is also included, as well as the cost of passenger and cargo type vehicles used by civil service personnel, also included are supplies, materials, and equipment used by the support contractor performing the function.

The increase from the 1988 Budget Estimate to the 1988 Current Estimate reflects maintenance and equipment needed for the administrative aircraft (replacement and overhaul of engine and propeller blades), and increased transportation requirements in preparation for return to flight. The increase from the 1988 Current Estimate to the 1989 Budget Estimate is for anticipated support contractor and vehicle maintenance rate and consumption increases for increased STS launches.

	1987 <u>Actual</u>	<u>1988</u>		1989
		<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
4. <u>Installation Common Services.....</u>	<u>20,051</u>	<u>22,966</u>	<u>19,645</u>	<u>23.760</u>

(Thousands of Dollars)

These funds provide for management and logistics services, mail and distribution services, medical services, and a wide variety of minor contracts for special and one-time services.

The base operations contractor provides a broad range of procurement and logistics services including receipt, storage, and issuing of supplies, parts and equipment, as well as maintaining various supply management systems. Mail and distribution services, provided by the support contractor include distribution of interoffice mail, classified document control, operation of the KSC branch post office, and postal service charges.

Two major types of medical services are provided, occupational medicine and environmental health. Occupational medicine includes emergency and first aid care for the workforce, guests, and tour visitors; health maintenance and counseling for civil service employees; and a variety of physical examinations and special programs for health maintenance, applied research, and job certification for civil service and contractor personnel. The contractor has been charged with ensuring compliance with Occupational Safety and Health Administration standards. The medical services are available on a three-shift basis to provide emergency and ambulance services and special standby service in support of launch operations including hazardous tests and operations. Environmental health consists of industrial hygiene, radiological health, and environmental sanitation program elements. This includes: monitoring hypergolic substances and other toxins; the maintenance of a centerwide toxic substances inventory; surveillance of the potable water supply and distribution; sewage management, sewage treatment and disposal; treatment and disposal of industrial wastes, solid wastes management and disposal; selection and use of pesticides; and the surveillance of sanitation practices in all food services areas.

Also, a support contractor is responsible for environmental monitoring efforts which include the generation of data and documentation of impact assessments, analyses, and environmental impact statements; field surveillance for impacts due to launch and recovery activities, industrial operations, and

specialized functions in support of space activities, including efforts to maintain and update ecological baseline data; data base management work, including development, operation, and maintenance of a Geographic Information System; and laboratory operations and equipment maintenance in support of the above activities.

This category also covers lease, maintenance, and purchase of administrative equipment. Rentals are primarily for special purpose office equipment more economical to lease than purchase. Maintenance is provided for all government-owned administrative equipment in active service. Purchases are largely replacements of office machines such as typewriters and calculators. Office supplies and equipment are provided to all civil service and institutional contractor personnel.

The increase from the 1988 Budget Estimate to the 1988 Current Estimate is due to a overall reduction and deferral of equipment purchases. The increase from the 1988 Current Estimate to the 1989 Budget Estimate results from the full year funding of support service contracts, restoration of some equipment replacement and repair and provides support for additional civil service workforce.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION JOHN F. KENNEDY SPACE CENTER

CENTER DIRECTOR		
	FY88	FY89
SES	5	5
GRAVSS-15	1	1
GRAVSS-14	1	1
OTHER GRAVSS	4	4
MG	--	--
TOTAL	9	9

STAFFING SUMMARY		
	FY88	FY89
SES	51	52
GRAVSS-15	105	108
GRAVSS-14	278	285
OTHER GRAVSS	1,862	2,100
MG	--	--
TOTAL	2,081	2,550

EXECUTIVE MANAGEMENT OFFICE		
	FY88	FY89
SES	1	1
GRAVSS-15	5	5
GRAVSS-14	8	8
OTHER GRAVSS	37	37
MG	5	5
TOTAL	56	56

PUBLIC AFFAIRS OFFICE		
	FY88	FY89
SES	1	1
GRAVSS-15	1	1
GRAVSS-14	2	2
OTHER GRAVSS	26	26
MG	--	--
TOTAL	30	30

CHIEF COUNSEL		
	FY88	FY89
SES	1	1
GRAVSS-15	1	1
GRAVSS-14	1	1
OTHER GRAVSS	5	5
MG	--	--
TOTAL	7	7

EQUAL OPPORTUNITY PROGRAM OFFICE		
	FY88	FY89
SES	--	--
GRAVSS-15	--	--
GRAVSS-14	1	1
OTHER GRAVSS	4	4
MG	--	--
TOTAL	5	5

PERSONNEL OFFICE		
	FY88	FY89
SES	--	--
GRAVSS-15	1	1
GRAVSS-14	4	4
OTHER GRAVSS	54	54
MG	--	--
TOTAL	59	59

PROTECTIVE SERVICES OFFICE		
	FY88	FY89
SES	1	1
GRAVSS-15	1	1
GRAVSS-14	2	2
OTHER GRAVSS	21	21
MG	--	--
TOTAL	25	25

COMPTROLLER		
	FY88	FY89
SES	1	1
GRAVSS-15	15	15
GRAVSS-14	95	95
OTHER GRAVSS	--	--
MG	--	--
TOTAL	116	116

BIOMEDICAL OPERATIONS & RESEARCH OFFICE		
	FY88	FY89
SES	1	1
GRAVSS-15	2	2
GRAVSS-14	5	5
OTHER GRAVSS	20	20
MG	--	--
TOTAL	28	28

ADVANCED PROJECTS & COMMERCIALIZATION OFFICE		
	FY88	FY89
SES	1	1
GRAVSS-15	8	8
GRAVSS-14	8	8
OTHER GRAVSS	11	11
MG	--	--
TOTAL	28	28

SPACE STATION PROJECT OFFICE		
	FY88	FY89
SES	1	2
GRAVSS-15	6	6
GRAVSS-14	13	13
OTHER GRAVSS	21	20
MG	--	--
TOTAL	41	41

DIRECTOR OF SIS MANAGEMENT & OPERATIONS		
	FY88	FY89
SES	2	2
GRAVSS-15	8	8
GRAVSS-14	8	8
OTHER GRAVSS	15	21
MG	--	--
TOTAL	29	35

DIRECTOR OF SAFETY RELIABILITY & QUALITY ASSURANCE		
	FY88	FY89
SES	1	1
GRAVSS-15	1	1
GRAVSS-14	7	7
OTHER GRAVSS	16	22
MG	--	--
TOTAL	25	31

DIRECTOR OF ENGINEERING DEVELOPMENT		
	FY88	FY89
SES	1	1
GRAVSS-15	4	2
GRAVSS-14	11	11
OTHER GRAVSS	22	22
MG	--	--
TOTAL	39	40

DIRECTOR OF CENTER FACILITY OPERATIONS		
	FY88	FY89
SES	2	2
GRAVSS-15	9	9
GRAVSS-14	21	21
OTHER GRAVSS	212	233
MG	--	--
TOTAL	244	266

DIRECTOR OF PAYLOAD MANAGEMENT & OPERATIONS		
	FY88	FY89
SES	1	1
GRAVSS-15	2	2
GRAVSS-14	5	5
OTHER GRAVSS	8	8
MG	--	--
TOTAL	16	16

DIRECTOR SHUTTLE OPERATIONS		
	FY88	FY89
SES	1	1
GRAVSS-15	9	10
GRAVSS-14	14	15
OTHER GRAVSS	65	125
MG	--	--
TOTAL	89	151

DIRECTOR SHUTTLE LOGISTICS PROJECT MANAGEMENT		
	FY88	FY89
SES	1	1
GRAVSS-15	6	6
GRAVSS-14	11	12
OTHER GRAVSS	50	70
MG	--	--
TOTAL	68	89

DIRECTOR SAFETY & RELIABILITY		
	FY88	FY89
SES	1	1
GRAVSS-15	2	2
GRAVSS-14	4	4
OTHER GRAVSS	44	89
MG	--	--
TOTAL	51	94

DIRECTOR QUALITY ASSURANCE		
	FY88	FY89
SES	1	1
GRAVSS-15	2	2
GRAVSS-14	4	5
OTHER GRAVSS	14	281
MG	--	--
TOTAL	14	289

DIRECTOR FACILITIES ENGINEERING		
	FY88	FY89
SES	1	1
GRAVSS-15	3	3
GRAVSS-14	4	5
OTHER GRAVSS	64	64
MG	--	--
TOTAL	76	76

DIRECTOR PAYLOAD PROJECTS MANAGEMENT		
	FY88	FY89
SES	1	1
GRAVSS-15	5	5
GRAVSS-14	14	14
OTHER GRAVSS	18	18
MG	--	--
TOTAL	48	48

DIRECTOR VEHICLE ENGINEERING		
	FY88	FY89
SES	1	1
GRAVSS-15	10	11
GRAVSS-14	17	19
OTHER GRAVSS	246	553
MG	--	--
TOTAL	294	604

DIRECTOR GROUND ENGINEERING		
	FY88	FY89
SES	1	1
GRAVSS-15	2	2
GRAVSS-14	16	17
OTHER GRAVSS	114	156
MG	--	--
TOTAL	136	179

DIRECTOR MECHANICAL ENGINEERING		
	FY88	FY89
SES	1	1
GRAVSS-15	4	4
GRAVSS-14	15	17
OTHER GRAVSS	82	82
MG	--	--
TOTAL	100	100

DIRECTOR ELECTRONIC ENGINEERING		
	FY88	FY89
SES	1	1
GRAVSS-15	4	4
GRAVSS-14	6	6
OTHER GRAVSS	18	18
MG	--	--
TOTAL	114	114

DIRECTOR SIS PAYLOAD OPERATIONS		
	FY88	FY89
SES	1	1
GRAVSS-15	4	4
GRAVSS-14	24	24
OTHER GRAVSS	140	140
MG	--	--
TOTAL	149	149

DIRECTOR EXPENDABLE VEHICLES OPERATIONS		
	FY88	FY89
SES	1	1
GRAVSS-15	5	4
GRAVSS-14	7	6
OTHER GRAVSS	40	21
MG	--	--
TOTAL	40	30

MARSHALL
SPACE FLIGHT CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1989 ESTIMATES

GEORGE C. MARSHALL SPACE FLIGHT CENTER

DESCRIPTION

Operations at Marshall Space Flight Center (MSFC) are conducted at three primary locations:

The principal MSFC site is near Huntsville, Alabama, on Army property at the Redstone Arsenal. The Center occupies 1,841 acres under a non-revocable use permit from the Army. The Huntsville location is connected by deep water access to its component Michoud Assembly Facility via the Tennessee, Ohio, and Mississippi Rivers.

The Michoud Assembly Facility, located 15 miles east of downtown New Orleans, Louisiana, is where the external tanks for the Space Shuttle are being manufactured and where activities for other Federal agencies are conducted. The Michoud Facility occupies 832 acres and provides 3,720,987 gross square feet of space, including the main assembly plant. The facility is located on the Gulf Intracoastal Waterway and has deep water access via the Mississippi River.

The Slidell Computer Complex, located at Slidell, Louisiana, 20 miles northeast of the Michoud Assembly Facility, occupies 14 acres and provides centralized computer services for MSFC, Michoud, other NASA Centers, and associated contractors, as well as other government agencies.

A number of individual facilities at MSFC and its component installations are unique within NASA, the Nation and the free world. The combined capability of the science and engineering laboratories, special development facilities, and test facilities provide a unique national resource for designing, developing, and testing large, complex space systems. The total capital investment of the Marshall Space Flight Center and its installations in Louisiana, including fixed assets in progress and contractor-held facilities at various locations was \$913,472,000 as of September 30, 1987.

CENTER ROLES AND MISSIONS

The Marshall Space Flight Center serves as one of NASA's primary centers for the design and development of Space Transportation Systems, elements of the Space Station, scientific and applications payloads, and other systems for present and future space exploration. MSFC has the principal role within NASA for large rocket propulsion systems. The Center also has a principal role for the design and development of manned vehicle systems; for Spacelab mission management and payload definition and development; for design and development of large, complex, and specialized automated spacecraft; for management of materials processing in space activities; for solar and magnetospheric physics; and for astrophysics. MSFC has a primary role within NASA for the development and processing of space science and applications experiments. In addition, MSFC conducts a vigorous research and technology program and is involved in the study and definition of future programs, including significant roles contributing to the development of large, complex space structures, space propulsion systems, materials and engineering, materials processing in space, power systems, guidance and control, fundamental electronics, advanced optical systems, and payload systems analysis and integration.

In addition to on-site activities at Huntsville, Alabama, MSFC manages the Michoud Assembly Facility at New Orleans and the Computer Complex at Slidell, Louisiana. Resident offices are maintained at other centers and in conjunction with major industrial sites in various locations throughout the nation, and in Europe. The principal and supporting roles are:

PRINCIPAL ROLES

Propulsion Systems - design, develop and procure propulsion-oriented systems and subsystems. Current focus is on Space Transportation Systems, including Space Shuttle main engine, solid rocket booster, external tank, Orbital Maneuvering Vehicle, Inertial Upper Stage in cooperation with the Air Force, procurement of upper stages for NASA missions and monitoring of commercially developed and produced upper stages such as the Payload Assist Module by McDonnell Douglas and the Transfer Orbit Stage by Orbital Sciences Corporation. Advanced program efforts are focused on analysis and definition of propulsion/transportation systems to meet national needs for the next 25 years. MSFC is currently leading NASA-wide efforts to define and plan for potential development of an unmanned cargo version of the Space Shuttle (Shuttle-C). In concert with other Centers and USAF, MSFC is continuing to examine potential needs for new upper stages and concepts/plans to meet these needs. The Center also has a key role in joint NASA-DOD activities to identify promising systems and to implement technologies to ensure a vigorous

national posture in space transportation, specifically an Advance Launch System. This includes propulsion/transportation systems for a next generation Space Shuttle, unmanned launch vehicles, heavy-lift launch vehicles, liquid rocket boosters, LOX/HC and LOX/H₂ engines, orbit transfer vehicles, and propulsion technologies for future high performance systems.

Manned Space Vehicle Development · design, development, and procurement of manned vehicle systems as assigned.

- Spacelab · focus is on program management, systems engineering, development of related payload carriers, procurement, flight and ground operations sustaining engineering.
- Advanced Development · technology advances focused on advanced missions.

Space Transportation System (STS) Sustaining Engineering · provide sustaining engineering for STS propulsion system hardware and software to assure maintenance of the original design requirements throughout the life of the STS program, decrease the unit cost of manufacturing through design improvements, and upgrade operational performance capabilities through product improvement redesign.

Payload Development and Mission Management · definition, management, and development of payloads, facilities, experiments, and instruments for space science and applications missions as assigned.

Specialized Automated Spacecraft · design, development, and procurement of large, complex, and/or specialized automated spacecraft as assigned.

- · Hubble Space Telescope: The current focus is on completion of the Hubble Space Telescope modifications, retest, and preparation for launch.
- · Advanced X-Ray Astronomy Facility · · spacecraft development and utilization.
- · Automated Servicing/Resupply/Retrieval Kits - definition and development of specialized mission kits to provide remote spacecraft servicing, resupply and retrieval capabilities supported by the Orbital Maneuvering Vehicle from the Shuttle and Space Station.

Space Station - Development of the Space Station pressurized structures (modules and nodes), habitability and laboratory modules, logistics elements, environmental control and life support system subsystem, internal thermal control, and internal audio and video subsystems.

Geostationary Platform Studies - identify and define concepts with associated attached payloads.

Space Processing - development of space processing discipline base, enlistment of user interest in potential applications, and development and management of space processing experiments and facilities.

Science - Support space research to act as a focal point for interaction with the scientific community in programs of interest, such as the Spacelab Program, and the Space Station. Define, manage and develop advanced science payloads for current and future programs such as Spacelab, Space Station, and large observatories.

SUPPORTING ROLES

Space Structures and Materials - contributing to the development of large, complex space structures and materials technology base; developing and testing technology for advanced optical systems.

Propulsion Technology - developing and evaluating alternate propulsion systems, techniques, and propellants for advanced launch systems and spacecraft.

DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM
MARSHALL SPACE FLIGHT CENTER

	1987 ACTUAL	1988		1989 BUDGET ESTIMATE
		REVISED ESTIMATE	CURRENT ESTIMATE	
SPACE STATION.....	370	655	430	430
SPACE FLIGHT PROGRAMS.....	1,493	1,479	1,619	1,725
SPACE TRANSPORTATION CAPABILITY DEV	502	509	619	628
SPACE SHUTTLE.....	991	970	1,000	1,097
SPACE SCIENCE AND APPLICATIONS.....	766	618	654	645
PHYSICS AND ASTRONOMY.....	631	491	552	538
SPACE APPLICATIONS.....	135	127	102	107
AERONAUTICS AND SPACE TECHNOLOGY.....	125	125	125	125
SPACE RESEARCH AND TECHNOLOGY.....	125	125	125	125
COMMERCIAL PROGRAMS.....	30	35	32	32
TRACKING AND DATA PROGRAMS.....	12	12	14	14
SUBTOTAL DIRECT.....	2,796	2,924	2,874	2,971
CENTER MANAGEMENT AND OPERATIONS.....	494	470	490	490
SUBTOTAL (FULL-TIME PERMANENTS).	3,290	3,394	3,364	3,461
OTHER CONTROLLED FTE'S..... (PMI's/CO-OPS/OTFTP's)	90	90	90	90
GRAND TOTAL (FULL-TIME EQUIVALENTS)	3,380	3,484	3,454	3,551

PROGRAM DESCRIPTION

Permanent Civil
Service Workyears

RESEARCH AND DEVELOPMENT

SPACE STATION..... **430**

The technical and programmatic management of Work Package #1 for the Space Station is the responsibility of MSFC. This package contains the habitation, logistics, laboratory modules and resource nodes structures and the internal thermal control, internal audio and video, and the environmental control and life support subsystems. The habitation module is the pressurized volume in which the crew lives. The logistics module provides the ground-to-orbit logistics and on-orbit supply for extended periods. The laboratory module is a manufacturing and technology laboratory outfitted to accommodate materials processing and other related disciplines. The resource nodes are large outfitted passageways connecting the laboratory and habitation modules.

In 1989, the design, development, test, evaluation and production of components, subsystems and systems for the modules will be continued by the prime contractor: MSFC will continue the technical assessment and evaluation of these activities including emphasis on SR&QA. A close working relationship will be maintained with other Centers and NASA Headquarters to assure accomplishment of the technical, cost and schedule objectives of the Program. System engineering, integration, test and verification, and simulation efforts will be continuing at MSFC. The Preliminary Design Review (PDR), which is the second formal Program review during Phase C/D, is scheduled for late 1989.

SPACE FLIGHT PROGRAMS **1725**

SPACE TRANSPORTATION CAPABILITY DEVELOPMENT..... 628

Spacelab

1989 Activities include continuation of program management and Spacelab system sustaining engineering; integration of ESA and NASA-provided hardware and software; mission integration and preparation for Spacelab flights in 1989 and 1990, plus other missions involving Spacelab hardware; and development of the capability to fly mixed cargoes will be completed using igloo pallet and MDM pallet configurations.

Inertial Upper Stages (IUS)

Activities involve four IUS/TDRS missions and three planetary missions, which will require (1) A series of readiness reviews conducted to assure the flight readiness of the upper stage prior to launch, (2) the conduct of joint integrated flight simulations prior to launch, (3) the launch and flight operations support; and (4) the post flight evaluation of the upper stage performance.

Transfer Orbit Stage (TOS)

Activities include technical direction and management of the production, integration, and launch support of a TOS vehicle for the Mars Observer which will require (1) a series of readiness reviews conducted to assure the flight readiness of the upper stage prior to launch, (2) the conduct of the joint integrated flight simulations prior to launch, (3) the launch and flight operations support, (4) the post flight of the upper stage performance.

Payload Assist Module (PAM)

Activities include monitoring the MDAC effort, procuring PAMs for NASA/STS missions, managing PAM-A inventory, and support planning and mission studies.

Solid Propulsion Integrity Program

Activities include issuance of RFPs and award of contracts for the Nozzles and Bondlines Work- Packages. These efforts include work to: (1) improve analytical capabilities; (2) validate models use for design; (3) further characterize and define the behavior of materials currently used for design; (4) improve understanding of the processes involved in manufacturing solid rocket motors (SRMs) and their components, fabrication and the influences of process and material variables on the final product; (5) develop criteria and techniques to enhance current capabilities and practices to nondestructively evaluate the acceptability of SRM elements; and (6) define and characterize some alternate design and construction approaches in selected areas. Also, a highly instrumented model verification firing of a STAR 48 representative test motor will take place.

Tethered Satellite System

Activities include continued technical and programmatic management involving the U. S. developed deployer and science instrument development, and overall system engineering activities for the cooperative effort between the U. S. and Italy; specifically, delivery of the deployer and the delivery of one U.S. science experiment.

Orbital Maneuvering Vehicle

Activities include completion of spacecraft preliminary design (PDR) including the completion of the program major milestone, PDR, continuation of the system engineering and integration activities, receipt of initial long lead procurement items; development of subsystem components and beginning of subsystem hardware fabrication and qualification; continued development of flight and ground software leading to completion of the PDR and the critical design review; and the Phase I safety review.

Advanced Programs

The Advanced Programs effort at MSFC includes the definition and implementation of in-house and contracted system studies to establish the fundamental planning and decision making data needed prior to proposing future space programs. Major 1988 advanced study activities include: (1) Shuttle C; (2) advanced transportation including reusable evolutionary upper stages, launch vehicle systems, new engines, and advanced recovery systems; (3) liquid rocket booster; (4) platforms and facilities in low-earth and geosynchronous orbit such as tethered satellite systems application and geostationary platform; (5) orbital services such as satellite servicing applications and in-orbit assembly, maintenance and repair; and (6) flight demonstration studies.

Permanent Civil
Service Workyears

SPACE SHUTTLE.....

1097

Activities include those necessary for the planned increase in flight rate including the proper emphasis on SRM&QA. This includes the analysis of the flight hardware performance (including the redesigned SRM joint/seal, SRB, SSME, and ET) as the Shuttle returns to flight. This effort also provides main engines for a four Space Shuttle orbiter fleet and continues a logistics support capability to provision spares

hardware. Activity will continue in the development of an alternate turbopump for the Shuttle main engine, as will certification testing of the engine design changes which will be incorporated in the SSME flight engine for margin improvements. The phase C/D start of the Advanced Solid Rocket Motor is planned for 1989.

Included in this activity is the standard operational support services for the Space Shuttle in the operations phase. Major activity in 1989 will be associated with the increase rate of Shuttle flights. Other activities will include the production, overhaul, and acquisition of hardware for shuttle flights. The flight hardware program element provides for the procurement of external tanks, solid rocket motors and propellants, booster hardware and replenishment spare components and overhaul for the main engine. Typical functions will be production engineering, manufacturing, sustaining engineering, anomaly resolution, logistics, configuration management, systems level analysis, test and integration tasks, ground operations, and contract management.

Permanent Civil
Service Workyears

SPACE SCIENCE AND APPLICATIONS

645

PHYSICS AND ASTRONO.....

538

Hubble Space Telescoue

The objective of the Hubble Space Telescope (HST) project is to place in orbit a high quality optical 2.4-meter telescope system by the Space Shuttle for use by the astronomical community in conjunction with NASA. MSFC is the lead Center for the management of the Hubble Space Telescope project and has overall implementation responsibility under the Office of Space Science and Applications. The HST project includes the design, development, delivery, launch, orbital verification, mission/science operations activities, data analysis and in-orbit servicing. Goddard Space Flight Center is responsible to MSFC for scientific instruments and mission operations. Approximately one year after launch (1991), the total HST project responsibility, including management, operations, and maintenance and refurbishment, will be phased over to GSFC.

Gamma Ray Observatory

The objective of the Gamma Ray Observatory (GRO) is to measure gamma radiation from the universe, and to explore the fundamental physical processes involved. MSFC has responsibility for the design and development of the Burst and Transient Source Experiment (BATSE) which is one of the four experiments being developed to attain the GRO objectives. BATSE hardware is scheduled for delivery in July 1988 for GRO integration and test activities in 1989 at the GRO integration contractor facility.

Advanced X-Ray Astronomy Facility (AXAF)

In 1989, definition efforts will be completed and development of the AXAF spacecraft will begin.

Payload Mission Management

In 1989, MSFC will be responsible for managing and planning activities of the Astro, Atlas, International Microgravity Laboratory, Spacelab J, United States Microgravity Laboratory, Materials Science Laboratory, Aeroassist Flight Experiment, and other dedicated and partial payload missions as assigned. MSFC is also responsible for definition and development of selected payloads, facilities, and instruments to be flown on these missions.

Mission management responsibility begins with the definition of the payload complement and ends with the dissemination and analysis of the experiment data and materials resulting from the flight. During 1989, MSFC will continue to manage the assigned mission planning and definition activities, as well as development of the required instruments and supporting hardware and software.

Interfaces will continue to be maintained in 1989 with the cognizant NASA program offices, principal investigators, and other appropriate organizations to assure accomplishment of the scientific objectives of the assigned missions. MSFC will continue to participate in and manage the analysis of the requirements, objectives, and constraints of the STS systems and payload complements in order to develop requirements for all levels of integration to insure physical, functional, and operational compatibility for all assigned missions.

Supporting Research and Technology

The Space Science and Applications supporting research and technology activities at MSFC are oriented to develop new technologies required for future science and applications missions. The principal science areas are Astrophysics and Solar Terrestrial. The principal application area is in earth science and materials science research, which support definition efforts of future STS payloads.

Permanent Civil
Service Workyears

SPACE APPLICATIONS 107

Microgravity Science and Applications

The Microgravity Science and Applications program emphasizes the fundamental science and technology of processing materials under conditions that allow detailed examination of the constraints imposed by gravitational forces. These studies are directed towards selected materials and processes which will best identify the limitations due to gravity, as well as demonstrate the enhanced control that may be possible by the weightless environment of space. In 1989, MSFC will continue to embody research and development activities in such areas as: (1) crystal growth, (2) containerless processing, (3) fluid and chemical processing, and (4) solidification of metals and alloys. Continuing activities include engineering and scientific analyses, advanced studies, definition, design, development, and operations of materials processing payloads.

Combined Release and Radiation Effects Satellite (CRRES)

The CRRES satellite consists of active experiments in low earth orbit and geosynchronous Orbit (GTO) to further understand the Earth's upper atmosphere and ionosphere. The CRRES satellite will be modified for launch into the GTO orbit by an Atlas Centaur vehicle. The low earth orbit experiment will be conducted with Scout and Sounding Rocket launches.

Atmospheric Supporting Research

Theoretical, field, and laboratory experimental research will be conducted in the global weather, severe storms, and local weather areas. Efforts will be concentrated on improving understanding of severe storms, mesoscale and global scale weather systems, and in defining Shuttle free flyer and Space Station missions to obtain data required to understand and predict severe storms and atmospheric conditions.

Permanent Civil
Service Workyears

SPACE RESEARCH AND TECHNOLOGY..... **125**

The space research and technology activities are in propulsion (including hydrocarbon engine), advanced SSME technology, space energy conversion, controls and guidance, automation and robotics, and systems analysis, flight experiments and sensor technology. The primary effort beginning in 1988 will be on developing technology for future high-performance systems and large space systems.

COMMERCIAL PROGRAMS **32**

The objectives of the Commercial Use of Space program are to establish close working relations with the private sector and academia to encourage investment in space technology and the use of such technology to facilitate private sector space activities. This is accomplished through access to government capabilities to encourage private sector investments which are independent of NASA funding. A commercial space policy has been developed to insure consistent NASA-wide implementation.

The Technology Utilization program identifies, acquires and disseminates the results of NASA research and development in useful forms and through a variety of technology transfer mechanisms to strengthen the national economy and industrial productivity. In order to accelerate and facilitate the application of NASA-related technology to meet technical needs in the industrial and public sectors, the program increasingly focuses participation by all NASA and contractor scientific and engineering personnel.

Permanent Civil
Service Workyears

SPACE AND GROUND NETWORK COMMUNICATIONS AND DATA SYSTEMS..... 14

These activities involve the management and monitoring of the Program Support Communications Network which is the communications hardware and software and transmission medium that inter-connects NASA Headquarters, field installations, and major contractor locations for the transfer of programmatic and institutional data, voice, and video.

CENTER MANAGEMENT AND OPERATIONS SUPPORT..... 490

Center Management and Operations Support is provided to all MSFC organizations and includes the following:

Director and Staff - The Center Director, Deputy Director, and immediate staff, e.g., Comptroller, Chief Counsel, Equal Opportunity, Public Affairs, and Industrial Safety.

Management Support - Those who provide management and support services to all levels of Center management, both program and functional. Specific functions include resources and financial management, program control, contracting and procurement, property management, personnel management, and management systems and analysis.

Operations Support - Those who manage or provide for the operation and maintenance of institutional facilities, buildings, systems and equipment, including those who manage or provide technical services such as automatic data processing, reliability and quality assurance, medical care, and photographic support.

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SUMMARY OF RESOURCES REQUIREMENTS

Funding Plan By Function

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
I. Personnel and Related Costs.....	154,619	172,856	157,878	171,331
11. Travel.....	6,189	7,326	7,125	8,196
III. Operation of Installation.....	51,238	66,857	66,111	69,577
A. Facilities Services.....	(26,072)	(27,321)	(26,463)	(28,285)
B. Technical Services.....	(9,983)	(11,961)	(11,707)	(13,094)
C. Management and Operations.....	<u>(15,183)</u>	<u>(27,575)</u>	<u>(27,941)</u>	<u>(28,198)</u>
Total, fund requirements.....	<u>212,046</u>	<u>247,039</u>	<u>231,114</u>	<u>249,104</u>

SUMMARY OF RESOURCES REOUREMENTS

Funding Plan by Function

	1987	<u>1988</u>		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
I. Personnel and Related Costs.....	154,619	172,856	157,878	171,331
11. Travel.....	6,189	7,326	7,125	8,196
III. Operation of Installation.....	51,238	66,857	66,111	69,577
A. Facilities Services.....	(26,072)	(27,321)	(26,463)	(28,285)
B. Technical Services.....	(9,983)	(11,961)	(11,707)	(13,094)
C. Management and Operations.....	<u>(15,183)</u>	<u>127,575)</u>	<u>(27,941)</u>	<u>(28,198)</u>
Total, fund requirements...	<u>212.046</u>	<u>247.039</u>	<u>231.114</u>	<u>249.104</u>

RESOURCES REQUIREMENTS BY FUNCTION

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
		(Thousands of Dollars)		
I. <u>PERSONNEL AND RELATED COSTS</u>	154.619	172.856	157.878	171.331
<u>Basis of Fund Requirements</u>				
A. <u>Compensation and Benefits</u>				
1. Compensation				
a. Permanent positions.....	130,730	137,473	131,098	141,635
b. Non-permanent.....	1,721	1,743	1,914	1,960
c. Overtime and other compensation.....	<u>1.927</u>	<u>2.273</u>	<u>2.213</u>	<u>2.231</u>
Subtotal, Compensation.....	134,378	141,489	135,225	145,826
2. <u>Benefits</u>	<u>18.131</u>	<u>27.837</u>	<u>20.398</u>	<u>22.891</u>
Subtotal, Compensation and Benefits.....	<u>152.509</u>	<u>169.326</u>	<u>155.623</u>	<u>168.717</u>
B. <u>Supporting Costs</u>				
1. Transfer of personnel.....	822	2,022	747	912
2. Personnel training.....	<u>1.288</u>	<u>1.508</u>	<u>1.508</u>	<u>1.702</u>
Subtotal, Supporting costs.....	<u>2.110</u>	<u>3.530</u>	<u>2.255</u>	<u>2.614</u>
Total, Personnel and Related costs.....	<u>154.619</u>	<u>172.856</u>	<u>157.878</u>	<u>171.331</u>

Explanation of Fund Reuirements

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
A. <u>Compensation and Benefits</u>	<u>152.509</u>	<u>169.326</u>	<u>155,623</u>	<u>168.717</u>
1. Compensation.....	134,378	141,489	135,225	145,826
a. Permanent positions.....	130,730	137,473	131,098	141,635

The decreases in the 1988 Current Estimate from the 1988 Revised Estimate are due to re-estimates for the FERS retirement System, reductions in overtime, and repricing of compensation estimates, offset by the 1988 pay raise, and MSFC's share of the \$42.0 million general reduction needed to reach 1988 authorized levels. The 1989 Estimate includes funding for additional civil service workforce and restoration of 1988 reductions.

Basis of Cost for Permanent Positions

In 1989 the cost of permanent positions will be \$141,635,000, an increase of \$10.6 million over 1988. This increase is calculated as follows:

Cost of full-time permanent workyears in 1988		131,098
Cost increases in 1989		15,340
Restoration of 1988 general reduction.....	6,013	
Within grade and career advances:		
Full-year cost of 1988 increases.....	1,733	
Partial-year cost of 1989 actions	2,215	
Additional FTE.....	2,868	
Full year cost of the 1988 payraises.....	947	
Decrease in reimbursements received.....	1,564	
Cost decreases in 1989		-4,803
Full-year effect of 1988 turnover savings	-795	
Partial-year effect of 1989 turnover savings	-2,964	
Two less paid days	-1,044	
Cost of full-time permanent workyears in 1989		<u>141,635</u>

b. Other than full-time permanent

(1) cost.....	1,721	1,743	1,914	1,960
(2) Manyears.....	131	136	136	136

The increase from the 1988 Revised Estimate to the 1988 Current Estimate reflect the 1987 actual plus five positions and the January 1988 pay raise. The 1989 Budget Estimate reflects the same level of effort.

Distribution of Other Than Full Time Permanent Workyears

	<u>Program Workyears</u>
Cooperative education programs.....	77
Other temporary programs.....	13
Youth opportunity programs.....	<u>46</u>
Total.....	<u>136</u>

	1987	1988	1989	
	<u>Actual</u>	<u>Revised Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	<u>Budget Estimate</u>
c. Overtime and Other Compensation.....	1,927	2,273	2,213	2,231

The 1988 Current Estimate reflects the effort of return to flight and remains constant through 1989.

2. <u>Benefits</u>	<u>18,131</u>	<u>27,837</u>	<u>20,398</u>	<u>22,891</u>
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The distribution of these costs by major categories is as follows:

<u>Category of Cost</u>				
Retirement Fund.....	10,046	19,862	8,787	10,457
Employee life insurance.....	281	314	384	417
Employee health insurance.....	3,745	3,399	5,819	5,832
FICA.....	883	850	2,164	2,780
Unemployment Compensation.....	9	15	10	10
Workmen's Compensation.....	1,587	1,528	1,571	1,662
Medicare.....	<u>1,580</u>	<u>1,869</u>	<u>1,663</u>	<u>1,733</u>
Total.....	<u>18,131</u>	<u>27,837</u>	<u>20,398</u>	<u>22,891</u>

The decrease in the 1988 Current Estimate from the 1988 Revised Estimate is due to reestimates in the civil service retirement system and repricing of the employee health insurance estimates and the concomitant retirement changes related to the reduction in permanent compensation for the the \$42.0 million general reductions.

	1987	<u>1988</u>		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
B. <u>Supporting Costs</u>	<u>2,110</u>	<u>3,530</u>	<u>2,255</u>	<u>2,614</u>
1. Transfer of personnel.....	822	2,022	747	912

This estimate provides for personnel relocation costs, such as the expenses of selling and buying a home and the movement of household goods. The major reason for the cost decrease from the 1988 Revised Estimate to the 1988 Current Estimate is due to a reduction in the number of hires eligible for permanent change of station reimbursement. The 1989 estimate includes anticipated relocations associated with the additional civil service workforce.

2. Personnel training.....	1,288	1,508	1,508	1,702
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The purpose of the MSFC training program is to continue the development of skills and knowledge of civil service employees in order to more efficiently support MSFC's roles and missions in the space program. The benefits to be derived by NASA from the training and educational programs conducted at MSFC include: enhancement of scientific and engineering leadership in the scientific community; maintenance of a high degree of professional competency with the administrative and clerical work force; development of needed skills and knowledge required in MSFC mission activities; and extending MSFC work force capability and increasing productivity. Increases in the 1989 requirements are primarily to support the Center's increasing computer capabilities, and scientific and engineering related requirements in areas such as robotics, optical systems, software engineering, and propulsion technology, and funding for training the additional civil service workforce.

	1987 <u>Actual</u>	1988		1989 Budget <u>Estimate</u>
		<u>Revised Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	
II. TRAVEL	<u>6.189</u>	<u>7.326</u>	<u>7,125</u>	<u>8.196</u>

Summary of Fund Reaquirements

A. Program Travel	5,323	6,511	6,337	7,299
B. Scientific and Technical Development Travel.....	174	265	188	197
C. Management and Operations Travel	<u>692</u>	<u>550</u>	<u>600</u>	<u>700</u>
TOTAL TRAVEL	<u>6.189</u>	<u>7.326</u>	<u>7.125</u>	<u>8.196</u>

Explanation of Fund Reaquirements

A. <u>Program Travel</u>	<u>5.323</u>	<u>6.511</u>	<u>6.337</u>	<u>7.299</u>
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Program travel is directly related to the accomplishment of the Center's mission, and accounts for almost eighty-five percent of total travel. Travel requirements include those for ongoing programs such as the Shuttle, Spacelab, Space Station, **OMV**, Upper Stages, Space Telescope, Spacelab Payloads, Space Science and Applications payloads and basic supporting research and technology, as well as support to the planning and definition of potential new programs. The decrease between the 1988 Revised Estimate and the 1988 Current Estimate is due to a reestimate based on 1987 actuals. The 1988 travel will focus on the testing, and qualification required to return the Shuttle system to flight status. The anticipated increase in 1989 travel costs is due to increased requirements in support of Space Shuttle payloads, Space Telescope, Space Station activities, and travel for the additional civil service workforce.

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
B. <u>Scientific and Technical</u>				
<u>Development Travel</u>	<u>174</u>	<u>265</u>	<u>188</u>	<u>197</u>

Scientific and technical related travel permits employees to participate in meetings and technical seminars with representatives of the aerospace community. This participation allows them to maintain and to grow in technical excellence, and benefit from exposure to technological advances outside MSFC, as well as to present both accomplishments and concerns to associates. These meetings are principally working panels convened to solve problems for the benefit of the Government. The decrease between the 1988 Revised Estimate and the 1988 Current Estimate reflects a re-evaluation based on 1987 actuals. The 1988 Current Estimate and 1989 Budget Estimate reflect the 1987 level of travel.

C. <u>Management and Operations</u>				
<u>Travel</u>	<u>692</u>	<u>550</u>	<u>600</u>	<u>700</u>

Management and Operations travel is required for the direction and coordination of general management matters. It includes travel by managers in such areas as personnel, financial management, and procurement activities and travel of the Center's top management to NASA Headquarters and other NASA Centers. This category of travel includes lease of aircraft, local travel, passenger vehicle rental and non-NASA travel. Local travel includes personal travel in and around the official station of the employee and includes tolls, parking fees and taxis. Passenger vehicle rental includes lease of commercial passenger vehicles. Non-NASA travel includes transportation of persons, per diem, and other incidental expenses for all non-NASA employees, such as unpaid members of research advisory committees and pre-employment interviews for NASA SES positions. The increase from the 1988 Revised Estimate to the 1988 Current Estimate is due to the continuation of the lease of an administrative aircraft until the NASA aircraft becomes available and a continuation of the 1987 level of travel. The 1989 Estimate maintains the same level of travel with anticipated cost per trip increases.

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
111. <u>OPERATION OF INSTALLATION</u>	<u>51.238</u>	<u>66.857</u>	<u>66.111</u>	<u>69.577</u>
		<u>Summary of Fund Reuirements</u>		
A. Facilities Services.....	26,072	27,321	26,463	28,285
B. Technical Services.....	9,983	11,961	11,707	13,094
C. Management and Operations.....	<u>15.183</u>	<u>27.575</u>	<u>27.941</u>	<u>28.198</u>
Total, Operation of Installation.....	<u>51.238</u>	<u>66.857</u>	<u>66.111</u>	<u>69.577</u>

Explanation of Fund Reuirements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Center's institutional activities. These are divided into three major functional areas: Facilities Services, the cost of maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; Technical Services, the cost of automatic data processing for management activities, and the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations, the cost of administrative communications, printing, transportation, medical, supply, and related services.

The decrease from the 1988 Revised Budget to the 1988 Current Estimate is due to deferral of a portion of repair and alteration projects, a delay in purchase of new and repair of existing equipment due to budget reductions and a realignment in the obligations of support service contracts. The 1989 Budget Estimate provides for restoration of delayed repair projects and deferred purchases, as well as anticipated mission service contractor rate increases and support to additional civil service workforce.

	<u>1987</u>	<u>1988</u>		<u>1989</u>
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
A. <u>FACILITIES SERVICES</u>	<u>26.072</u>	<u>27.321</u>	<u>26.463</u>	<u>28.285</u>

The Marshall Space Flight Center occupies 1,841 acres under a Department of the Army non-revocable lease in a complex of science and engineering laboratories and special development and test facilities. The complex encompasses approximately 3.7 million gross square feet of building space on Redstone Arsenal. This physical plant houses an average daily on-Center population of approximately 5,225 personnel.

Summary of Fund Reairements

1. <u>Maintenance and Related</u> <u>Services</u>	<u>9.137</u>	<u>6.933</u>	<u>5.904</u>	<u>7.338</u>
2. <u>Custodial Services</u>	<u>4.577</u>	<u>5.482</u>	<u>5.176</u>	<u>5.537</u>
3. <u>Utility Services</u>	<u>12.358</u>	<u>14.906</u>	<u>15.383</u>	<u>15.410</u>
Total, Facilities Services....	<u>26.072</u>	<u>27.321</u>	<u>26.463</u>	<u>28.285</u>

Explanation of Fund Reairements

1. <u>Maintenance and Related</u> <u>Services</u>	<u>9.137</u>	<u>6.933</u>	<u>5.904</u>	<u>7.338</u>
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This activity involves maintenance and operation of a total of 211 facilities (buildings, structures, and trailers). The decrease from the 1988 Revised Estimate to the 1988 Current Estimate is due to delay of a portion of repair and alteration projects. The increase in 1989 is due to restoration of delayed projects and support to additional permanent employees.

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised	Current	Budget
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
2. <u>Custodial Services</u>	<u>4.577</u>	<u>5.482</u>	<u>5.176</u>	<u>5.537</u>

Custodial services include janitorial services, security services, fire protection, trash removal, sanitary landfill operations, and related supplies and materials. Janitorial services are provided to about 3 million square feet of facility space and trash removal for approximately 130 separate locations. Security and fire protection services include 24-hour coverage of MSFC property, law enforcement, and motor vehicle registration and control. The 1988 Revised Estimate reflects decreased purchases to accommodate budget reductions. The increase in 1989 reflects negotiated labor rates and anticipated price levels for other goods and services.

3. <u>Utility Services</u>	<u>12.358</u>	<u>14.906</u>	<u>15,383</u>	<u>15.410</u>
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This function provides for the cost of electricity, steam, natural gas, water, and sewage disposal service provided by Redstone Arsenal Support Activity (RASA) on a reimbursable basis. It also provides for the propane and burner fuel to generate steam for heating and cooling. The increase between the 1988 Revised Estimate and the 1988 Current Estimate reflects an increase in consumption due to the reactivation of Test Stand 4696 for advanced LOX/hydrocarbon engine system tests. The 1989 increase reflects the same level of activity as the 1988 Current Estimate.

	1987 <u>Actual</u>	1988		1989 Budget <u>Estimate</u>
		<u>Revised Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	
B. <u>TECHNICAL SERVICES</u>	<u>9.983</u>	<u>11.961</u>	<u>11.707</u>	<u>13.094</u>

Summary of Fund Requirements

1. <u>Automatic Data Processing</u>	<u>6.657</u>	<u>7.305</u>	<u>6.997</u>	<u>7.662</u>
2. <u>Scientific and Technical Information</u>	<u>1.421</u>	<u>1.480</u>	<u>1.658</u>	<u>1.778</u>
3. <u>Shop Support Services</u>	<u>1.905</u>	<u>3.176</u>	<u>3.052</u>	<u>3.654</u>
Total, Technical Services.....	<u>9.983</u>	<u>11.961</u>	<u>11.707</u>	<u>13.094</u>

Explanation of Fund Requirements

1. <u>Automatic Data Processing</u>	<u>6.657</u>	<u>7.305</u>	<u>6.997</u>	<u>7.662</u>
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Funds provide centralized systems analysis, systems and applications, operations, and related computational services to meet the management and administrative computing requirements. This category also includes maintenance of ADP equipment such as central site computers and associated equipment. Activities supported include IBM 3083, systems software, and data base management system.

The decrease from the 1988 Revised Estimate to the 1988 Current Estimate is due essentially to delay in purchase of equipment. The increase from the 1988 Current Estimate to the 1989 Budget Estimate is due to anticipated mission service contractor rate increases, and provides funding to support the additional civil service workforce in 1989.

	1987	<u>1988</u>		1989
	<u>Actual</u>	<u>Revised</u> <u>Estimate</u>	<u>Current</u> <u>Estimate</u>	<u>Budget</u> <u>Estimate</u>
		(Thousands of Dollars)		
2. <u>Scientific and Technical Information</u>	<u>1.421</u>	<u>1.480</u>	<u>1.658</u>	<u>1.778</u>

This activity provides for the cost sharing operation of the Redstone Scientific Information Center (RSIC) library on Redstone Arsenal and other scientific and technical information services. Scientific information and library services are provided to MSFC employees and associated NASA contractor personnel through RSIC operations. The RSIC contains a central collection of books and journals, periodicals, documents on microfilm, and technical papers. Operation of the RSIC by the Army is under direction of a joint MSFC/Army Redstone scientific information board, with shared costs. These funds also provide for MSFC's share of the operation of the MSFC Visitor Information Center located at the Alabama Space and Rocket Center. The increase in the 1988 Current Estimate from the 1988 Revised Estimate is due to a revised estimate based on 1987 actual cost and purchase of equipment, supplies and materials. The increase from 1988 Current Estimate to the 1989 Budget Estimate is due to escalation and purchase of equipment, supplies and materials.

3. <u>Shop Support Service</u>	<u>1.905</u>	<u>3.176</u>	<u>3.052</u>	<u>3.654</u>
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These funds provide the Center with support in the areas of graphics, photographic services, and related supplies, materials, and equipment. The decrease from the 1988 Revised Estimate to the 1988 Current Estimate is due to a lower negotiated contract cost than expected for essentially the same level of effort. The 1989 Budget Estimate is based on anticipated price levels.

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised	Current	Budget
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
C. <u>MANAGEMENT AND OPERATIONS</u>	<u>15.183</u>	<u>27.575</u>	<u>27.941</u>	<u>28.198</u>

Summary of Fund Requirements

1. <u>Administrative Communications</u> ...	3,552	14,887	15,251	14,469
2. <u>Printing and Reproduction</u>	618	753	683	808
3. <u>Transportation</u>	3,748	4,253	3,840	3,963
4. <u>Installation Common Services</u>	<u>7.265</u>	<u>7.682</u>	<u>8.167</u>	<u>8.958</u>
<u>Total, Management and Operations</u>	<u>15.183</u>	<u>27.575</u>	<u>27.941</u>	<u>28.198</u>

Explanation of Fund Requirements

1. <u>Administrative Communications</u> ...	<u>3.552</u>	<u>14.887</u>	<u>15.251</u>	<u>14.469</u>
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Communications support for MSFC consists of local administrative telephone service, local area data networks, local base/mobile/portable radio services to include radio paging, the MSFC Emergency Warning System, and the MSFC fire Surveillance System. The MSFC Private Automated Branch Exchange (PABX) furnishes local telephone service as provided by Boeing Computer Support Services. Federal Telephone Service (FTS) is provided by GSA, long distance tolls by South Central Bell (SCB), and American Telephone and Telegraph Communications (AT&T COM). AUTODIN network, furnished by the Air Force, is a secure digital message system that provides institutional support in sending classified and non-classified messages in a

classified mode. The AUTODIN network is also used to interface with world-wide DoD elements in ordering supplies and materials from the Defense Logistics Agency. The increase from the 1988 Revised Estimate to the 1988 Current Estimate reflects adjusted price levels for long distance tolls (FTS) and other required services. The decrease in the 1989 Budget Estimate reflects anticipated costs resulting from a new telephone system and less supplies, materials and equipment.

	1987	<u>1988</u>		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
2. <u>Printing and Reproduction</u>	<u>618</u>	<u>753</u>	<u>683</u>	<u>808</u>

A portion of MSFC's printing and reproduction requirements is met by a contractor operated on-site reproduction plant. MSFC also purchases reproduction services from the Government Printing Office, Redstone Arsenal Support Activity, and private firms. Off-site printing is an overflow requirement that cannot be handled within the on-site workload or capability. The decrease from the 1988 Revised Estimate to the 1988 Current Estimate is based on a reduction of off-site printing and related Supplies and Materials. The increase in 1989 is based on anticipated in-house printing requirements in support of Shuttle related activities.

3. <u>Transportation</u>	<u>3.748</u>	<u>4.253</u>	<u>3.840</u>	<u>3.963</u>
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Transportation includes operation and maintenance of vehicles and aircraft, transportation of related supplies and materials, and purchases of transportation equipment. Included is the maintenance of general purpose vehicles, material handling equipment, special purpose trailers and vehicles, equipment such as cranes, tractors, generators and welders; and intermediate and major inspections. Freight charges for shipment of materials and equipment by both surface and air transportation are also included. The decrease in the 1988 Current Estimate reflects less FAA required aircraft maintenance. The increase from the 1988 Current Estimate to the 1989 Budget Estimate is escalation.

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
4. <u>Installation Common Services....</u>	<u>7.265</u>	<u>7.682</u>	<u>8.167</u>	<u>8.958</u>

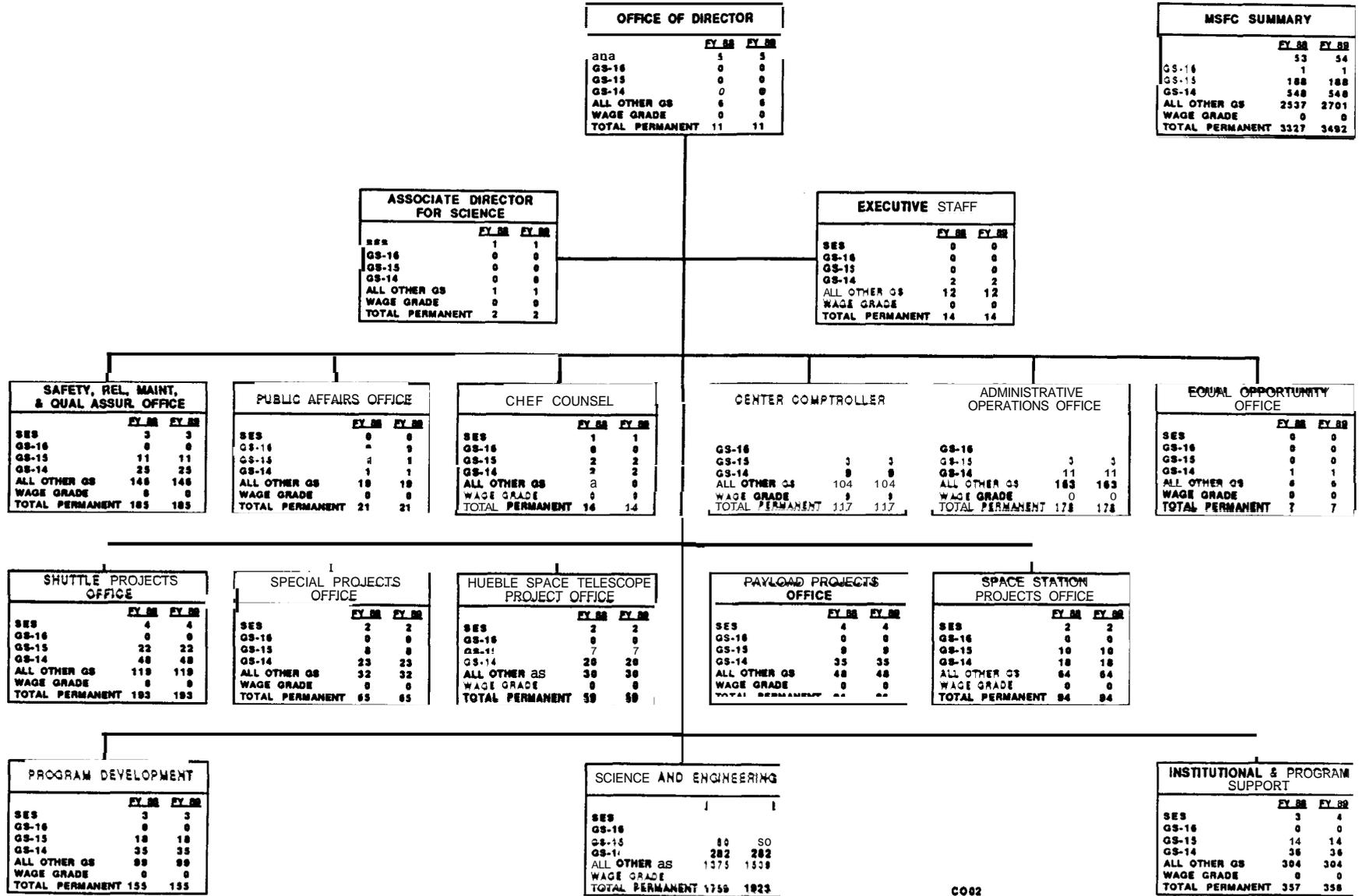
This activity provides administrative support to Center management and staff activities, medical services, and various other installation support services.

Center management and staff functions include patent counsel services, tort claims, and equal opportunity activities. Medical services provide occupational medicine and environmental health services for the maintenance and improvement of employee health at MSFC, with emphasis on prevention, diagnosis, treatment, and care of illnesses and injuries.

Installation support services include maintenance and repair of office equipment, equipment rental, acquisition of supplies and materials and other miscellaneous services such as: (1) receiving supplies, materials, and equipment; (2) distributing supplies, materials, equipment, and program-critical hardware; (3) preparing supplies, materials, and equipment for shipment, and (4) warehousing of raw materials.

Also provided are such services as the disposal of toxic waste, inspection of hazardous cargo prior to entry to Redstone Arsenal; receipt, storage, and issuance services for hazardous substances such as explosives, pyrotechnics and solid rocket motors; minor services such as laundry, furniture repair, postage, and acquisition of supplies and materials. The increase from the 1988 Revised Estimate to the 1988 Current Estimate is due to a refinement of estimate based on 1987 actual cost. The 1989 Budget Estimate includes funding to support additional civil service workforce.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION GEORGE C. MARSHALL SPACE FLIGHT CENTER



NOTE: ALL MANPOWER SHOWN IN ED1

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NATIONAL SPACE
TECHNOLOGY
LABORATORIES

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1989 ESTIMATES

NATIONAL SPACE TECHNOLOGY LABORATORIES

DESCRIPTION

The National Space Technology Laboratories is located in southwest Mississippi, approximately 50 miles northeast of New Orleans, Louisiana. Total land area is 138,807 acres of which 13,480 acres make up the actual installation owned by NASA. The remaining 125,327 acres are held as a buffer zone. In the buffer zone, 7,162 acres are owned by NASA and 118,165 acres are under restrictive easements. The installation has deep water access via the Pearl River and the Intercoastal Waterway. Capital investment for the National Space Technology Laboratories, as of September 30, 1987, was \$330,509,000.

CENTER ROLES AND MISSIONS

The National Space Technology Laboratories (NSTL), formerly the Mississippi Test Facility (MTF), is NASA's prime static test facility for large liquid propellant rocket engines and propulsion systems. The redesignation by NASA of MTF to the NSTL in June 1974 recognized the emerging role of the installation in space and environmental technology laboratories.

NSTL is presently engaged in development and acceptance testing of the Space Shuttle Main Engines and Main Propulsion System development testing. NSTL also conducts applied research and development in the fields of remote sensing, environmental sciences, and other selected applications programs. NSTL manages the installation and, through interagency agreements, provides support and maintains full utilization of all facilities by NASA and co-located elements of other executive agencies. These agencies are engaged in compatible research, development, and operational activities. They include the Department of Defense, the Department of Interior, the Department of Commerce, the Environmental Protection Agency, the Department of Transportation, the State of Mississippi, and the State of Louisiana. The principal roles are:

Space Shuttle: • NSTL provides, maintains and manages the facilities and the related capabilities required for the continued development and acceptance testing of the Space Shuttle Main Engines and the Shuttle's Main Propulsion Test Article which consists of a cluster of three main engines, an external tank and an orbiter aft-fuselage structure.

Space Applications: • Conducts fundamental and applied research, develops advanced airborne sensors and data/information systems, and conducts test and evaluation activities of remote sensing technology in the areas of renewable and non-renewable resources.

Support to Tenant Agencies: • Provides technical and institutional support to resident agencies.

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM
NATIONAL SPACE TECHNOLOGY LABORATORIES

	1988			1989 BUDGET ESTIMATE
	1987 ACTUAL	REVISED ESTIMATE	CURRENT ESTIMATE	
SPACE STATION.....	4	5	4	4
SPACE FLIGHT PROGRAMS.....	45	32	50	70
SPACE SHUTTLE.....	45	32	50	70
SPACE SCIENCE AND APPLICATIONS.....	16	30	16	16
LIFE SCIENCES.....	1	0	1	1
SPACE APPLICATIONS.....	15	30	15	15
COMMERCIAL PROGRAMS.....	13	5	13	13
SUBTOTAL DIRECT.....	78	72	83	103
CENTER MANAGEMENT AND OPERATIONS.....	50	66	56	56
SUBTOTAL (FULL-TIME PERMANENTS).....	128	138	139	159
OTHER CONTROLLED FTE'S..... (PMI's/CO-OPS/OTFTP's)	11	11	10	10
GRAND TOTAL (FULL-TIME EQUIVALENTS)	139	149	149	169
	=====	=====	=====	=====

PROGRAM DESCRIPTION

Permanent Civil
Service Workyears

SPACE STATION..... 4

NSTL will be supporting the Space Station program during FY 1989, particularly in the areas of earth and ocean observation.

SPACE SHUTTLE..... 70

In 1989, the National Space Technology Laboratories will continue to provide, maintain, and manage the facilities and the related capabilities required by development and acceptance testing of the Space Shuttle Main Engines.

SPACE SCIENCE AND APPLICATIONS..... 16

In 1989, the NSTL's Earth resources laboratory's program will continue to

- Conduct research investigations in the application of remotely sensed data using existing aircraft and satellite programs as a basic source of remotely sensed data in conjunction with surface data to develop techniques and procedures for practical applications.
- Conduct applied research investigations for the application of new sensor data to priority information requirements of national concern in the areas of agricultural productivity, geological explorations, and land resources management including studies for aligning appropriate sensor technology with applicable disciplinary requirements.
- Promote the effective transfer of applications technology as well as to reduce systems costs, and improve compatibility with other information sources and products.

Permanent Civil
Service Workyears

- Conduct research and development applications in non-remote sensing applications primarily in such areas as environmental system development and closed ecosystems development.

COMMERCIAL PROGRAMS 13

This effort will establish an organizational focal point to initiate a program specifically intended to foster commercial use and access to space. Applications Engineering Projects are conducted with non-NASA users to adapt NASA technology for solving problems that have widespread public benefit and for improving the competitiveness of U.S. industry. The States of Louisiana and Mississippi maintain active technology transfer offices that team with the NASA Technology Utilization Office to promote the transfer of technology to users within their states. Programs of national scope are conducted with other government agencies and industry to expedite the transfer of NASA technology.

CENTER MANAGEMENT AND OPERATIONS SUPPORT 56

Center Management and Operations Support is defined as that support or services being provided to all NSTL organizations which cannot be identified exclusively to a single program or project. The civil service personnel involved are:

Director and Staff - The Installation Director, Deputy Director, and immediate staff, e.g., Legal, Equal Opportunity, and Public Affairs.

Management Support - Those who provide information and management services supporting all levels of Center management, both program and functional. Specific functions include resources and financial management, program control, contracting and procurement, property management, personnel management, and management systems and analysis.

Operations Support - those who manage or provide for the operation and maintenance of institutional facilities, buildings, systems and equipment, including those who manage or provide technical services such as automatic data processing, reliability and quality assurance, medical care, and photographic support.

SUMMARY OF RESOURCES REQUIREMENTS

Funding Plan by Function

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
I. Personnel and Related Costs	5,812	6,885	6,597	8,041
II. Travel	264	355	330	457
111. Operation of Installation	5,944	14,017	13,772	14,850
A. Facilities Services	(3,462)	(6,352)	(6,347)	(7,319)
B. Technical Services	(370)	(3,290)	(3,073)	(2,926)
C. Management and Operations	<u>(2,112)</u>	<u>(4,375)</u>	<u>(4,352)</u>	<u>(4,605)</u>
Total, Fund Requirements	<u>12,020</u>	<u>21,257</u>	<u>20,957</u>	<u>22,348</u>

SUMMARY OF RESOURCES REOUIREMENTS

	1987	1988	1988	1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
I. Personnel and Related Costs.....	5,812	6,885	6,597	8,041
		<u>Summary of Fund Reouirements</u>		
A. <u>Compensation and Benefits</u>				
1. <u>Compensation</u>				
A. Permanent Positions.....	4,789	5,283	5,151	5,991
B. Other than full-time permanent positions.....	201	186	204	208
C. Overtime and other compensation.....	<u>16</u>	<u>24</u>	<u>47</u>	<u>57</u>
Subtotal - Compensation.....	5,006	5,493	5,402	6,256
2. <u>Benefits</u>	<u>688</u>	<u>1,051</u>	<u>820</u>	<u>1,239</u>
Subtotal - Compensation & Benefits.....	<u>5,694</u>	<u>6,544</u>	<u>6,222</u>	<u>7,495</u>
B. <u>Supporting Costs</u>				
1. Transfer of Personnel.....	82	283	317	485
2. Personnel Training.....	<u>36</u>	<u>58</u>	<u>58</u>	<u>61</u>
Subtotal Supporting Costs.....	<u>118</u>	<u>341</u>	<u>375</u>	<u>546</u>
Total Personnel and Related costs.....	<u>5,812</u>	<u>6,885</u>	<u>6,597</u>	<u>8,041</u>

	1987 <u>Actual</u>	1988		Budget <u>Estimate</u>
		<u>Revised Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	
<u>Compensation and Benefits</u>	<u>5.694</u>	<u>6.544</u>	<u>6.222</u>	<u>7.495</u>
1. Compensation.....	<u>5.006</u>	<u>5.493</u>	<u>5.402</u>	<u>6.256</u>
A. Permanent Positions.....	4,789	5,283	5,151	5,991

The 1988 Current Estimate reflects decreases for re-estimates for the FERS (Federal Retirement System) offset by an increase for the 1988 pay raise; and NSTL's share of the \$42.0 million general reduction needed to reach 1988 authorized levels. The 1989 includes funding for additional civil service workforce and restoration of 1988 reductions.

Basis of Cost for Permanent Positions

In 1989, the cost of permanent positions will be \$5,991,000, an increase of \$840,000 from 1988. The increase results from the following:

Cost of full-time permanent workyears in 1988.....		5,151
Cost increases in 1989.....		1,050
Restoration of 1988 general reduction.....	+236	
Within grade and career advances:		
Full year cost of 1988 increases.....	+42	
Partial year cost of 1989 actions.....	+62	
Additional FTE.....	+683	
Full year cost of the 1988 payraises.....	+27	
Cost decreases in 1989.....		-210
Full year effect of 1989 actions.....	-72	
Partial year effect of 1989 turnover savings.....	-99	
Two less paid days.....	-39	
Cost of full-time permanent workyears in 1989.....		<u>5.991</u>

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u>	<u>Current</u> <u>Estimate</u>	
(Thousands of Dollars)				
b. Other than full-time permanent				
1. cost.....	201	186	204	208
2. Workyears.....	11	11	10	10

The distribution of 1989 workyears is as follows

Distribution of Other than Full-Time Permanent Workyears

<u>Program</u>	<u>Workyears</u>
Developmental programs.....	3
Summer employment programs.....	3
Other temporary programs.....	4
Total.....	10

c. Overtime and other compensation.....	<u>16</u>	<u>24</u>	<u>47</u>	<u>57</u>
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The increase from the 1988 budget estimates to the 1989 current estimate is overtime to support increased testing requirements on the Space Shuttle Main Engine.

	1987 <u>Actual</u>	1988		Budget <u>Estimate</u>
		Revised <u>Estimate</u>	Current <u>Estimate</u>	
2. <u>Benefits</u>	<u>688</u>	<u>1,051</u>	<u>820</u>	<u>1,239</u>

(Thousands of Dollars)

Following are the amounts of contribution by category:

Retirement Fund.....	404	790	468	881
Employee Life Insurance.....	10	12	12	17
Employee Health Insurance.....	148	129	149	170
FICA.....	74	51	136	100
Medicare.....	52	69	55	71
Annuitant & Other Benefits,...	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Total.....	<u>688</u>	<u>1,051</u>	<u>820</u>	<u>1,239</u>

The decrease from the 1988 Budget Estimate to the 1988 Current Estimate is the result of a lower estimate of the number of employees switching to the Federal Employees Retirement System (FERS) and decrease in the FERS percentage contribution and the concomitant retirement changes in permanent compensation for the \$42.0 million general reduction. The 1989 estimate includes funding for additional civil service workforce.

B. <u>Supporting Costs</u>	<u>118</u>	<u>341</u>	<u>375</u>	<u>546</u>
1. Transfer of personnel.....	82	283	317	485

The estimates for 1988 and 1989 are based on projected hiring plans including anticipated relocations associated with additional civil service workforce in 1989.

	1987	<u>1988</u>		
	<u>Actual</u>	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
		(Thousands of Dollars)		
2. Personnel training.....	36	58	58	61

The personnel training program continues to develop the skills and knowledge of NSTL employees in order to more effectively support NSTL roles and missions, primarily through "Upward Mobility" training of women and minorities, and equal opportunity seminars. The increase in the 1989 Budget Estimate is for additional funding for NASA employee training to help maintain the current skill level and funding for training the additional civil service workforce.

	1987 <u>Actual</u>	1988		Budget <u>Estimate</u>
		<u>Revised Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	
11. <u>TRAVEL</u>	<u>264</u>	<u>355</u>	<u>330</u>	<u>457</u>

Summary of Fund Requirements

A. Program Travel.....	139	219	186	242
B. Scientific and Technical Development Travel.....	4	16	4	4
C. Management and Operations Travel.....	<u>121</u>	<u>120</u>	<u>140</u>	<u>211</u>
Total Travel.....	<u>264</u>	<u>355</u>	<u>330</u>	<u>457</u>

Explanation of Fund Requirements

A. <u>Program Travel</u>	<u>139</u>	<u>219</u>	<u>186</u>	<u>242</u>
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Program travel requirements are directly related to the accomplishments of the Laboratories' mission, and will primarily be in support of Space Science and Applications Programs. Program travel accounted for about 35 percent of total travel in 1987. The decrease from the 1988 budget estimate to the 1988 current estimate and 1989 budget estimate reflects re-estimates based on 1987 experience.

B. <u>Scientific and Technical Development Travel</u>	<u>4</u>	<u>16</u>	<u>4</u>	<u>4</u>
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Scientific and technical development travel will permit employees to participate in meetings and technical seminars with other representatives of the aerospace community. This participation allows them to retain their technical competency and gain awareness of technological advances outside NSTL as well as to present both accomplishments and problems to their associates. Many of the meetings are working panels convened to solve certain problems for the benefit of the Government. The decrease from the 1988 Revised Estimate to the 1988 Current Estimate is a re-evaluation of requirements based on 1987 actual experience.

	1987	1988		1989
	<u>Actual</u>	Revised	Current	Budget
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
C. <u>Management and Operations</u>				
<u>Travel</u>	<u>121</u>	<u>120</u>	<u>140</u>	<u>211</u>

Management and operations travel is used for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management, and procurement activities as well as travel of the Laboratories' top management to NASA Headquarters and other NASA Centers. The increase from the 1988 Budget Estimate to the 1988 Current Estimate reflects new programs at NSTL resulting in increased top management travel, and the expected transportation and per diem increases.

	<u>1987</u>	<u>1988</u>		<u>1989</u>
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
111. <u>OPERATION OF INSTALLATION</u>	<u>5.944</u>	<u>14.017</u>	<u>13.772</u>	<u>14.850</u>
		<u>Summary of Fund Requirements</u>		
A. Facilities Services.....	3,462	6,352	6,347	7,319
B. Technical Services.....	370	3,290	3,073	2,926
C. Management and Operations.....	<u>2.112</u>	<u>4.375</u>	<u>4.352</u>	<u>4.605</u>
Total, Operation of Installation.....	<u>5.944</u>	<u>14.017</u>	<u>13.772</u>	<u>14.850</u>

Explanation of Fund Requirements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Center's institutional activities. These are divided into three major function areas: Facilities Services, the cost of maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; Technical Services, the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations, the cost of administrative communications, printing, transportation, and related services.

Funding deltas from the 1988 Budget Estimate to the 1988 Current Estimate is due to the realignment of maintenance equipment from Technical Services Shop Support to Facility Services Equipment Maintenance. The 1989 increase reflects the anticipated rate increases in support service contracts, utilities, equipment, and other goods and services required at NSTL and support to additional civil service workforce.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u>	<u>Current</u> <u>Estimate</u>	
		(Thousands of Dollars)		
A. <u>FACILITIES SERVICES</u>	<u>3.462</u>	<u>6.352</u>	<u>6.347</u>	<u>7.319</u>

The NSTL covers 138,807 acres of grounds, and a complex of facilities which are comprised of laboratories, offices, and rocket engine test facilities. The complex encompasses some 1,456,829 gross square feet of building space. This physical plant supports an average daily on-site population of 5,162. Many of the test facilities are utilized on schedules involving more than one shift operation and operations during off-peak hours.

Summary of Fund Reauirements

1. <u>Rental of Real Property</u>	<u>20</u>	<u>31</u>	<u>31</u>	<u>32</u>
2. <u>Maintenance and Related Services</u>	<u>1.305</u>	<u>1.993</u>	<u>3.314</u>	<u>4.340</u>
3. <u>Custodial Services</u>	<u>168</u>	<u>1.979</u>	<u>738</u>	<u>836</u>
4. <u>Utility Services</u>	<u>1.969</u>	<u>2.349</u>	<u>2.264</u>	<u>2.111</u>
Total, Facilities Services....	<u>3.462</u>	<u>6.352</u>	<u>6.347</u>	<u>7.319</u>

Explanation of Fund Requirements

1. <u>Rental of Real Property</u>	<u>20</u>	<u>31</u>	<u>31</u>	<u>32</u>
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Provides for lease of hanger space for earth resources laboratory aircraft.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u>	<u>Current</u> <u>Estimate</u>	
		(Thousands of Dollars)		
2. <u>Maintenance and Related Services</u>	<u>1.305</u>	<u>1.993</u>	<u>3,314</u>	<u>4.040</u>

This activity provides for the modification and alteration of facilities in support of B-1 test stand operations and maintenance. Also provided are the modifications, alterations and maintenance of installation facilities and movements of personnel and equipment of the Earth Resources Laboratory (ERL) and purchase of O&M equipment and updated equipment to support the shop activities at NSTL. The 1988 Current Estimate is based on 1987 actual cost along with realignment of costs from custodial services. The 1989 Estimate reflects an increase in funding for projects to support additional civil service workforce.

3. <u>Custodial Services</u>	<u>168</u>	<u>1.979</u>	<u>738</u>	<u>836</u>
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Provides for NASA's share of janitorial services and fire protection services by the NSTL institutional support services contractor. The decrease in the 1988 revised Estimate to the FY 1988 Current Estimate reflects a realignment of costs from Custodial to Maintenance and Related. The 1989 Estimate is the current level of activity with anticipated escalation.

4. <u>Utility Services</u>	<u>1.969</u>	<u>2.349</u>	<u>2.264</u>	<u>2.111</u>
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Provides for the purchase of the two utility commodities; electricity from the Mississippi Power Company and natural gas from the United Gas Pipe Line Company. Natural gas is the primary heating fuel used at NSTL. Also provided is NASA's share of the operation and maintenance of the utility distribution and control systems, water wells, and sewage systems. The decrease from the 1988 revised Estimate to the 1988 Current Estimate is the result of lower than originally anticipated utility rates. The decrease in the 1989 Budget Estimate reflects expected rates for utilities.

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
B. <u>TECHNICAL SERVICES</u>	<u>370</u>	<u>3.290</u>	<u>3.073</u>	<u>2.926</u>

Summary of Fund Reuirements

1. <u>Automatic Data Processing</u>	<u>0</u>	<u>1.177</u>	<u>1.496</u>	<u>1.280</u>
2. <u>Scientific and Technical Information</u>	<u>180</u>	<u>271</u>	<u>271</u>	<u>282</u>
3. <u>Support Services</u>	<u>190</u>	<u>1.842</u>	<u>1.306</u>	<u>1.364</u>
Total - Technical Services....	<u>370</u>	<u>3.290</u>	<u>3.073</u>	<u>2.926</u>

Explanation of Fund Reuirements

1. <u>Automatic Data Processing</u>	<u>0</u>	<u>1,177</u>	<u>1,496</u>	<u>1,280</u>
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The 1988 Current Estimate exceeds the 1988 Revised Estimate due to funding for development of ongoing and additional software systems. Examples include MASS (Management Accounting & Statusing System, Release I for NASA Financial Data), MASS, Release II for Support Service Contractor Financial Systems and TIMS the Telephone Information Management System. The 1989 number is slightly lower due to the MASS Release I and the TIMS going from the development to the maintenance stage.

2. <u>Scientific and Technical Information</u>	<u>180</u>	<u>271</u>	<u>271</u>	<u>282</u>
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Provides for books, periodicals, and other technical reports by the Center, and NASA's share of upgrading and operating the NSTL Visitor Information Center. The 1988 and 1989 estimate includes current requirements at expected cost levels.

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
3. <u>Support Services</u>	<u>190</u>	<u>1.842</u>	<u>1.306</u>	<u>1.364</u>

Provides for NASA's share of such technical services as safety, photography and graphics. The 1988 current estimate reflects reclassification of equipment costs to the Facilities services subfunction. The increase in 1989 reflects expected cost escalation.

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u> <u>Estimate</u>	<u>Current</u> <u>Estimate</u>	<u>Budget</u> <u>Estimate</u>
		(Thousands of Dollars)		
C. <u>MANAGEMENT AND OPERATIONS</u>	<u>2.112</u>	<u>4.375</u>	<u>4.352</u>	<u>4.605</u>

Summary of Fund Requirements

1. Administrative Communications.....	1,037	2,632	2,574	2,727
2. Printing and Reproduction.....	43	94	94	98
3. Transportation.....	907	972	972	1,064
4. Installation Common Services.....	<u>125</u>	<u>677</u>	<u>712</u>	<u>716</u>
Total - Management and Operations.....	<u>2.112</u>	<u>4.375</u>	<u>4.352</u>	<u>4.605</u>

Explanation of Fund Requirements

1. <u>Administrative Communications</u>	<u>1.037</u>	<u>2.632</u>	<u>2.574</u>	<u>2.727</u>
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Provides for NASA's share of the local telephone service, Federal Telecommunications System (FTS), long distance, and operation and maintenance of the on-site communications equipment and switchboard. The decrease from the 1988 revised Estimate to the Current Estimate reflects a re-evaluation based on 1987 actuals and new requirements. The increase from the 1988 current estimate to the 1989 budget estimate reflects expected cost increases.

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
2. <u>Printing and Reproduction</u>	<u>43</u>	<u>94</u>	<u>94</u>	<u>98</u>

Provides for printing and reproduction services in support of the Earth Resources Laboratory and the NSTL organization. The increase from the 1988 Current Estimate to the 1989 Budget Estimate reflects expected cost escalation.

3. <u>Transportation</u>	<u>907</u>	<u>972</u>	<u>972</u>	<u>1,064</u>
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This estimate includes local transportation for the NSTL staff and the support contractors, as well as freight costs, government bills of lading, air freight, other general shipments and related transportation costs. The increase from the 1988 current estimate to the 1989 budget estimate reflects additional anticipated cost increases in vehicle rentals.

4. <u>Installation Common Services</u>	<u>125</u>	<u>677</u>	<u>712</u>	<u>716</u>
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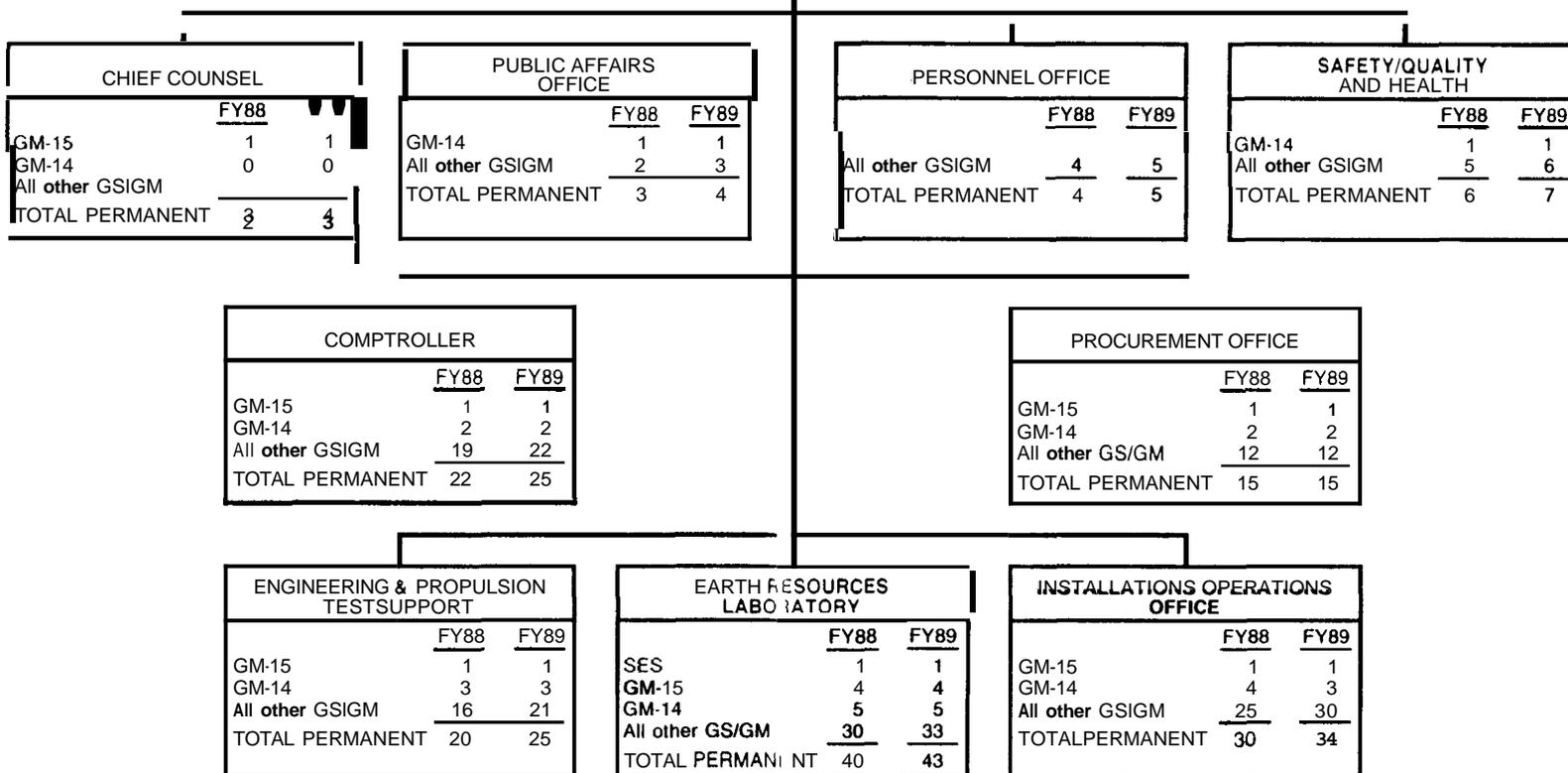
Provides supplies, materials and equipment for the Center. The increase from the 1988 Current Estimate to the 1989 Budget Estimate reflects expected cost escalation for the same level of service.

ORGANIZATION CHART

FY1989 CONGRESSIONAL BUDGET
 NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
 NATIONAL SPACE TECHNOLOGY LABORATORIES

NSTL SUMMARY STAFFING		
	FY88	FY89
SES	3	4
GM-15	10	9
GM-14	18	17
All other GSIGM	117	139
TOTAL PERMANENT	148	169

OFFICE OF THE DIRECTOR		
	FY88	FY89
SES	2	3
GM-15	1	0
All other GSIGM	2	4
TOTAL PERMANENT	5	7



GODDARD
SPACE FLIGHT CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1989 ESTIMATES

GODDARD SPACE FLIGHT CENTER

DESCRIPTION

The Goddard Space Flight Center (GSFC), located 15 miles northeast of Washington, D.C., at Greenbelt, Maryland, is situated on a 552-acre main site. Three additional nearby plots of 554 acres--comprise the remote site area and contain the Goddard Antenna Test Range, the Goddard Optical Facility, the Propulsion Research Facility, the Laser Facility, the Magnetic Fields Component Test Facility, the Attitude Control Test Facility, and the Network Training and Test Facility. The Center also utilizes an additional 6,176 acres at the Wallops facility located on the Atlantic Coast of Virginia's eastern shore. The Wallops facility consists of 1,833 acres on the main base, 3,095 acres on Wallops Island launching site, 108 acres on the mainland tracking site, and 1,140 acres of marshland. The total capital investment for the Goddard Space Flight Center, including tracking stations, work in progress, contractor-held facilities at various locations, and the Wallops facility, as of September 30, 1987, was approximately \$753,526,000.

The majority of the Goddard Center's personnel are located at Greenbelt, Maryland; other personnel are located at the Wallops facility in Virginia, the Goddard Institute for Space Studies in New York City, and throughout the world, managing the operation of satellite tracking and communications network stations.

CENTER ROLES AND MISSIONS

The GSFC, established in 1959 as the first major United States installation devoted to the investigation and exploration of space, conducts a wide-ranging program in earth and space sciences. The GSFC has developed many diverse capabilities: the management of complex projects; the development of wholly integrated spacecraft, ranging from systems engineering to development, integration, and testing; the development and operation of satellite tracking networks, and data acquisition and analysis; scientific research to include both theoretical studies and the development of many significant scientific experiments flown on satellites; and the operation of a research airport, located at Wallops, in support of NASA's aeronautics research programs. The principal and supporting roles are:

PRINCIPAL

EARTH ORBITAL SPACECRAFT DEVELOPMENT, ON-ORBIT SERVICING AND FLIGHT OPERATIONS - includes spacecraft propulsion and supporting technology such as low cost structural evaluation and reliability demonstration, advanced guidance systems and space power systems. Major emphasis is on automated, standard spacecraft systems, free-flyers, experiment development and integration, on-orbit free-flyer and payload servicing, Space Station Platforms, and the planning and conducting of associated flight operations.

SPACE SCIENCE AND APPLICATIONS - develops the bases for science and technology discipline, develops and calibrates spaceborne sensors, and ground data processing and analysis systems, conducts scientific research and theoretical modeling studies, and implements science and applications experiments in astronomy, solar physics, high energy astrophysics, solar terrestrial studies, and atmospheric, oceanic, and land processes.

TRACKING AND DATA ACQUISITION SYSTEMS AND SUPPORT OPERATIONS - plans, develops, implements and operates tracking facilities and provides for the related data processing, communications, and mission control; plans and conducts support of Earth orbital spacecraft, aeronautical research and sounding rockets; and network planning and implementation support for the Shuttle. Also, this includes the implementation of Tracking and Data Relay Satellite System (TDRSS).

LAUNCH RANGE AND RESEARCH AIRPORT MANAGEMENT AND OPERATIONS - plans and operates the Wallops launch range, associated aircraft, and a research airport in support of NASA aerospace programs as well as other Government agencies, such as the Department of Defense, and the academic and international community. Launch support and related services are provided for various sounding rockets and the expendable Scout launch vehicles launched at the Wallops facility.

EXPENDABLE LAUNCH VEHICLES - management of the Delta launch vehicle and Scout class launch vehicle from procurement through launch operations and placing a variety of spacecraft into earth or solar orbit.

SOUNDING ROCKET DEVELOPMENT, PROCUREMENT AND OPERATIONS - develops and procures sounding rockets and carries out all phases of operations from mission/flight planning to landing and recovery, including supporting systems (i.e., guidance, telemetry and attitude control, power, payload housing, separation systems, and recovery).

BALLOON PROGRAM - manages and provides technical oversight and direction to the balloon activities conducted for both NASA and other agencies.

SPACELAB PAYLOAD DEVELOPMENT - develops, analytically integrates and processes data for Spacelab payloads in astrophysics, solar terrestrial physics, astronomy, and applications.

WALLOPS ROCKET RANGE AND AERONAUTICAL OPERATIONS - develops, maintains, and operates the Wallops Flight Facility rocket range and research airport for conducting scientific experiments and aeronautical tests Plans and conducts launch of scientific payloads and aeronautical tests and other research, development and related activities as requested by elements of NASA, other government agencies, and the world-wide scientific community. Assists and trains foreign nationals in launch techniques and operations, collection of flight data, and other phases of launch support.

ATTACHED PAYLOADS - manages and develops low-cost reusable carrier systems which accommodate a variety of payloads to be flown on Shuttle missions. Three basic carrier systems are currently on-line to support Spartan, GAS, and Hitchhiker payloads. These payloads will be integrated and tested with the carrier and then flown with compatible Shuttle missions. These activities involve development and operation of diverse mechanical, power, electrical, aerodynamic, propulsion, control, thermal and combined systems. In addition, Center personnel coordinate with an international array of experimenters (including private citizens, high schools, university, industry and other government agencies) to facilitate the accommodation of their investigations with the carrier and Shuttle systems.

SUPPORTING

PLANETARY SCIENCE - develops and applies techniques for the investigation and analysis of planetary atmospheres.

AEROSPACE FLIGHT TEST SUPPORT - plans and conducts launches of scientific payloads and aeronautical tests and other research, development and related activities as requested by elements of NASA, the Department of Defense, other Government agencies, and the worldwide scientific community.

DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM
GODDARD SPACE FLIGHT CENTER

	1988			1989 BUDGET ESTIMATE
	1987 ACTUAL	REVISED ESTIMATE	CURRENT ESTIMATE	
SPACE STATION.....	187	249	234	234
SPACE FLIGHT PROGRAMS.....	92	60	73	88
SPACE TRANSPORTATION CAPABILITY DEV	27	24	29	27
SPACE SHUTTLE.....	65	36	44	61
SPACE SCIENCE AND APPLICATIONS.....	2,030	1,977	1,939	1,935
PHYSICS AND ASTRONOMY.....	1,247	1,178	1,168	1,160
LIFE SCIENCES.....	2	1	1	1
PLANETARY EXPLORATION.....	89	75	83	82
SPACE APPLICATIONS.....	692	723	687	692
AERONAUTICS AND SPACE TECHNOLOGY.....	73	77	84	91
AERONAUTICAL RESEARCH AND TECHNOLOGY	11	10	10	10
SPACE RESEARCH AND TECHNOLOGY.....	62	67	74	81
COMMERCIAL PROGRAMS.....	11	9	12	12
TRACKING AND DATA PROGRAMS.....	604	569	601	590
SUBTOTAL DIRECT.....	2,997	2,941	2,943	2,950
CENTER MANAGEMENT AND OPERATIONS.....	627	635	635	634
SUBTOTAL (FULL-TIME PERMANENTS).....	3,624	3,576	3,578	3,584
OTHER CONTROLLED FTE'S..... (PMI's/CO-OPS/OTFTP's)	83	99	97	91
GRAND TOTAL (FULL-TIME EQUIVALENTS)	3,707	3,675	3,675	3,675

PROGRAM DESCRIPTION

Permanent FTE's
Civil Service

SPACE STATION..... 234

Space Station activities include management of the major work package development and the Flight Telerobotic Servicer (FTS). Development of user science requirements, automated free-flying platforms, attached payload accommodation equipment for payloads that are not in pressurized modules and development of the architecture to permit servicing, maintenance and repair of space platforms and free-flying spacecraft will be undertaken. In addition, systems engineering and integration efforts will be performed in direct support of the Space Station Program Office. Discipline studies in robotics, thermal and data systems requirements will be conducted. Working groups of scientists will continue to involve potential users in Space Station requirements definition. In FTS, the key activities will be engineering analyses and the evaluation of proposals for and initiation of design and development of the Flight Telerobotic Servicing System.

SPACE FLIGHT PROGRAMS..... 88

SPACE TRANSPORTATION CAPABILITY DEVELOPMENT..... 27

GSFC is developing the Hitchhiker, a reusable carrier system which will provide increased flight opportunities with reduced leadtime, maximizing Shuttle load factors and minimizing spaceflight costs.

SPACE SHUTTLE (SPACE TRANSPORTATION OPERATIONS) 61

Goddard manages and coordinates the Agency's GAS program. Center personnel coordinate with an international array of experimenters (including private citizens, high schools, universities, and industry) who have procured, through Agency established procedures, payload space on the Shuttle. Tasks include ensuring that experiments meet flight and safety specifications and securing the experiments into containers for Space Shuttle flight. Individual experimenters are responsible for the performance of their **instruments/experiments.**

Activities also include the management of a flight support system which is the electromechanical interface between the orbiter and Multimission Modular Spacecraft and other spacecraft with compatible interface parameters. It will be used for ascent, retrieval, repair, and descent phases of Space Shuttle flights carrying Multimission Modular Spacecraft and other compatible spacecraft.

Goddard is the Management Center for the Delta expendable launch vehicle which is capable of accurately putting a wide variety of spacecraft into a broad spectrum of orbits, ranging from equatorial to polar inclinations. The Delta is used for a wide range of reimbursable missions for other government agencies, domestic commercial users, and international users. The modern Delta launch vehicles (#103-181) have achieved a 90% success record.

Goddard is the Management Center for the Scout class small scientific satellite program. Activities include management, launch vehicle procurement, all aspects of launch operations, and spacecraft development, test and integration. A Scout launch capability is maintained by Wallops.

<u>SPACE SCIENCE AND APPLICATIONS</u>	<u>1,935</u>
PHYSICS AND ASTRONOMY.....	1,160

Astrophysics activities at GSFC are responsible for laboratory and flight scientific research to increase human knowledge of the Earth's space environment, the stars, the sun, and other objects in space; and provide advanced technical development of experiments and spacecraft components for future astrophysics missions. GSFC manages activities in the pursuit of scientific progress in all of the following discipline areas of astrophysics: gamma ray astronomy, X-ray astronomy, ultraviolet and optical astronomy, infrared and radio astronomy, particle astrophysics, solar physics, interplanetary physics, planetary magnetospheres, and astrochemistry.

During 1989, the Hubble Space Telescope will be launched and will provide a space observatory and dedicated ground system to extend the sensitivity, resolving power, and spectral range of astronomical observatories significantly beyond those achievable from ground-based observations. Development activities will continue on the Gamma Ray Observatory mission, the Cosmic Background Explorer, various Shuttle/Spacelab Payloads and integrated rocket experiments; and the analysis of data from several major Physics and Astronomy missions including the High Energy Astronomy Observatories, the Dynamics Explorer, the repaired Solar Maximum Mission and the Active Magnetospheric Particle Tracer Explorer.

The International Ultraviolet Explorer spacecraft, with its unique satellite control and data management systems, will continue to afford guest observers the opportunity to point the satellite in real-time from the ground, make quick observations, and receive data in visual formats.

During 1988 and 1989, GSFC will be responsible for the delivery and integration of a U.S. supplied focal plane high resolution imaging instrument to be flown on the German Roentgen Satellite which is scheduled for launch early 1990 on an Expendable Launch Vehicle (Delta 11). The Roentgen Satellite, another NASA international cooperative project with the Federal Republic of Germany, will perform the first all sky survey of X-ray sources and will point to and study specific X-ray sources for extended periods of time.

Goddard will provide the management and support of the NASA domestic and international sounding rocket programs. The project involvement extends from conception through launch and analysis of the data obtained in the following areas: galactic astronomy, high energy astrophysics, solar physics, plasma physics, upper atmospheric and interdisciplinary research, and the space applications of materials processing science.

Goddard will continue development of sounding rocket-class payloads for flight on the Space Shuttle. This is a cost-effective approach which allows instruments to be flown for much longer periods of time than available with sounding rockets.

Goddard will continue to manage the scientific balloon program providing for launch and tracking support, flight hardware, and technical support including new systems development. Goddard has responsibility for operation of the National Scientific Balloon Facility at Palestine, Texas, and provides management and technical oversight.

During 1988 and 1989, both the sounding rocket program and the balloon program will conduct extensive flights to collect data from the Supernova 1987.

LIFE SCIENCES..... 1

The Goddard Life Sciences activities involve the utilization of data from remote sensing satellites to increase our understanding of global biological characteristics and processes.

PLANETARY EXPLORATION..... 82

The GSFC science activity within the Planetary Exploration program emphasizes the physics of interplanetary and planetary space environments. To this end, GSFC will maintain a strong and viable research group, including participation in Galileo and Mars Observer instrument development and mission operations and data analysis activity.

The 1989 program activities will span GSFC's broad roles and missions mandate, including activities in the discipline areas of land, oceans, and atmospheric sciences. GSFC is engaged in three major types of activities in these areas: research and technology, flight projects, and data analysis.

The research and technology effort is directed toward solving major problems in the disciplines mentioned and involves conceptual instrument design and testing, mission payload studies, and conceptual flight missions. This is accomplished through the design and construction of mathematical models to study:

1. The global circulation of the Earth's atmosphere for better weather and climate predictions, including extensive ozone studies;
2. The geopotential fields (gravity and magnetic) of the Earth to provide a better understanding of the structure and evolution of the Earth;
3. The processes of the oceans such as surface winds, waves, temperature, currents, and circulation to support of the ongoing weather and climate studies and the ocean research program;
4. The physical characteristics of the Earth's vegetation cover, water resources, and land use which can be remotely sensed; and
5. The interaction between the Earth's atmosphere, hydrosphere, and cryosphere.

Some examples of instrumentation activities which GSFC is supporting include instrumentation for measuring temperature and pressure profiles in the atmosphere which are essential parameters for weather and climate models; user active and passive microwave systems for measuring sea surface temperatures and winds, and measurement of soil moisture essential for water resources modeling and agricultural yield predictions; new instruments for ocean color measurements; and high precision laser electronic ranging systems in support of the Earth and ocean dynamics activities.

At GSFC flight project responsibilities in 1989 include:

1. Operational weather satellite missions for the National Oceanic and Atmospheric Administration (NOAA), including launch of NOAA-D;

2. Continued operations of the Nimbus satellites to provide remotely sensed resources data and environmental observations to a worldwide applications research community;
3. The data from the Landsat-4 and 5 will continue to be analyzed to evaluate the benefits of a new generation of land observation instruments;
4. Earth Radiation Budget Experiment data will be collected for the study of geographical and seasonal variations of the Earth's radiation budget;
5. Conducting correlation measurements from balloons, sounding rockets, aircraft, and ground installations;
6. Development activities will be continued on the Upper Atmospheric Research Satellite instrument and the spacecraft, leading to a launch in late 1991;
7. Development activities will continue on the Extreme Ultraviolet Explorer toward a planned launch of 1991;
8. The Phase B Definition Studies for the X-Ray Timing Explorer (XTE) will continue.

Earth Science activities involve the formulation, analysis, and distribution of data received from satellites for which GSFC has management responsibility. Such demonstrations involve the use of data from the Nimbus-7 spacecraft for the solution of problems concerning pollution, ocean resources and dynamics, and weather and climate. Similar activities will be conducted by using the data from Landsat-4; this information will be of use to investigators in the disciplines of agriculture, forestry, geology, land use, cartography, hydrology, ecology, and oceanography. Solar Terrestrial research efforts will include analysis of data collected from operating satellites, for example, the Dynamics Explorer, the Interplanetary Monitoring Probe and the International Sun-Earth Explorers which are providing opportunities to study the dynamic interactions of the solar wind and the Earth's magnetosphere from various points in space,

AERONAUTICS AND SPACE TECHNOLOGY..... 91

AERONAUTICAL RESEARCH AND TECHNOLOGY..... 10

The Wallops airport will be used to conduct research tests of various aircraft in their terminal area operating environment. Flight studies will be made of new approach and landing procedures utilizing the latest in guidance equipment and techniques, pilot information displays, terminal area navigation, and tests of other systems leading to increased landing rates and all weather automatic landing of aircraft.

One runway is being used to study aircraft hydroplaning, water ingestion and tire design on wet or slush-covered surfaces. The data acquired from this research testing will ultimately assist in the development of safer, more flexible transportation systems. Wallops will continue to support aircraft noise and safety research for general aviation.

SPACE RESEARCH AND TECHNOLOGY..... 81

Goddard's Space Research and Technology program activities provide results directly applicable to future space flight missions. During 1989, major program thrusts in support of the Civil Space Technology Initiative (CSTI) will be implemented in the Advanced Data Systems and Science Sensors Technology areas. Expanded efforts are also planned in 1989 in the following space technology programs areas: Optical Communications; Robotics, Cryogenics; and Computer Science. A major role is also envisioned for Goddard in support of OAST's space flight experiments program during 1989. Program areas of continuing emphasis include Thermal Management, Contamination Control, and Spacecraft System Analysis.

COMMERCIAL PROGRAMS..... 12

Technology Utilization activities at Goddard are directed toward the application of space technology to public and private sector needs. Foremost among the technology applications projects in 1988 and 1989 are the cerebrospinal fluid control system, the biomedical implantable devices systems, and applications of the programmable implantable medication system. Other activities include: (1) new technology identification, evaluation, and publication; (2) dissemination methods and techniques; (3) public section technology applications projects; and (4) outreach activities to encourage industrial participation in the program.

The objective of Goddard's Commercial Use of Space program is to increase private sector awareness of space opportunities and encourage increased industry investment and participation in high technology space based research and development.

Goddard's Research and Technology activity in this area involves the investigation and development of advanced tracking and data acquisition systems techniques. The primary objectives are to: (1) obtain new and improved tracking and data capabilities that will meet the needs of approved new missions; and (2) improve the cost effectiveness and reliability needed for overall support of space flight missions.

The operational part of the Space Tracking and Data Systems program at GSFC involves five main areas: Operation of the Space Tracking and Data Network (STDN); mission control, data processing, and orbit/attitude computation support for flight projects; the Tracking and Data Relay Satellite System (TDRSS); the NASA Communications(NASCOM) Network, and aeronautics and sounding rocket support.

The Space Tracking and Data Network is operated in direct support of NASA's Earth orbiting scientific and applications satellites and Shuttle/Spacelab programs. In addition, the Network provides, on a reimbursable basis, services to satellites that are operated by other United States Government Agencies, such as the Department of Defense and the National Oceanic and Atmospheric Administration, by foreign Governments, and by commercial companies. Appropriate segments of the Network deliver critical coverage for the launch of spacecraft that are on deep space missions by providing support during portions of the early flight path not visible to NASA's Deep Space Network (DSN).

The NASA Communications Network provides all operational communications required by NASA. Facilities of this network link the stations of the STDN, the TDRSS, the DSN, and other tracking and data acquisition support elements with control centers and the data processing and computation center, thereby, making it possible for all participants to operate as a network.

GSFC provides tracking, data acquisition, communication, and control in support of the aeronautics sounding rocket, and balloon programs. This includes support of balloons, sounding rockets, reentry vehicles and satellites launched from Wallops Island and other locations.

The TDRSS will become operational during 1989 with the White Sands Ground Terminal providing telemetry, tracking, and command support. The systems employs both S- and Ku-band frequencies and will greatly increase coverage capabilities available to Earth orbiting spacecraft. The network will provide the operational interface between the project users and the TDRSS.

With the demonstration of a successful TDRSS, a number of Spaceflight Tracking and Data Network ground stations will be closed. However, some of the current stations will be maintained to provide for Shuttle launch and planetary support.

During 1989, the GSFC Tracking Network will provide tracking support, mission control, orbit/attitude computing and data processing for the Space Transportation System launched payloads. Support will also continue for a number of operating satellites such as the International Ultraviolet Explorer, Solar Maximum Mission, Dynamic Explorer, and Nimbus.

In data processing, emphasis will continue to be placed on the operation of data processing facilities. During the latter part of 1988, the Spacelab Data Processing Facility will be returned to operational status to support the resumption of Spacelab missions. Testing with the Hubble Space Telescope (HST) Data Capture Facility will be completed and a state of mission readiness obtained in preparation for the launch of the HST in 1989. Implementation of both the generic data capture facility for packet processing and the generic time division multiplexed data capture facility will be completed by the end of 1989. These implementations will replace outdated equipment and systems, and, as generic facilities, will minimize the repetitive development cost currently encountered in support of different scientific missions.

In the area of mission control, implementation of the Hubble Space Telescope Operations Control Center will be completed, spacecraft testing supported, and mission readiness obtained to support the 1989 HST launch and subsequent orbital and science verification and operations. Development and testing to support the Upper Atmosphere Research Satellite (UARS) and Gamma Ray Observatory (GRO) Satellite will continue. Launch and in-orbit operations of the Cosmic Background Explorer (COBE) will be supported.

Flight dynamics development and testing will continue for support of the UARS, GRO, and Extreme Ultra-Violet Explorer Spacecraft. Mission readiness will be achieved and launch and operation support provided for the COBE. The Trajectory Computation and Orbit Products System (TCOPS) development will be fully implemented. TCOPS represents a major upgrade to the current orbit and trajectory support systems.

During FY 1989, definition studies for the Customer Data and Operations System (CDOS) will begin. The CDOS, when implemented, will provide payload and platform command and control, data capture and data handling for use in the Space Station era.

In order to support the appropriate use of the most advanced technologies in these data systems, prototypes will be developed to provide lower cost and higher performance data handling components based on VLSI gate arrays; to incorporate routine operations decisions in expert systems to reduce manpower costs; and to provide automated tools for software engineering and systems development management. An interactive systems prototyping environment will be assembled to allow simulation of critical man-machine operations interfaces early in the development cycle to reduce the need for expensive design changes later in the cycle. An integrated, distributed data base system will be implemented to improve the flow of management and technical information.

CENTER MANAGEMENT AND OPERATIONS SUPPORT..... **634**

Center Management and Operations Support is support of services being provided to all GSFC organizations which cannot be identified exclusively to a single program or project. The civil service personnel involved are:

Director and Staff - **The** Center Director, Deputy Director and the immediate staff, staff organizations, e.g., Comptroller, Chief Counsel, Equal Opportunity, and Public Affairs.

Management Support - Those who provide information and control services supporting all levels of Center management, both program and functional. Specific functions include resources and financial management, contracting and procurement, property management, personnel management, and management systems and analysis.

Operations Support - Those who provide for the operation and maintenance of institutional facilities, buildings, systems and equipment, including those who manage or provide technical services such as automated data processing, health and safety, and medical care.

SUMMARY OF RESOURCES REQUIREMENTS

FUNDING PLAN BY FUNCTION

	1987 <u>Actual</u>	1988		1989 Budget <u>Estimate</u>
		<u>Revised Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	
I. Personnel and Related Costs.....	165,125	179,868	166,186	179,592
11. Travel.....	4,967	5,575	5,705	6,200
III. Operation of Installation.....	43,760	70,388	64,850	71,031
A. Facilities Services.....	(21,944)	(28,611)	(25,439)	(28,404)
B. Technical Services.....	(9,734)	(14,372)	(12,833)	(14,499)
C. Management Operations.....	<u>(12,082)</u>	<u>(27,405)</u>	<u>(26,578)</u>	<u>(28,128)</u>
Total, fund requirements.....	213,852	255,831	243,662	256,823

RESOURCES REQUIREMENTS BY FUNCTION

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
I. <u>PERSONNEL AND RELATED COSTS</u>	165,125	179,868	166,186	179,592
<u>Summary of Fund Requirements</u>				
A. <u>Compensation and Benefits</u>				
1. <u>Compensation</u>				
a. Permanent positions.....	141,a32	144,856	139,059	148,356
b. Other than full-time permanent.....	1,531	2,001	1,a59	1,753
c. Overtime and other compensation.....	<u>2,190</u>	<u>2,456</u>	<u>2,364</u>	<u>2,527</u>
Subtotal, Compensation.....	145,553	149,313	143,282	152,636
2. <u>Benefits</u>	<u>17,108</u>	<u>27,536</u>	<u>19,588</u>	<u>23,199</u>
Subtotal, Compensation and Benefits.....	162,661	176,a49	162,870	175,a35
B. <u>Supporting Costs</u>				
1. Transfer of personnel.....	543	1,196	1,524	1,a93
2. Personnel training.....	<u>1,921</u>	<u>1,a23</u>	<u>1,792</u>	<u>1,864</u>
Subtotal, Supporting Costs...	2,464	3,019	3,316	3,757
Total, Personnel and Related costs.....	<u>165,125</u>	<u>179,868</u>	<u>166,186</u>	<u>179,592</u>

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
A. <u>Comuensation and Benefits</u>	<u>162.661</u>	<u>176.849</u>	<u>162.870</u>	<u>175.835</u>
1. <u>Comuensation</u>	<u>145.553</u>	<u>149.313</u>	<u>143.282</u>	<u>152.636</u>
a. Full-time workyears.....	141,832	144,856	<u>139.059</u>	148,356

The change in compensation from the 1988 Revised Estimate to the 1988 Current Estimate is due to the 1988 pay raise offset by reductions in temporary employment costs and overtime and miscellaneous compensation and GSFC's share of the \$42.0 million general reduction needed to reach 1988 authorized levels. Compensation increases from the 1988 Current Estimate to the 1989 Budget Estimate result from the full year effect of the 1988 pay raise, a realignment of workyears from special employment programs to full-time permanent status, and 1988 and 1989 personnel actions. The change in full-time workyear costs from the 1988 Current Estimate to the 1989 Budget Estimate are due to the adjustments described below:

Basis of Cost for Permanent Workyears

In 1989, the cost of full-time workyears will be 153,012. The increase from 1988 is calculated as follows:

Cost of full-time permanent workyears in 1988.....		139,059
Cost increases in 1989.....		11,469
Restoration of 1988 general reduction.....	6,379	
Within-grade and career advances.....	4,343	
Full year cost of 1988 actions.....	2,003	
Part year cost of 1989 actions.....	2,340	
Full year effect of 1988 pay raise.....	747	
Cost Decreases in 1989.....		-2,172
Turnover Savings.....	-1,030	
Full year effect of 1988 actions.....	-814	
Partial year effect of 1989 actions.....	-216	
Two less paid days.....	-1,142	
Cost of full-time permanent workyears in 1989.....		148,356

	1987	<u>1988</u>		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
b. Other than full-time permanent workyears				
1. Cost.....	1,531	2,001	1,859	1,753
2. Workyears.....	105	136	134	128

The distribution of 1989 workyears is as follows:

Distribution of Other than Full-Time Permanent Workyears

	<u>Program Workyears</u>
Developmental programs.....	59
Other temporary.....	32
Youth opportunity programs.....	<u>37</u>
Total.....	<u>128</u>

c. Overtime and other compensation.....	2,190	2,456	2,364	2,527
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The change from the 1988 Revised Estimate to the 1988 Current Estimate is due to a reduction in the estimate of overtime hours and revised pricing due to the 1988 pay raise. The increase to the 1989 Budget Estimate is due to the projected impact of launch activities.

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
2. Benefits.....	<u>17,108</u>	<u>27,536</u>	<u>19,588</u>	<u>23,199</u>

The following are the amounts of contribution by category:

Retirement and Thrifts Plan Costs Fund....	10,401	21,050	11,803	13,885
Employee Life Insurance.....	264	320	283	303
Employee Health Insurance.....	3,467	3,323	3,687	3,908
Workmen's Compensation.....	251	410	264	280
FICA.....	1,087	736	1,856	3,026
Medicare.....	1,638	1,693	1,695	1,797
Other.....	<u>-0-</u>	<u>4</u>	<u>-0-</u>	<u>-0-</u>
Total	<u>17,108</u>	<u>27,536</u>	<u>19,588</u>	<u>23,199</u>

The decrease in benefits from the 1988 Revised Estimate to the 1988 Current Estimate is due to revised estimates for retirement costs resulting from the significantly fewer number of employees who switched from CSRS to FERS than anticipated, and the concomitant retirement changes related to the reduction in permanent compensation for the \$42.0 million general reduction. The increase from the 1988 Current Estimate to the 1989 Budget Estimate primarily reflects cost associated with increasing enrollment in the Federal Employee Retirement System.

B. Support Costs.....	<u>2,464</u>	<u>3,019</u>	<u>3,316</u>	<u>3,757</u>
1. Transfer of personnel.....	543	1,196	1,524	1,893

The category includes the reimbursement of employees for movement of household goods to the employee's new duty station, transfer between tracking stations, and other relocation expenses. The increase from the 1988 Current Estimate reflects the costs associated with the contract for services to assist employees in permanent change of station moves.

	1987 <u>Actual</u>	1988		1989
		<u>Budget Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	<u>Budget Estimate</u>
2. Personnel Training.....	1,921	1,823	1,792	1,864

The personnel training costs are based on current training programs and the need to reorient skills of employees into areas compatible with the direction of the current space program and GSFC's role in the program.

11. <u>TRAVEL</u>	<u>4.967</u>	<u>5,575</u>	<u>5.705</u>	<u>6,200</u>
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Summary of Fund Requirements

A. Program Travel.....	3,861	4,735	4,620	5,025
B. Scientifics and Technical Development Travel.....	652	420	620	700
C. Management and Operations Travel.....	454	420	465	475
Total, Travel.....	<u>4.967</u>	<u>5.575</u>	<u>5.705</u>	<u>6.200</u>

Explanation of Fund Requirements

A. Program Travel.....	3,861	4,735	4,620	5,025
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Program travel is essential to the accomplishment of the Center's mission, particularly with regard to the Space Science and Applications, Aeronautics and Space Technology, Tracking and Data Acquisition, and Space Transportation system and space station programs. In these areas, efforts will be devoted to performing applications research, developing complex satellites and launch systems, managing data processing systems, and creating scientific instruments for further research. Program travel includes travel to industry contractors to monitor and evaluate the contractor's effort, and to other centers for integration meetings, design, technical and safety reviews, and pre and post launch mission activities. The 1988 Current Estimate funds travel associated with the sounding rocket and balloon

campaigns in Australia for studying the Supernova. The budget impact of the Supernova campaigns is minor in 1989. The 1988 Current Estimate also reflects resumption of STS Operations and increased programmatic activity necessary for meeting launch readiness dates. Travel requirements for STS and other program activities will increase further in 1989.

	1987 <u>Actual</u>	1988		1989
		<u>Budget Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
(Thousands of Dollars)				
B. Scientific and Technical Development				
Travel.....	652	420	620	700

Scientific and technical development travel permits employees to participate in meetings and technical seminars with other representatives and aerospace community. This participation allows them to benefit from exposure to technological advances outside GSFC, as well as to present both accomplishments and problems to their associates. Many of the meetings are working panels convened to solve certain problems for the benefit of the Government. The increase from the 1988 Revised Estimate to the 1988 Current Estimate reflects the impact of revised estimates based on 1987 experience offset by fund realignments to support Supernova program travel. The 1989 Estimate reflects a resumption of desirable levels for scientific meeting trips.

C. Management and Operations Travel.....	454	420	465	475
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Management and operations travel is used for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management, and procurement activities, travel of the center top management to other NASA Centers and local travel in and around the Washington metropolitan area, and to and from Wallops. The increases from the 1988 Revised Estimate to the 1988 Current Estimate and from the 1988 Current Estimate to the 1989 Budget Estimate result from an increase in local transportation costs with a significant increase in travel to the Space Station program office located in Reston, Virginia.

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
111. <u>OPERATION OF INSTALLATION</u>	<u>43,760</u>	<u>70,388</u>	<u>64,850</u>	<u>71,031</u>

SUMMARY OF FUND REQUIREMENTS

A. Facilities Services.....	21,944	28,611	25,439	28,404
B. Technical Services.....	9,734	14,372	12,833	14,499
C. Management and Operations.....	<u>12,082</u>	<u>27,405</u>	<u>26,578</u>	<u>28,128</u>

Total, Operation of Installation..... 43,760 70,388 64,850 71,031

EXPLANATION OF FUND REQUIREMENTS

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Center's institutional activities. These are divided into three major functional areas: 1) Facilities Services--the cost of renting real property, maintaining and repairing institutional facilities and equipment, the cost of custodial services and utilities; 2) Technical Services--the cost of automatic data processing for management activities, and the cost of library services, educational and informational programs; and 3) Management and Operations--the cost of administrative communications, transportation, printing, medical, supply, and related services.

Estimates for 1988 and 1989 reflect an existing level of effort. The 1989 Budget Estimate also provides the estimated costs to prevent further deterioration of the aging GSFC and Wallops complexes.

A. FACILITIES SERVICES.....	21,944	28,611	25,439	28,404
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The Greenbelt facility is located on a 552-acre main site, and on 554-acre remote site area with a complex of laboratory and office-type buildings as well as test facilities. This complex encompasses 2.5 million gross square feet of building space including 34 buildings. This physical plant supports an average daily on-center population of about 9,000. Many of the test facilities are used on schedules involving more than one shift, often during off-peak hours.

The Wallops Facility includes 6,175 acres and a complex of facilities which mainly consists of a research airport and launch operation facilities. This complex encompasses 1.1 million gross square feet of building space including three major buildings. Also included are three major technical facilities. This physical plant supports an average daily on-site population of approximately 1,000.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u>	<u>Current</u> <u>Estimate</u>	

(Thousands of Dollars)

SUMMARY OF FUND REQUIREMENTS

1. Rental of Real Property.....	770	817	882	1,346
2. Maintenance and Related Services.....	6,173	9,445	8,280	9,424
3. Custodial Services	5,222	6,084	5,740	6,657
4. Utility Services	<u>9,779</u>	<u>12,265</u>	<u>10,537</u>	<u>10,977</u>
Total, Facilities Services.....	<u>21,944</u>	<u>28,611</u>	<u>25,439</u>	<u>28,404</u>

EXPLANATION OF FUND REQUIREMENTS

1. Rental of Real Property.....	770	817	882	1,346
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Provides space for personnel at tracking stations and the Goddard Institute for Space Studies in New York. The 1988 Current Estimate and the 1989 Budget Estimate reflect current projected rates based on 1987 experience. Additional funding in 1989 will meet requirements for warehousing of the Hubble Space Telescope spares and replacement hardware previously stored in contractor facilities.

2. Maintenance and Related Services...	6,173	9,445	8,280	9,424
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This activity includes general building maintenance such as painting, inspection, and mechanical and electrical maintenance, as well as rehabilitation and modification projects in office buildings. This activity provides for roads and grounds maintenance. Funding is also provided for supplies, materials, and equipment costs associated with maintenance and

related services. The decrease from the 1988 Revised Budget to the 1988 Current Estimate is due to deferral of some planned facilities repair projects. The increase from 1988 to 1989 results from the need to adequately fund maintenance of facilities, equipment, roads, and grounds.

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
3. Custodial Service.....	5,222	6,084	5,740	6,657

The estimate provides for janitorial, plant security, fire fighting, and ambulance services. These services include washing and relamping of light fixtures, office cleaning, minor laundry services, trash removal, badging of all on-site personnel and visitors, vehicle identification, and fire fighting. In 1988 and 1989, funding also provides for special mission related security support and special cleaning services in several of the technical facilities. The decrease from the 1988 Revised Estimate to the 1988 Current Estimate reflects experience in 1987. The increase to the 1989 Budget Estimate is due to anticipated rate changes in support service contracts and enhancement of security, fire protection, and custodial services.

4. Utility Services.....	9,779	12,265	10,537	10,977
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The estimate provides for maintenance of the utility plant and distribution systems as well as the purchase of utility services, and supplies, materials, and equipment required for the maintenance of these systems. At the Greenbelt facility, electricity is purchased from the Potomac Electric and Power Company, natural gas from the Washington Gas Light Company, and fuel oil from a local supplier. Water and sewage service is provided by the Washington Suburban Sanitary Commission. The purchased utilities at Wallops are electricity from the Delmarva Power Co. and fuel oil from a local supplier. Rate decreases that were experienced in 1987 are reflected in the current 1988 and 1989 estimate. Requirements for unique utility systems support for our technical computer facilities are also supported in the 1988 Current Estimate and the 1989 Budget Estimate. Utility system improvements are planned for 1989 including electrical substation, feeder and power line modifications, water main repairs, and HVAC repairs.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u> (Thousands of Dollars)	<u>Current</u> <u>Estimate</u>	
B. TECHNICAL SERVICES.....	<u>9.734</u>	<u>14.372</u>	<u>12.833</u>	<u>14.499</u>

SUMMARY OF FUND REOUIREMENTS

1. Automatic Data Processing.....	8,416	8,171	6,594	7,664
2. Scientific and Technical Information.....	810	3,068	3,045	3,127
3. Shop Support Services.....	<u>508</u>	<u>3.133</u>	<u>3.194</u>	<u>3.708</u>
Total, Technical Services.....	<u>9.734</u>	<u>14.372</u>	<u>12.833</u>	<u>14.499</u>

EXPLANATION OF FUND REOUIREMENTS

1 . Automatic Data Processing.....	8,416	8,171	6,594	7,664
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This funding provides for the mainframe, micro & mini-computer hardware, system software, maintenance, and programming and operations support necessary to supply management with accurate and timely information necessary to support Center operations and missions, and respond to Congressional and other external budget, administrative, and operational requirements. All administrative and management systems are supported including institutional management, finance and accounting, procurement, personnel management, project management and management of the Research and Development program. The decrease from the 1988 Revised Estimate to the 1988 Current Estimate results from a need to purchase supplementary hardware and software for the new administrative computer in 1987, rather than 1988 as originally planned. Additional ADP purchases facilitated by the mass buy contract have been initiated at the Center, which have contributed to savings for ADP purchases. The 1989 Budget Estimate provides for further enhancements to the administrative computer to keep pace with new systems development and on-line capabilities, and increased contractual support for systems design/development and operations support. A specific project planned for 1989 is development of the Accounts, Reporting, Inquiring, and Entry System (ARIES), which will consolidate and upgrade existing accounting data storage facilities.

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
2. Scientific and Technical Information.	810	3,068	3,045	3,127

(Thousands of Dollars)

FY 1988 and 1989 reflect the costs of maintaining the GSFC library, including operations support, information systems, books and subscriptions. These funds also provide for a public affairs educational and information program, and support to the Center in the provision of various scientific and technical information services. Costs include exhibit management and refurbishment, demonstration models, workshops and symposia, and education and information materials. The Center is making a concerted effort to vitalize its outreach to the community and to provide a comprehensive and participative view of the space program. Replacement and continued maintenance and upgrade of the existing exhibits in the Visitor Center, as well as an increase in distribution of literature and films, is provided for in 1988 and 1989.

3. Shop Support Services.....	508	3,133	3,194	3,708
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In all years, support is given in the areas of safety, fire protection system maintenance, and related supplies and equipment. Beginning in 1988, this function will include all Operating System Documentation and crane recertification activities at Greenbelt and Wallops. Non-technical photographic and chart and art support to all Center organizations is also included. The increase in 1989 reflects estimated costs of adequate support in these areas.

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
C. MANAGEMENT AND OPERATIONS.....	<u>12.082</u>	<u>27.405</u>	<u>26.578</u>	<u>28.128</u>

(Thousands of Dollars)

SUMMARY OF FUND REQUIREMENTS

1. Administrative Communications....	4,333	8,984	8,947	8,968
2. Printing and Reproduction.....	80	1,625	1,636	1,590
3. Transportation.....	2,450	2,002	1,834	2,332
4. Installation Common Services.....	5,219	14,794	14,161	15,238
Total, Management and Operations..	<u>12.082</u>	<u>27.405</u>	<u>26.578</u>	<u>28.128</u>

EXPLANATION OF FUND REQUIREMENTS

1. Administrative Communications..	4,333	8,984	8,947	8,968
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These funds support local telephone service, long distance service, FTS, and other administrative communications. Estimates for 1988 and 1989 include full funding for the **ROLM** interconnect phone system, including equipment purchase, maintenance, installations and moves, engineering support and all system lease/purchase costs.

2. Printing and Reproduction.....	80	1,625	1,636	1,590
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This category covers the costs associated with the maintenance of administrative copiers across the Center and all administrative printing costs including all in-house operations, supplies, materials and equipment, and contracted printing. The decrease from 1988 to 1989 reflects one time equipment purchases in 1988.

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
		(Thousands of Dollars)		
3. Transportation.....	2,450	2,002	1,834	2,332

This funding supports: the operation and maintenance of the GSFC Administrative Aircraft; the purchase, maintenance, and repair of the installation's vehicle fleet; fuel and supplies associated with the operation of the aircraft and vehicles; special vehicle rental; and packing, crating and shipping costs associated with the transportation of non-project unique materials. The decrease for 1988 from the Revised Budget to the Current Estimate is due to delays in contractor staffing for vehicle maintenance activities and adjustment of costs based on 1987 experience. The 1989 Budget Estimate provides much needed funding to upgrade the Center's transportation fleet to Government standards.

4. Installation Common Services....	5,219	14,794	14,161	15,238
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This activity supports Center management and staff activities, provides medical services, and covers various installation support services. Funding supports: patent searches and applications; mailroom services and all associated costs; administrative equipment purchase, lease, and maintenance; office supplies and materials; operation of the GSFC on-site health unit and medical services for the Goddard Institute for Space Studies employees in New York, including emergency care, annual physical exams, fitness programs, immunizations, and counseling. Annual physical exams are provided for approximately 3,600 employees at the Center. The necessary supplies, materials, and equipment for operation of the Health Unit are included. This category also provides funding for institutional supply management activities, storage and warehousing.

The decrease from the 1988 Revised Budget to the 1988 Current Estimate is the effect of revised estimates for support service contracts based on 1987 experience. The increase from the 1988 Current Estimate to the 1989 Budget Estimate reflects anticipated contractor rate increases, and additional logistics support.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
 GODDARD SPACE FLIGHT CENTER
 Greenbelt, Maryland

DIRECTOR		
DEPUTY DIRECTOR		
	88	89
SES	3	3
EXCEPTED	0	0
GS/IG 16	0	0
GS/IG 15	2	2
GS/IG 14	0	0
OTHER GS/IG	5	5
WAGE GRADE	0	0
TOTAL	10	10

NASA OFFICE OF
 INSPECTOR GENERAL
 GSFC FIELD OFFICE

COMPTROLLER		
	88	89
SES	1	1
EXCEPTED	0	0
GS/IG 16	0	0
GS/IG 15	3	3
GS/IG 14	5	5
OTHER GS/IG	96	96
WAGE GRADE	0	0
TOTAL	105	105

DIRECTOR OF FLIGHT ASSURANCE		
	88	89
SES	1	1
EXCEPTED	0	0
GS/IG 16	0	0
GS/IG 15	18	18
GS/IG 14	24	24
OTHER GS/IG	85	85
WAGE GRADE	0	0
TOTAL	128	128

TOTAL		
	88	89
SES	48	48
EXCEPTED	2	2
GS/IG 16	1	1
GS/IG 15	328	329
GS/IG 14	567	568
OTHER GS/IG	2553	2551
WAGE GRADE	128	128
TOTAL	3627	3627

CHIEF COUNSEL		
	88	89
SES	1	1
EXCEPTED	0	0
GS/IG 16	0	0
GS/IG 15	2	2
GS/IG 14	2	2
OTHER GS/IG	4	4
WAGE GRADE	0	0
TOTAL	9	9

EQUAL OPPORTUNITY PROGRAMS OFFICE		
	88	89
SES	0	0
EXCEPTED	0	0
GS/IG 16	0	0
GS/IG 15	0	0
GS/IG 14	1	1
OTHER GS/IG	4	4
WAGE GRADE	0	0
TOTAL	5	5

OFFICE OF PUBLIC AFFAIRS		
	88	89
SES	0	0
EXCEPTED	0	0
GS/IG 16	0	0
GS/IG 15	1	1
GS/IG 14	3	3
OTHER GS/IG	15	15
WAGE GRADE	0	0
TOTAL	19	19

DIRECTOR OF MANAGEMENT OPERATIONS		
	88	89
SES	3	3
EXCEPTED	0	0
GS/IG 16	0	0
GS/IG 15	15	15
GS/IG 14	38	38
OTHER GS/IG	493	493
WAGE GRADE	128	128
TOTAL	677	677

DIRECTOR OF FLIGHT PROJECTS		
	88	89
SES	10	10
EXCEPTED	0	0
GS/IG 16	0	0
GS/IG 15	79	79
GS/IG 14	98	98
OTHER GS/IG	135	135
WAGE GRADE	0	0
TOTAL	322	322

DIRECTOR OF MISSIONS OPERATIONS DATA SYSTEMS		
	88	89
SES	4	4
EXCEPTED	0	0
GS/IG 16	0	0
GS/IG 15	09	45
GS/IG 14	83	83
OTHER GS/IG	447	447
WAGE GRADE	0	0
TOTAL	579	579

DIRECTOR OF SPACE AND EARTH SCIENCES		
	88	89
SES	13	13
EXCEPTED	2	2
GS/IG 16	1	1
GS/IG 15	100	100
GS/IG 14	148	148
OTHER GS/IG	472	472
WAGE GRADE	-	-

DIRECTOR OF ENGINEERING		
	88	89
SES	8	8
EXCEPTED	0	0
GS/IG 16	0	0
GS/IG 15	52	53
GS/IG 14	132	133
OTHER GS/IG	599	599
WAGE GRADE	0	0
TOTAL	787	787

DIRECTOR OF SUBORBITAL PROJECTS AND OPERATIONS		
	88	89
SES	4	4
EXCEPTED	0	0
GS/IG 16	0	0
GS/IG 15	11	11
GS/IG 14	33	33
OTHER GS/IG	207	202
WAGE GRADE	0	0
TOTAL	250	250

APPROVED: _____ DATE: _____

AMES
RESEARCH CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1989 ESTIMATES

AMES RESEARCH CENTER

DESCRIPTION

Established in 1940, Ames Research Center operates in two locations. The Ames Moffett location is on 423.5 acres at the southern end of San Francisco Bay on land contiguous to the U.S. Naval Air Station, Moffett Field, California. Certain facilities, such as the utilities and airfield runways, are used jointly by NASA and the Department of the Navy. Also housed at this location is the U.S. Army Aviation Research and Technology Activity. The capital investment at Ames Moffett, including fixed assets in progress and contractor-held facilities at various locations, as of September 30, 1987, was \$794,746,000.

The Ames Dryden Flight Research Facility is 65 air miles northeast of Los Angeles. Ames Dryden is located at the north end of Edwards Air Force Base on 521 acres of land under a permit from the Air Force. The total capital investment at Dryden, including fixed assets in progress and contractor-held facilities at various locations, as of September 30, 1987, was \$120,016,000.

CENTER ROLES AND MISSIONS

The programs at Ames involve research and development in the fields of aeronautics, life sciences, space sciences and applications, and space technology, as well as support for national needs of the new science and technology growing from the aerospace program. Specifically, the Center's major program responsibilities are concentrated in: theoretical and experimental fluid mechanics and aerodynamics, rotorcraft technology, powered-lift technology, high performance aircraft technology, flight simulation, flight research, computational fluid dynamics, fluid and thermal physics, space sciences, intelligent systems automation, airborne sciences and applications, controls and guidance, human factors, space biology and medicine, and ground and flight projects in support of aeronautics and space technology. In addition to these major program responsibilities, the Center provides major support for military programs.

The principal and supporting roles are:

PRINCIPAL

Fundamental Aerodynamics - advance the general state of the art, both theoretical and experimental.

Rotorcraft Technology - advance the tools of rotorcraft performance analysis and design, and develop a technology base for improving efficiency, safety, performance and environmental acceptability.

Low-Speed Vehicle Systems - conduct research in the short and vertical takeoff and landing capable aircraft.

Computational Fluid Dynamics - advance the state of the art through the definition of new systems, both hardware and software, and apply these advances to aeronautical and other related areas.

Aeronautical Flight Research - conduct flight research using aircraft as flight test facilities and conduct flight research programs of advanced aerospace vehicle concepts, including demonstrator vehicles, when appropriate.

Flight Test Techniques - investigate and develop new flight test techniques to improve the capability of conducting flight research.

Flight Instrumentation Development - direct the development of new methods and equipment for flight measurements.

Guidance and Control - conduct theoretical investigation, simulation and flight research evaluation of new and innovative concepts in rotorcraft and powered-lift aircraft flight control to validate design methods and verify system performance in the flight environment.

Human-Vehicle Interactions - advance the state of the art through the study of machine and other human factor interactions and considerations involved in aircraft operations.

High-Performance Aircraft - conduct flight research on advanced military configurations and demonstrate the potential for improved aircraft performance through the integration of aircraft systems.

Aircraft Automation - develop a technology base for automated aircraft by conducting research in the integration of artificial intelligence, controls, and human factors.

Short Takeoff and Vertical Landing (STOVL) Technology - develop a technology base for military STOVL systems in support of Department of Defense missions.

Materials and Structures - conduct tests to increase the understanding of structural responses to aerodynamic heating, with particular emphasis on high-temperature space or hypersonic vehicle structures.

Flight Simulation - improve the state of the art to permit more effective use of simulators in aircraft design and validation-of-flight simulation; provide support to NASA and other government agencies' development and flight programs.

Military and FAA Aeronautics - provide facilities and technical support to military and civil aviation in areas consistent with other Ames aeronautics roles and unique capabilities.

Transatmospheric Research and Technology - Combine aeronautics and space disciplines to provide the technology for a future class of vehicles capable of flight to orbit and/or hypersonic cruise.

Airborne Research and Applications - conduct airborne research and applications experiments by operating instrumented jet aircraft as airborne laboratories for world wide science investigations.

Information Sciences - advance the nation's automation capabilities by focusing research efforts on the technology development of intelligent, autonomous systems for support of space station, planetary, astrophysical and aeronautical missions, and commercial use of space.

Fluid and Thermal Physics - develop thermal analysis methods and thermal protection systems required for aerospace planes and orbital transfer vehicles, including probe development for the Galileo mission.

Planetary Mission Operations and Data Analysis - conduct mission operations and data analysis support for the Pioneer series of missions, and for the Galileo planetary entry probe.

Physics and Astronomy - conduct research in infrared astronomy, astrophysics, atmospheric physics, and solar physics to contribute to basic understanding of the planet Earth.

Space Automation - advance the state of the art by focusing research in human factors, artificial intelligence, and guidance and controls to support productive, efficient, and safe missions including the space station and beyond.

Life Sciences Spaceflight Project - develop, manage and operate spaceflight experiments and facilities in the life sciences to provide information applicable to solving space medicine problems.

Space Biology - utilize the unique environment of space to expand our understanding of basic biological phenomena.

Biomedical Research - understand and ameliorate biomedical problems experienced by humans during and following long duration spaceflight.

Life in the Universe - provide understanding of the origin, evolution, nature and distribution of life in the universe and understand its interaction with the terrestrial environment.

SUPPORTING

Space Transportation System - provide prime and contingency landing support to the Space Transportation System.

Advanced Turboprop - Conduct a combined computational and experimental research program to define the aerodynamic technology required to efficiently integrate advanced turboprop propulsion systems with advanced transport aircraft.

DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM
AMES RESEARCH CENTER

	1987 ACTUAL	1988		1989 BUDGET ESTIMATE
		REVISED ESTIMATE	CURRENT ESTIMATE	
SPACE STATION.....	20	15	20	20
SPACE FLIGHT PROGRAMS.....	12	36	19	37
SPACE SHUTTLE.....	12	36	19	37
SPACE SCIENCE AND APPLICATIONS.....	341	346	341	341
PHYSICS AND ASTRONOMY.....	105	120	105	105
LIFE SCIENCES.....	131	124	131	131
PLANETARY EXPLORATION.....	49	50	49	49
SPACE APPLICATIONS.....	56	52	56	56
AERONAUTICS AND SPACE TECHNOLOGY.....	1,157	1,128	1,153	1,135
AERONAUTICAL RESEARCH AND TECHNOLOGY	964	955	960	937
SPACE RESEARCH AND TECHNOLOGY.....	156	143	149	154
TRANSATMOSPHERIC RESEARCH & TECH....	37	30	44	44
COMMERCIAL PROGRAMS.....	4	5	4	4
TRACKING AND DATA PROGRAMS.....	27	27	24	24
SUBTOTAL DIRECT.....	1,561	1,557	1,561	1,561
CENTER MANAGEMENT AND OPERATIONS.....	503	502	507	507
SUBTOTAL (FULL-TIME PERMANENTS)....	2,064	2,059	2,068	2,068
OTHER CONTROLLED FTE'S..... (PMI's/CO-OPS/OTFTP's)	79	85	76	76
GRAND TOTAL (FULL-TIME EQUIVALENTS)	2,143	2,144	2,144	2,144

PROGRAM DESCRIPTION

FY 1989
Permanent Civil
Service Workyears

RESEARCH AND DEVELOPMENT

SPACE STATION 20

In 1989, Space Station activities will focus upon developing user payload designs and outfitting requirements for incorporation into the revised baseline station configuration as well as evolutionary requirements. These Phase A and early Phase B activities will support life sciences and various space science activities. Efforts in human factors, i.e., designs for internal architecture and proximity operations about the station will continue. The AX-5 hard suit will be tested in the Neutral Buoyancy Test Facility and transfer of technology to JSC for joint testing will begin. Information sciences will demonstrate Artificial Intelligence technology in a Thermal System Management test bed at JSC. Further research on expert systems will continue to focus upon automation of both on board and ground control functions of the station.

SPACE FLIGHT PROGRAMS

SPACE SHUTTLE..... 37

Dryden Flight Research Facility is the primary recovery site for the Space Shuttle missions. Upon landing, Dryden provides Orbiter convoy operations support, support in deservicing the Orbiter, in mating the Orbiter to the Shuttle Carrier Aircraft for transporting the Orbiter to Kennedy Space Center. Dryden is also responsible for maintaining the on-site Space Shuttle servicing facilities.

SPACE SCIENCE & APPLICATIONS PROGRAMS 341

PHYSICS AND ASTRONOMY 105

In 1989, civil service personnel will provide support for the airborne astronomy program, which includes a C-141 Kuiper Airborne Observatory Aircraft, and a Lear Jet aircraft. These aircraft are operated by Ames

as flying astronomical observatories with the bulk of the observing accomplished by various university research teams. These facilities are supported through in-house research in astronomy and astrophysics and with in-house capability to operate research aircraft. The Center controls a variety of other operational aircraft, including two U-2C's, two ER-2's, a DC-8, and a C-130, some of which serve as unique National and international facilities for research in astronomy, geophysics, meteorology, and Earth resources; others acquire data for remote sensing projects and provide a mechanism for integration of spaceborne, airborne, and ground-based data acquisition and processing systems. Support for the astronomy program is also provided by a sophisticated laboratory effort in spectroscopy and dust physics.

Ames has an active program of laboratory, theoretical, and computational studies to develop the basic astrophysical modeling concepts, to obtain the necessary physical data, to interpret the infrared astronomical observations, and to support the development of improved scientific instrument concepts for use on aircraft and spacecraft. This program has as its objectives to investigate the nature and evolution of solar systems, galactic and extragalactic objects through the unique insights to be gained by infrared observations of these astrophysical systems.

Permanent Civil
Service Workyears

LIFE SCIENCES 131

In 1989, civil service personnel will continue to be involved in research, hardware development, and program management related to meeting program milestones in the areas of understanding the effects of space flight on humans and other life forms, managing non-human biological experiments in space, and understanding the origin, evolution, and distribution of life-related chemicals on Earth and elsewhere in the universe.

Research in space medicine and biology will be conducted to investigate the effects of space flight on humans and other organisms. Specifically, causes and potential counter measures for neurophysiological, musculoskeletal, and cardiovascular changes observed during and immediately following space flight will continue to be studied. Ground-based space flight simulations and actual flight experiments with humans and animals will continue to be performed to provide a basis for understanding why and how biological systems are affected by space flight. Newer areas to be emphasized will be long-duration bedrest studies and research to identify the physiological and behavioral requirements of artificial gravity in future

solar system manned missions. Computationally-based reconstructions and modeling of biosystems will be employed to increase understanding of their functioning on Earth and under conditions of short- and long-term weightlessness.

Because of the Challenger accident the Life Sciences Shuttle/Spacelab missions have been delayed. The first scheduled mission, Spacelab Life Sciences-1 (SLS-1), will not be launched until 1990. During this hiatus the emphasis in 1989 will be on testing the redesign of the Research Animal Holding Facility and all other flight hardware to ensure biological containment and other safety features. Work will continue on Final Integration of Experiment payloads for SLS-1, International Microgravity-1, Spacelab-J, and D-2 for flight readiness in 1989 and beyond. In addition, data analysis will be conducted for 27 experiments flown on COSMOS the mission launched September 1987 and preparation will begin for a joint US/USSR mission in 1989.

Ames is developing a biological research facility for the Space Station, which includes a 1.8 meter research centrifuge and a ZERO-G Modular Habitat System. The centrifuge is scheduled to first fly on Spacelab in the 1994-1995 time period.

Research into the origin and distribution of life and life-related molecules will also be continued through analyses of biochemical pathways in living systems, and of chemicals abundances in meteorites, cosmic dust, Precambrian deposits, and modern analogs of ancient microbial systems by the use of ultrasensitive organic chemical analyses and stable isotope measuring systems. Research efforts in the origin and distribution of biogenic elements and the evolution of advanced life will increase. Work will continue on the development of techniques to collect and analyze Martian samples, cometary material, and cosmic dust both in space and in Earth laboratories. Techniques for organic chemical analyses of the atmospheres of Saturn and Titan will also be studied. The Life Sciences Microwave Observing Project will be completing its definition and design phases in 1989.

The Ames controlled ecological life support system (CELSS) program supports the scientific experiments, technological investigations and potential flight experiments necessary for the development of bioregenerative life support systems. In FY 1989, the CELSS program will initiate laboratory-scale experiments in a completed closed crop growth facility, initiate investigations of specific subsystems of a flight experiments facility intended for use on Space Station, initiate the development of a CELSS Science

Laboratory that will provide the capabilities for chemical and biological analysis necessary to support the consortium of CELSS investigators, continue investigations of various aspects of waste processing for use in space, and initiate development of several essential CELSS subsystems, including those for cellulose recovery, ammonia extraction from urine, gas separation, and nutrient composition maintenance.

The biospherics research program will continue to enhance the understanding of the biological aspects of global conditions and biogeochemical processes on Earth. NASA derived technologies will be employed to study and model the environmental parameters which influence the distribution and prevalence of vectorborne disease. Nitrous oxide and non-methane hydrocarbons will be studied over tropical and temperate ecosystems and related to major soil types and various disturbance processes, including fire. These in situ studies will then be expanded to large area estimation through remotely-sensed data. Finally, the consequences of various disturbance regimes on atmosphere water biosphere interactions will be investigated through in situ and remote observations.

Permanent Civil
Service Workyears

PLANETARY EXPLORATION 49

A continuing series of project management activities, backed by the scientific expertise of principal investigators from Ames, other NASA Centers and the university community will be continued in 1989 to accomplish the ongoing programs in planetary exploration. An in-house supporting research and technology program serves both to maintain the Center's scientific and technological expertise and to provide the stimulus and definition for new planetary research.

In 1989, civil service personnel will continue to provide project management and scientific support for: Pioneers 6 through 9, a series of spacecraft exploring the physics of the interplanetary medium and providing ongoing data on the plasma in which the Earth is immersed; Pioneers 10 and 11, spacecraft that made the initial exploratory close approaches to Jupiter and Saturn and now continue exploration beyond all known planets of the outer solar system; Pioneer Venus Orbiter which is still taking data at Venus; examined Halley's Comet in the ultraviolet range during perihelion passage; and the Galileo Probe will be in pre-launch operations for a launch date of November 1989.

Ames maintains an active program of laboratory, computational, and theoretical studies to develop basic atmospheric modeling concepts, obtain the necessary physical data to interpret the spacecraft observations, and develop improved scientific measurements and instrument concepts for use on spacecraft. This program concentrates on planetary atmospheres and has been particularly active in combining radiative transfer concepts with aerosol physics to obtain comprehensive planetary cloud and dust models.

SPACE APPLICATIONS 56

In 1989, a highly diversified group of scientists, engineers, and technicians will support programs in Earth and environmental observations including space, atmospheric, and stratospheric programs; and the Agency's applications satellite programs; interpret and process both spaceborne and airborne remotely sensed data; and interact with and disseminate data and associated processing techniques to the user community.

The Ames atmospheric research program is an integrated activity that blends the expertise of the Center personnel and university scientists, in the development of computer models for the atmosphere and in the measurement of atmospheric constituents and properties from aircraft platforms. Computer modeling of the atmosphere is being performed to understand the atmosphere and predict the effects of various pollutants, such as aircraft emissions and fluorocarbons, and of natural events such as the solar cycle, solar storms and volcanic eruptions. These modeling efforts make effective use of the unique computational resources at the Center. A similar program which focuses on the climatic effects of aerosol and cloud particles in the Earth's atmosphere through models of aerosols and their radiative effects and through measurements of aerosol and cloud properties from aircraft is also underway at Ames.

The Ames land processes research program uses remote observation to derive biochemical, biophysical, and climate information from leaf and plant canopy spectra. This information is then related to ecosystem productivity, evapotranspiration, nutrient cycling, and trace gas fluxes through computer modeling. The biophysical response of airborne pollutants in select ecosystems is also related to remote observation. The colorimetric properties of water bodies as indicators of alga populations are studied in relation to manganese cycling in freshwater lakes. Methane gas flux measurements from arctic and tundra ecosystems are obtained and related to remotely-sensed ecosystem variables.

Ames also conducts a continuing program of applied research and development to enhance the use of remote and in-situ sensing technology for Earth resources applications and defining, developing, and evaluating

potential future satellite sensors, data acquisition and processing techniques, and associated communications technology.

Permanent Civil
Service Workyears

AERONAUTICS AND SPACE TECHNOLOGY PROGRAMS

1.135

AERONAUTICAL RESEARCH AND TECHNOLOGY.....

937

In 1989, the program in aeronautics will be characterized in terms of three elements: generic research and technology, vehicle specific technology; e.g., high performance rotorcraft and advanced short takeoff and vertical landing (ASTOVL) aircraft, and aeronautical support to other government agencies and to industry. These three elements form a coherent and interdependent program to meet the objectives of reducing rotorcraft noise and vibration and improving the operational performance and efficiency of high performance aircraft.

The generic research and technology program is principally focused in the disciplines of fluid and thermal physics, propulsion, structures, aeromechanics, flight dynamics, guidance and control, and human factors. The program provides the fundamental disciplinary advances, both theoretical and experimental, that extend the state of the art. Substantial progress is anticipated in Ames' ability to compute the theoretical behavior of flows about aerodynamic components and full configurations and to measure experimental aircraft configuration parameters. Continued efforts will be directed toward providing advances in computational capability supporting aeronautical research. numerical aerodynamic Simulation will focus on augmenting the Nation's program in computational fluid dynamics and other areas of computational physics by developing an advanced capability that will provide modern and efficient access for users nationwide for application to computational aerodynamics, computational chemistry, and other complex analytical problems. Also, fundamental aerodynamic research will be continued using large- and small-scale research facilities and flight research vehicles to develop design methodologies for advanced aircraft. Flight research will continue for the development and validation of aircraft systems integration technology, including flight, propulsion, and aerodynamic controls. In controls and guidance, advanced control technology will focus on developing the methodology to design highly coupled, highly nonlinear control systems; evaluating and improving digital flight control system prediction tools, techniques, methodology and criteria; applying optimal control theory in conjunction with artificial intelligence to provide new concepts for automation; and conducting flight research on digital fly-by-wire concepts to continue to support the development of

advanced flight systems technology. In 1989, the human factors program will continue basic and applied research in human performance, computational models for human machine visual perception, development of advanced pilot-vehicle interface concepts for rotorcraft, transport, and high-performance aircraft, aviation safety and other crew factors affecting the safety and efficiency of aircraft operations.

The vehicle specific technology is focused on rotorcraft, and high-performance aircraft, including powered-lift. The vehicle technology emphasis at Ames relates to, and depends on, the basic capabilities and the aeronautical research disciplines described previously. The 1989 research program will include small-scale and large-scale wind tunnel testing, and ground-based simulation, and flight research. Powered-lift aircraft performance is highly dependent on high-lift technology (both propulsive and aerodynamic lift) and advanced guidance and control systems, both of which are part of the ongoing program at Ames. High-performance aircraft research requirements include the areas of high angle-of-attack performance and control, sophisticated flight and aerodynamic controls, structural, aerodynamic, flight control and propulsive system interactions, and superaugmented aircraft. In rotorcraft aerodynamics, research will be conducted to improve the understanding and prediction of rotor aerodynamics, rotor/fuselage interaction and tilting prop-rotor hover and forward flight performance. In guidance, work will be pursued to improve all-weather rotorcraft capability for terminal area operations. In the controls area, flying qualities design criteria will be developed to improve control system concepts for better performance and mission capabilities for rotorcraft. In addition, efforts will be continued to investigate the requirements for flying night, all weather, nap-of-the-earth missions with a single pilot. Research to provide major improvements in aircraft automation will be conducted through the use of artificial intelligence. In 1989, technology for next-generation rotorcraft will pursue further understanding and evaluation of high speed rotorcraft concepts.

Ames has traditionally received requests from other agencies and industry, as well as from other NASA Centers, for test support of their aircraft and systems development programs. Typically, Ames provides 8,000 to 9,000 hours per year of wind tunnel occupancy time in support of both commercial and military aircraft development, as well as support for large NASA projects, such as the Space Shuttle. The research and Technology Directorate of the U.S. Army Aviation Systems Command is located at Ames. The Aeroflightdynamics Directorate, the primary investigator of Army rotorcraft flight dynamics and controls, and aeromechanics, is also located at Ames, working both on independent research and development projects and with a staff integrated into the NASA organization on projects of joint interest. Extensive use is made of Ames aeronautical research facilities in these efforts.

There are also a large number of joint programs with the Air Force Systems Command, the Naval Air Systems Command, and the Defense Advanced Research Projects Agency (DARPA). Examples of these joint efforts include: (1) V/STOL and STOVL fighter studies, V-22 support, LHX support and an AV-8B flight test program with the Navy; (2) participation in the joint NASA/DARPA/USAF X-29A forward swept wing demonstration programs; (3) US/UK research program on ASTOVL Aircraft Technology; (4) continued participation in the joint NASA/USAF Advanced Fighter Technology Integration program for research and development of a mission adaptive wing that will obtain smooth in-flight contour changes to the wing aerodynamic shape to achieve improved aerodynamic efficiency in the F-111 and demonstration of the benefits of integration of the flight and free control systems on the F-16; and (5) work on digital flight control system verification and validation with the FAA. Advanced structural, aerodynamic, propulsion, and control concepts will be investigated. In conjunction with DARPA, flight investigation of the X-wing rotor system will be conducted, utilizing the Rotor Systems Research Aircraft.

Permanent Civil
Service Workyears

SPACE RESEARCH AND TECHNOLOGY.....

154

In 1989, civil service personnel will provide support to/for a space research and technology program which encompasses both basic research and project support. The basic research focuses on entry technology and materials research, with germinal effort in artificial intelligence emphasizing advanced, knowledge-based systems methodologies for expert systems applications. The project work supports Space Shuttle, the Orbiter Experiments program, the Galileo Probe, and advanced work related to technology definition of a Space Station. The ARC Space R&T program includes activities of the civil space technology initiative (CSTI) in the areas of robotics, autonomous systems, science sensor technology and the airoassist flight experiment. ARC involvement in the Pathfinder program will include support to transfer vehicle technology and humans-in-space technology.

The entry technology research will provide aerothermodynamic data required for the design, development, and verification of planetary entry vehicles and aero-assisted orbital transfer vehicles (AOTV), and for computational fluid dynamic codes to predict space vehicle flow fields and performance. Work is proceeding to apply laser physics and nonintrusive laser techniques to the development of flow diagnostic tools that will be used to probe gas dynamic flows which will in turn be used to define and verify turbulence models. Research efforts in the materials area will provide advanced thermal protection systems concepts and materials for heat shields to protect Earth and planetary entry vehicles (probes) and AOTV's and will develop computational chemistry codes to calculate basic properties of matter and expand the understanding

of surface environment interactions (corrosion). Research is also being conducted in the advanced electronics and materials areas to determine atomic structure and properties of absorbed surface layers and to advance the state of the art of computing wave functions for molecules and atomic clusters. Research in artificial intelligence (AI) will focus on technology developments for autonomous intelligent systems and will include spaceborne symbolic processing architectures, information understanding and extraction, software tools for development of knowledge-based systems, machine learning, and validation methodologies. The AI research will be directed towards the demonstration of a major System Autonomy Demonstration Project (SADP) in 1989, the Thermal Control System for the Space Station, a joint NASA ARC/JSC collaborative effort.

In 1989, the Space Shuttle program will be supported with ground-based facilities to study a variety of aerodynamic and thermodynamic problems. The Galileo project will be supported with heat shield design and performance data, heat shield shape change effects on aerodynamics, and subsonic probe stability. Ground-based facilities will also simulate AOTV heating environments and debris-impact on space station components. In the area of orbiting astronomical instruments, work will continue to develop infrared detectors, define systems for precision pointing and control of telescopes, and advance the technology required to cool detectors to very low temperatures. Ames is supporting Space Shuttle orbiter experiments to study advanced materials and evaluate possible cost and weight reduction for the thermal protection system for Shuttle and advanced space transportation systems.

Ames work will be directed primarily toward developing and conducting selected Space Shuttle experiments and performing disciplinary research in the high temperature space structures technology area. The Shuttle experiments include: continuation of simulation studies to assist in analysis and solution of various problems that exist in certain flight profile areas between entry and landing, and evaluation of the performance of the Shuttle Entry Air Data System; in-flight evaluation of the effects of rain on thermal protection system tiles; studies to evaluate adequacy and provide a basis for improving Shuttle handling qualities criteria; and application of modified maximum likelihood parameter estimation methods for determination of digital flight control systems, stability and control, performance, and structural and atmospheric turbulence characteristics in the Shuttle reentry environment.

High temperature space structures disciplinary research will involve analyses and laboratory tests of medium-sized specimens to evaluate predictive techniques for thermal structures. Also, airloads data will be obtained from calibrated strain gauges on the orbiter and compared with wind tunnel and theoretical predictions to evaluate flight measurement techniques and analytical methods.

The infrared astronomy program is technologically supported in three primary areas: IR detector research, cryogenics, and optics. This technology research is developing techniques for measuring infrared sensitivity and bandwidth to provide much enhanced data for scientific research. Specific work consists of developing detector arrays and electronics, lightweight mirrors and optics, structures, and cryogenic systems including replenishable systems.

The Space Human Factors program will continue basic and applied research in space human factors to ensure high levels of productivity and operational safety for future space missions. Applications of understanding and specific results arising from these research activities will be focused on human-system problems in space missions. Other space activities include development of advanced extravehicular activity systems and research on space habitat and operational systems designs.

Permanent Civil
Service Workyears

TRANSATMOSPHERIC RESEARCH AND TECHNOLOGY..... 44

Transatmospheric Research and Technology activities at ARC focus on two major areas. The first area emphasizes the special capabilities and expertise in hypersonic and computational facilities at Ames Research Center for the conduct of extremely high Mach number tests and analysis of both wind tunnel and flight data. The strength of the computational methods using the Class VI and the Numerical Aerodynamic Simulation computers, combined with the advanced materials activities, provides unique capabilities to design and tailor lightweight, high-temperature structures, instrumentation, data acquisition systems, and a range of capabilities necessary for future potential flight testing of a hypersonic/transatmospheric research vehicle over the required range of speed, altitude and envelope conditions will be developed at the Ames Research Center. These capabilities are being applied to the maturation of specific technologies required for the National Aero-Space Plane Program.

COMMERCIAL PROGRAMS..... 4

The objective of the Commercial Use of Space program is to increase private sector awareness of space opportunities and encourage increased industry investment and participation in high technology space-based research applications and development. This effort establishes an organizational focal point specifically intended to foster commercial use of and access to space.

The technology utilization program serves to transfer knowledge developed through the NASA programs into industry for effective use in the marketplace.

TRACKING AND DATA PROGRAMS..... 24

In 1989, Dryden will maintain and operate the NASA Western Aeronautical Test Range, which provides direct operational support for a wide variety of aeronautical and aerospace programs including support of the Space Shuttle missions. During real-time mission support operations, the various functional elements such as radar, tracking and data processing, communications, airborne video acquisition, and telemetry data processing all function in an integrated manner in the range Mission Control Centers to provide real-time control, monitoring, processing and command uplink capabilities. Post-mission processing support is also provided.

Permanent Civil
Service Workyears

CENTER MANAGEMENT AND OPERATIONS SUPPORT 507

Center Management and Operations provides support or services to all Ames organizations which cannot be identified exclusively to a single program or project. The civil service personnel involved are as follows:

Director and Staff - The Center Director, Deputy Director, Associate Director, and the immediate staff; e.g., Chief Counsel, Patent Counsel, Equal Opportunity, Public Affairs, Comptroller and the Chief Engineer.

Management Support - Provides information and control services supporting **all** levels of Center management, both program and functional. Specific functions include financial management, contracting and procurement, property management, and personnel management.

Operations Support - Provides for the operation and maintenance of institutional facilities, buildings, systems, and equipment, and technical services such as administrative automatic data processing, library and information services.

SUMMARY OF RESOURCES REQUIREMENTS

Funding Plan by Function

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
I. Personnel and Related Costs.....	100,407	106,863	100,785	108,006
11. Travel.....	3,331	3,915	3,884	4,335
III. Operation of Installation	29,880	58,899	63,325	67,057
A. Facilities Services	(16,879)	(22,572)	(26,526)	(31,161)
B. Technical Services	(5,134)	(14,809)	(15,022)	(16,660)
C. Management and Operations	<u>17,867</u>	<u>(21,518)</u>	<u>(21,777)</u>	<u>(19,236)</u>
Total, fund requirements	<u>133,618</u>	<u>169,677</u>	<u>167,994</u>	<u>179,398</u>

REQUIREMENTS BY FUNCTION

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	<u>Budget Estimate</u>
I. <u>PERSONNEL AND RELATED COSTS</u>	<u>100.407</u>	<u>106.863</u>	<u>100.785</u>	<u>108.006</u>

Summary of Fund Requirements

A. Compensation and Benefits

1. Compensation

a. Full-time permanent.....	82.354	83.786	82.214	87.836
b. Other than full-time permanent.....	2.118	2.247	2.094	2.130
c. Reimbursable detailees.....	348	599	521	784
d. Overtime and other compensation.....	<u>1.788</u>	<u>1.705</u>	<u>1.734</u>	<u>1.757</u>

Subtotal. Compensation..... 86.608 88.337 86.563 92.507

2. Benefits 11.765 16.538 12.171 13.365

Subtotal. Compensation and Benefits..... 98.373 104.875 98.734 105.872

B. Supporting Costs

1. Transfer of personnel	464	357	420	437
2. Personnel training	<u>1.570</u>	<u>1.631</u>	<u>1.631</u>	<u>1.697</u>

Subtotal. Supporting Costs..... 2.034 1.988 2.051 2.134

Total. Personnel and Related Costs 100,407 106.863 100.785 108.006

	<u>Explanation of Fund Requirements</u>			
	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u> (Thousands of Dollars)	<u>Current</u> <u>Estimate</u>	
A. <u>Compensation and Benefits</u>	<u>98,373</u>	<u>104,875</u>	98,734	<u>105,872</u>
1. <u>Compensation</u>	<u>86,608</u>	<u>88,337</u>	86,563	<u>92,507</u>
a. Full-time permanent workyears.....	82,354	83,786	82,214	87,836

The decrease from the 1988 revised estimate to the 1988 current estimate is due to the 1988 pay raises, and ARC's share of the \$42.0 million general reduction needed to reach 1988 authorized levels.

Basis of Cost for Permanent Workyears

In 1989, the cost of permanent workyears will be \$87,836.000 The increase from 1988 is calculated as follows:

Cost of full-time permanent workyears in 1988.....	82,214
Cost Increases in 1989	7,272
Restoration of 1988 general reduction.....	3,771
Within grade and career development advances:	
Full year cost of 1988 increases.....	1,574
Partial year cost of 1989 actions.....	1,457
Full year cost of the 1988 pay raises.....	470
Cost Decreases in 1989.....	-1,650
Full year effect of 1988 turnover actions.....	-500
Partial year effect of 1989 turnover actions.....	-508
Two less paid days.....	-642
Cost of full-time permanent workyears in 1989.....	<u>87,836</u>

	1987	1988		1988
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
b. Other than full-time permanent				
1. cost	2,118	2,247	2,094	2,130
2. Workyears.....	119	128	119	119

The distribution of 1989 workyears is as follows

Distribution of Other Than Full-Time Permanent Workyears

<u>Program</u>	<u>Workyears</u>
Development programs	47
Summer employment program.....	1
Youth opportunity programs	43
Other temporary.....	<u>28</u>
 Total	 <u>119</u>

The net reduction from the 1988 revised budget estimate to the 1988 current estimate is due to an adjustment between permanent and other FTE's. The 1989 estimate increase is due to the full year effect of 1988 pay raises.

c. Reimbursable detailees.....	348	599	521	784
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The military personnel detailed to Ames on a reimbursable basis are individuals experienced in aeronautics, rotorcraft technology, veterinary medicine, and related fields. The net decrease in 1988 reflects the actual number of detailees. The increase in 1989 reflects an increase in the number of technical military detailees planned.

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
d. Overtime and other compensation.....	1,788	1,705	1,734	1,757

Overtime and other compensation includes overtime, holiday pay, incentive awards, Sunday premium pay, and night work differential. The use of overtime and other compensation is primarily for off-peak operation of major facilities such as the Unitary Plan Wind Tunnel System, 40 X 80 X 120 foot Wind Tunnel, and the 6-by-6 foot Supersonic Wind Tunnel, and preparation for test flights. The increase from 1988 to 1989 reflects the full year effect of 1988 pay raises.

2. <u>Benefits</u>	<u>11.765</u>	<u>16.538</u>	<u>12.171</u>	<u>13.365</u>
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The following are the amounts of contributions by category:

Retirement Fund.....	6,806	11,421	6,504	7,333
Employee Life Insurance.....	160	182	173	179
Employee Health Insurance.....	2,167	2,117	2,246	2,325
Workmen's Compensation.....	767	624	667	670
FICA.....	925	1,220	1,604	1,848
Medicare.....	<u>940</u>	<u>974</u>	<u>977</u>	<u>1,010</u>
Total.....	<u>11.765</u>	<u>16.538</u>	<u>12.171</u>	<u>13.365</u>

The decrease from the 1988 revised budget to the 1988 current estimate reflects the actual number of employees switching from the civil service retirement system to the new Federal Retirement System and the concomitant retirement changes related to the reduction in permanent compensation for the \$42.0 million general reductions. The 1989 increase reflects the full year effect of 1988 pay raises.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		Revised <u>Estimate</u>	Current <u>Estimate</u>	
		(Thousands of Dollars)		
B. <u>Supporting Costs</u>	<u>2,034</u>	<u>1,988</u>	<u>2,051</u>	<u>2,134</u>
1. Transfer of personnel.....	464	357	420	437

The increase from 1988 revised estimate to 1988 current estimate reflects costs based on 1987 actuals. The 1989 estimate reflects the same level as 1988.

2. Personnel training.....	1,570	1,631	1,631	1,697
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The purpose of the training program is to continue the development and education of civil service employees to support Ames' roles and missions more efficiently. Increases in the 1989 estimates reflect expected rate increases.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u>	<u>Current</u> <u>Estimate</u>	
		(Thousands of Dollars)		
11. TRAVEL	<u>3,331</u>	<u>3,915</u>	<u>3,884</u>	<u>4,335</u>
<u>Summary of Fund Requirements</u>				
A. Program Travel.....	2,010	2,609	2,667	3,004
B. Scientific and Technical Development Travel.....	580	693	604	628
C. Management and Operations Travel.....	<u>741</u>	<u>613</u>	<u>613</u>	<u>703</u>
Total, Travel.....	<u>3,331</u>	<u>3,915</u>	<u>3,884</u>	<u>4,335</u>
<u>Explanation of Fund Requirements</u>				
A. <u>Program Travel</u>	<u>2,010</u>	<u>2,609</u>	<u>2,667</u>	<u>3,004</u>

Program travel is required for the accomplishment of the Center's missions and accounts for 69 percent of travel costs in 1989. Travel for program purposes is required for the continual monitoring and management efforts in space research, aeronautical research and technology, flight simulation, fluid mechanics, airborne research and applications, space life sciences, space station, flight test techniques, flight measurements, guidance and flight control, and flight measurement development activities. The increase from the 1988 revised estimate to the 1988 current estimate is due to a change of program requirements. The 1989 estimate reflects an increase in the Aeronautics and Life Sciences programs and in the number of high altitude mission deployments.

	1987 <u>Actual</u>	1988		1989
		Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
B. <u>Scientific and Technical Development Travel</u>	<u>580</u>	<u>693</u>	<u>604</u>	<u>628</u>

(Thousands of Dollars)

Scientific and technical development travel permits employees to participate in meetings and technical seminars with other representatives of the scientific and aerospace community. This participation allows personnel to benefit from exposure to technological advances outside Ames as well as to present both accomplishments and problems to associates. Many such meetings are working panels convened to solve certain problems for the benefit of the Government. The decrease from the 1988 revised estimate to the 1988 current estimate reflects 1987 experience. The increase in the 1989 budget estimate from the 1988 current estimate reflects expected rate increases.

C. <u>Management and Operations Travel</u>	<u>741</u>	<u>613</u>	<u>613</u>	<u>703</u>
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Management and operations travel provides for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management and procurement; travel of the Center's top management to NASA Headquarters, other NASA Centers, and contractor plants; and local transportation. The increase from the 1988 current estimate to the 1989 budget estimate reflects expected rate increases.

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
III. OPERATION OF INSTALLATION.....	<u>29.880</u>	<u>58.899</u>	<u>63.325</u>	<u>67.057</u>

(Thousands of Dollars)

Summary of Fund Requirements

A. Facilities Services.....	16,879	22,572	26,526	31,161
B. Technical Services.....	5,134	14,809	15,022	16,660
C. Management and Operations.....	<u>7.867</u>	<u>21.518</u>	<u>21.777</u>	<u>19.236</u>
Total, Operation of Installation.....	<u>29.880</u>	<u>58.899</u>	<u>63.325</u>	<u>67.057</u>

Explanation of Fund Requirements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the center's institutional activities. These are divided into three major functional areas: Facilities Services, the cost of maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; Technical Services, the cost of automatic data processing for management activities, and the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations, the cost of administrative communications, printing, transportation, medical, supply, and related services.

The increase from the 1988 revised estimate to the 1988 current estimate is primarily due to increased electricity rates due to the termination of the diversity agreement with Western Area Power Administration and increased consumption. The 1989 estimate provides for full year funding of support contractor costs and expected rate increases in the support contractor and utility areas. Utility consumption will increase with planned wind tunnel activity and small increases in support contracts are planned in the maintenance, janitorial, and medical services areas.

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	<u>Budget Estimate</u>
A. <u>FACILITIES SERVICES</u>	<u>16.879</u>	<u>22.572</u>	<u>26.526</u>	<u>31.161</u>

Ames-Moffett includes 11 major technical facilities within its 2.3 million square feet of buildings and structures. This physical plant supports an average daily on-site population of about 2,900 personnel. The physical plant at Dryden houses an average daily on-site population of about 1,200 personnel. At both locations, many of the test facilities operate on schedules involving more than one shift, i.e., during off-peak hours.

The increase from the 1988 revised estimate to the 1988 current estimate is due to the anticipated higher electricity rates. The 1989 estimate provides for increased utility rates and consumption as well as an increase in support contractor rates.

Summary of Fund Requirements

1. <u>Rental of Real Property</u>	0	91	70	73
2. <u>Maintenance and Related Services</u>	<u>3.168</u>	<u>5.535</u>	<u>6.088</u>	<u>5.334</u>
3. <u>Custodial Services</u>	<u>4.822</u>	<u>5.326</u>	<u>5.568</u>	<u>7.128</u>
4. <u>Utility Services</u>	<u>8.889</u>	<u>11.620</u>	<u>14.800</u>	<u>18.626</u>
Total, Facilities Services	<u>16.879</u>	<u>22.572</u>	<u>26.526</u>	<u>31.161</u>

Explanation of Fund Requirements

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
1. <u>Rental of Real Property</u>	0	91	70	73

At Dryden, this item provides for the rental of trailers to provide office, shop, laboratory, and storage space in support of the Space Shuttle program. The decrease from 1988 revised estimate to the 1988 current estimate is due to the purchase of trailers. The 1989 estimate provides for the same level as 1988.

2. <u>Maintenance and Related Services</u>	3,168	5,535	6,088	5,334
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Maintenance and repair includes the maintenance of grounds and repairs of heating, ventilating, and lighting equipment in institutional buildings and offices. Maintenance of grounds includes maintenance of approximately 30 acres of improved planted areas and associated pest control; maintenance of approximately 45 acres of unimproved areas such as substations, aircraft taxiways, drainage ditches, large fields and roadway shoulders within these areas; and vacuum sweeping approximately 42 acres of streets, parking lots, and aircraft ramp, taxiway and V/STOL areas. The increase from the 1988 revised estimate to the 1988 current estimate reflects preparation for one time equipment installation and higher than anticipated contractor rates. The decrease from the 1988 current estimate to the 1989 budget estimate reflects a return to prior level of effort.

3. <u>Custodial Services</u>	4,822	5,326	5,568	7,128
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Janitorial and building cleaning services are associated with approximately three million square feet of various types of space located in 231 buildings and structures, and in trailers which provide temporary office and shop space. Security services are for buildings and property, including research aircraft and computer facilities, and "round-the-clock" staffing of a duty office which monitors and coordinates fire protection, security, and safety functions at the Center. Other services include pest control, refuse collection, laundry and custodial supplies. These services are provided by support contractors. The increase from the 1988 revised estimate to the 1988 current estimate reflects higher than expected support

contractor rates. The increase in 1989 budget estimate is due to expected contractor escalation increases, additional janitorial workyears to support new facilities, and provision of Nation Resource Protection security for the Space Shuttle at Dryden.

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised	Current	Budget
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
4. Utility Services.....	<u>8.889</u>	<u>11,620</u>	<u>14,800</u>	<u>18.626</u>

The major utility service is electricity; the balance is natural gas, fuel oil, water, and sewage services. At Ames-Moffett, electricity is provided by the U. S. Bureau of Reclamation's Central Valley Project, marketed by the Western Area Power Administration (WAPA) of the Department of Energy, and the Pacific Gas and Electric Company (PG&E); natural gas is provided by PG&E; water by the U. S. Naval Air Station Moffett Field; and sewage by the City of Mountain View.

Research facilities are the largest consumers of electric power at Ames-Moffett. High users include the Unitary Plan Wind Tunnel system, the 40x80x120 foot Wind Tunnel, the 14-foot Transonic Wind Tunnel, and the operation of simulators and smaller wind tunnels. Approximately 55 percent of the natural gas is used in research facilities; the other part is used for heating and ventilation of institutional buildings. Ames-Moffett accounts for 95 percent of the overall utility energy usage. At Dryden, electricity is purchased through Air Force contracts with regional utility companies and estimates are based on Air Force projections. Natural gas is purchased from Pacific Gas and Electric. Other commodities include fuel oil, water, and sewage services.

The increase between the 1988 revised estimate and the 1988 current estimates is mainly attributable to increased consumption due to the 40x80x120 foot wind tunnel becoming operational and higher rates following termination of the diversity agreement between WAPA and Ames. The increase from the 1988 current estimate to the 1989 budget estimate reflects full utilization of the wind tunnels and a full year projection of increased rates due to the diversity agreement being terminated.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u> (Thousands of Dollars)	<u>Current</u> <u>Estimate</u>	
B. <u>TECHNICAL SERVICES</u>	<u>5.134</u>	<u>14,809</u>	<u>15.022</u>	<u>16.660</u>

Summary of Fund Requirements

1. <u>Automatic Data Processing</u>	<u>3.589</u>	<u>7.422</u>	<u>7.550</u>	<u>8.150</u>
2. <u>Scientific and Technical Information</u>	<u>677</u>	<u>3.384</u>	<u>3.456</u>	<u>4.169</u>
3. <u>Support Services</u>	<u>868</u>	<u>4.003</u>	<u>4.016</u>	<u>4.341</u>
Total, Technical Services.....	<u>5.134</u>	<u>14,809</u>	<u>15.022</u>	<u>16.660</u>

Explanation of Fund Requirements

1. <u>Automatic Data Processing</u>	<u>3.589</u>	<u>7.422</u>	<u>7.550</u>	<u>8.150</u>
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This category includes the central administrative ADP facility equipment and operating costs. The increase from the 1988 revised estimate to the 1988 current estimate is due primarily to rephasing of a planned financial management recoding, offset by deferral of mainframe upgrades. The 1989 increase provides for continued support to the recoding effort and the mainframe upgrade and for anticipated support contractor rate increases.

2. <u>Scientific and Technical Information</u>	<u>677</u>	<u>3.384</u>	<u>3.456</u>	<u>4.169</u>
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This category provides for the purchase of **books**, supplies, and materials for the operation of the Ames' libraries. Also included is a support contract to perform public information services, media development, and education programs. The 1988 current estimate increase reflects slightly higher support contractor rates. The 1989 estimate reflects a higher level of support related to Shuttle landings.

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
3. <u>Support Services</u>	868	4,003	4,016	4,341

This category includes photo and graphics, and audiovisual services primarily supporting the public affairs activity. The increase from the 1988 current estimate to the 1989 budget estimate reflect contractor cost escalation and the purchase of audio visual equipment.

C. <u>MANAGEMENT AND OPERATIONS</u>	<u>7,867</u>	<u>21,518</u>	<u>21,777</u>	<u>19,236</u>
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Summary of Fund Reauirements

1. <u>Administrative Communications</u>	2,777	9,770	10,396	5,092
2. <u>Printing and Reproduction</u>	139	1,821	1,818	1,945
3. <u>Transportation</u>	754	1,606	1,480	1,677
4. <u>Installation Common Services</u>	<u>4,197</u>	<u>8,321</u>	<u>8,083</u>	<u>10,522</u>
Total, Management and Operations.....	<u>7,867</u>	<u>21,518</u>	<u>21,777</u>	<u>19,236</u>

Explanation of Fund Requirements

1. <u>Administrative Communications</u>	<u>2,777</u>	<u>9,770</u>	<u>10,396</u>	<u>5,092</u>
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Communications services are provided by the General Services Administration for the Federal Telecommunications Service, and the Pacific Telephone and Telegraph Company and the General Telephone and Telegraph Company for local services at Ames-Moffett and Dryden, respectively. Other communications consist of teletype equipment and services provided by Western Union, the lease of switchboard equipment, and a support contract for communications services. The increase from the 1988 revised estimate to the

1988 current estimate provides communications services for Dryden's Integrated Test Facility and rate increases. The 1989 estimate reflects the same level of service at anticipated rates following a major upgrade of telecommunications facilities at Ames-Moffett in 1988.

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	<u>Budget Estimate</u>
2. <u>Printing and Reproduction</u>	<u>139</u>	<u>1.821</u>	<u>1.818</u>	<u>1.945</u>

The estimate for administrative printing includes the operating costs of the printing and reproduction facility as well as supplies, materials, and equipment. All common processes of duplication, including photostating, blueprinting and microfilming are included. The 1989 estimate provides the same level of service as 1988 with expected rate increases.

3. <u>Transportation</u>	<u>754</u>	<u>1.606</u>	<u>1.480</u>	<u>1.677</u>
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The estimates include motor pool operation costs for NASA-owned and GSA-owned vehicles, Government bills of lading, and air freight costs. The decrease from the 1988 revised estimate to the 1988 current estimate reflects a decrease in contractor rates coupled with the savings from deferred vehicle purchases. The 1989 estimate provides the same level of service as in 1988, at anticipated support contractor rates and with purchase of deferred vehicles.

4. <u>Installation Common Services</u>	<u>4.197</u>	<u>8.321</u>	<u>8.083</u>	<u>10.522</u>
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These services include support to center management and staff activities, medical services, and installation support activities. For example, this category includes those supplies, materials and services in support of Center management functions such as personnel, procurement, and financial management. Medical services include the staffing of the health units, laboratory service fees, clinic supplies, and maintenance of clinic equipment. Installation support services provide contractor support for supply and property management, mail, pickup and delivery services, and postage. The decrease from 1988 revised estimate to the 1988 current estimate is due to deferred purchases. The increase in 1989 provides for restored purchase levels, anticipated support contractor rate increases, and additional support contract workyears to improve the level of medical services.

STAFFING SUMMARY		
SES	88	82
GS/GM 16	35	36
GS/GM 15	182	183
GS/GM 14	3111	3209
OTHER GS/GM	1197	1194
WAGE	341	341
TOTAL	2674	2674

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AMES RESEARCH CENTER
 ORGANIZATION AND STAFFING CHART

OFFICE OF THE DIRECTOR		
SES		
GS/GM 15		
GS/GM 14		
OTHER GS/GM	12	12
WAGE		
TOTAL	20	20

EQUAL OPPORTUNITY PROGRAMS OFFICE		OFFICE OF THE CHIEF ENGINEER		ADV. TECHNOLOGY & SPACE STATION PLANNING OFFICE		OFFICE OF THE COMPTROLLER		OFFICE OF THE PATENT COUNSEL		OFFICE OF THE CHIEF COUNSEL		EXTERNAL AFFAIRS OFFICE	
SES	88 82	SES	0 0	SES	0 0	SES	1 1	SES	0 0	SES	0 0	SES	1 1
GS/GM 16	0 0	GS/GM 16	0 0	GS/GM 16	0 0	GS/GM 16	0 0	GS/GM 16	0 0	GS/GM 16	0 0	GS/GM 16	0 0
GS/GM 15	0 0	GS/GM 15	2 2	GS/GM 15	3 3	GS/GM 15	3 3	GS/GM 15	1 1	GS/GM 15	2 2	GS/GM 15	0 0
GS/GM 14	1 1	GS/GM 14	4 4	GS/GM 14	1 1	GS/GM 14	3 3	GS/GM 14	0 0	GS/GM 14	1 1	GS/GM 14	4 4
OTHER GS/GM	3 3	OTHER GS/GM	15 15	OTHER GS/GM	0 0	OTHER	60 60	OTHER GS/GM	1 1	OTHEROYGM	2 2	OTHER GS/GM	9 5
WAGE	0 0	WAGE	0 0	WAGE	0 0	WAGE	0 0	WAGE	0 0	WAGE	0 0	WAGE	0 0
TOTAL	4 4	TOTAL	21 21	TOTAL	4 4	TOTN	67 67	TOTAL	2 2	TOTN	5 5	TOTAL	14 14

DIRECTOR OF ADMINISTRATION		DIRECTOR OF ENGINEERING AND TECHNICAL SERVICES		DIRECTOR OF AEROSPACE SYSTEMS		DIRECTOR OF FLIGHT OPERATIONS AND RESEARCH		DIRECTOR OF AEROPHYSICS		DIRECTOR OF SPACE RESEARCH	
SES	1 1	SES	2 2	SES	2 2	SES	1 1	SES	1 1	SES	2 2
GS/GM 16	0 0	GS/GM 16	0 0	GS/GM 16	0 0	GS/GM 16	0 0	GS/GM 16	0 0	GS/GM 16	0 0
GS/GM 15	1 1	GS/GM 15	1 1	GS/GM 15	1 1	GS/GM 15	3 3	GS/GM 15	2 2	GS/GM 15	3 3
GS/GM 14	1 1	GS/GM 14	1 1	GS/GM 14	1 1	GS/GM 14	1 1	GS/GM 14	2 2	GS/GM 14	2 2
OTHER GS/GM	3 3	OTHER GS/GM	2 2	OTHER GS/GM	3 3	OTHER GS/GM	4 4	OTHER GS/GM	3 3	OTHER GS/GM	7 7
WAGE	0 0	WAGE	0 0	WAGE	0 0	WAGE	0 0	WAGE	0 0	WAGE	0 0
TOTAL	6 6	TOTAL	6 6	TOTAL	7 7	TOTAL	9 9	TOTAL	8 9	TOTAL	14 14

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LANGLEY
RESEARCH CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1989 ESTIMATE

LANGLEY RESEARCH CENTER

DESCRIPTION

The Langley Research Center (LaRC), located at Hampton, Virginia, was established in 1917. It is situated between Norfolk and Williamsburg, Virginia, in the Tidewater area of Hampton Roads. The Center utilizes 807 acres of Government-owned land, divided into two areas by the runway facilities of Langley Air Force Base. Runways, some utilities, and certain other facilities are used jointly by NASA and the Air Force. Under a permit from the Department of Interior, Langley has access to 3,276 acres. The total capital investment of the Langley Research Center, including fixed assets in progress and contractor-held facilities at various locations, as of September 30, 1987, was \$763,876,000.

CENTER ROLES AND MISSIONS

Langley continues to play a leading role in the development of aeronautics and space technology. Technical excellence in specified research areas is attributed to the quality and capability of the civil service staff and to the availability of unique aeronautical and space facilities. The principal and supporting roles are:

PRINCIPAL

Transport Aircraft Technology - develop a technology base for improving transport aircraft as a cost effective, safe, and environmentally compatible transportation mode.

General Aviation and Commuter Aircraft Technology - develop and maintain an engineering technology base related to improving general aviation and commuter aircraft.

Aero-Space Plane Technology - combine aeronautics and space disciplines to provide the technology to enable vehicles capable of airbreathing flight from Earth to orbit.

High-speed, Highly Maneuverable Aircraft Technology - conduct advanced disciplinary research applicable to military aircraft and missiles.

Fundamental Aerodynamics - advance the general state-of-the-art, both theoretical and experimental.

Acoustics - conduct research and develop a technology base related to reducing interior and exterior aircraft noise and acoustic structural loads.

Aero-Space Vehicle Structures and Materials - advance materials and structures technology base to achieve high performance aircraft and spacecraft systems.

Guidance and Control Technology - develop a technology base related to improving aircraft and spacecraft control and guidance systems.

Advanced Space Vehicle Configuration Technology - develop technology for future space transportation systems, including Earth-to-orbit launch vehicles, aeroassisted orbit transfer and planetary exploration concepts, transatmospheric vehicles, and maneuvering reentry vehicles.

Advanced Space Systems Technology - develop a technology base and systems analysis capability for advanced spacecraft, large space systems, Space Station system trade studies, and manned Mars and lunar base missions.

Sensor and Data Acquisition Technology - develop a technology base for sensors and data acquisition devices.

Technology Experiments in Space - define and develop space technology experiments in support of Langley roles including materials, structures, control and dynamics of large space structures, large space antenna systems, remote sensing atmospheric sciences, and advanced transportation systems.

Atmospheric Sciences Technology - develop improved techniques for atmospheric sensing. Includes research, experiment development/management, data analysis, and principal investigator management and specialized ground/aircraft investigations, This also includes development of Shuttle payloads and instruments for free fliers related to atmospheric sensing.

Upper Atmospheric Research - provide mission analysis, sensor development, data interpretation, principal investigator management, and utilization for remote sensing contributing to model development.

Hypersonic Propulsion Systems - contribute to the technology base of airbreathing propulsion systems by advancing the state-of-the-art of hypersonic propulsion.

Space Station - Ensure Space Station design flexibility for evolution and conduct the planning and analyses needed to establish direction and content of the evolutionary Space Station program (including advanced technology requirements).

SUPPORTING

Rotorcraft Technology - contribute to the development of the technology base to advance rotorcraft performance with emphasis on structures, aeroelasticity, acoustics, and avionics components.

Computational Fluid Dynamics - contribute to the software technology base; improve the capability to compute the flow about vehicles at entry velocities to permit accurate assessments of aerodynamic performance and heat shield requirements.

Launch Vehicle Procurement - management and operation of the existing Scout launch vehicle system for Government and commercial users.

DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM
LANGLEY RESEARCH CENTER

	1987 ACTUAL	1988		1989 BUDGET ESTIMATE
		REVISED ESTIMATE	CURRENT ESTIMATE	
SPACE STATION.....	74	79	44	44
SPACE FLIGHT PROGRAMS.....	39	39	27	27
SPACE TRANSPORTATION CAPABILITY DEV.	9	16	7	10
SPACE SHUTTLE	30	23	20	17
SPACE SCIENCE AND APPLICATIONS.....	228	195	180	180
PHYSICS AND ASTRONOMY.....	8	8	0	0
LIFE SCIENCES.....	3	11	4	4
SPACE APPLICATIONS.....	217	176	176	176
AERONAUTICS AND SPACE TECHNOLOGY.....	1,769	1,846	1,906	1,906
AERONAUTICAL RESEARCH AND TECHNOLOGY	1,167	1,251	1,216	1,216
SPACE RESEARCH AND TECHNOLOGY.....	515	478	563	563
TRANSATMOSPHERIC RESEARCH & TECH....	87	117	127	127
COMMERCIAL PROGRAMS.....	13	10	12	12
SUBTOTAL DIRECT.....	2,123	2,169	2,169	2,169
CENTER MANAGEMENT AND OPERATIONS.....	686	643	643	643
SUBTOTAL (FULL-TIME PERMANENTS).....	2,809	2,812	2,812	2,812
OTHER CONTROLLED FTE'S..... (PMI's/CO-OPS/OTFTP's)	100	99	99	99
GRAND TOTAL (FULL-TIME EQUIVALENTS)	2,909	2,911	2,911	2,911

PROGRAM DESCRIPTION

Permanent Civil
Service Workyears

RESEARCH AND DEVELOPMENT

SPACE STATION **44**

Space Station efforts will directly support the Space Station Program by performing studies and analyses to assure the future capability of the Station through evolution and growth. Langley will be responsible for representing the research, technology, and engineering experiments to the program and systems engineering and integration support. Langley is responsible for assessing Space Station Crew Emergency Return Vehicle concepts with a lift capability and moderate performance that will minimize entry loads and allow it to land horizontally. Conceptual design studies will be conducted and experimental aerodynamic data will be obtained and analyzed.

SPACE FLIGHT PROGRAMS

SPACE TRANSPORTATION CAPABILITY DEVELOPMENT..... **27**

Langley has the lead Center focus for Shuttle II studies which provides the Agency long-range planning for a second generation Space Shuttle anticipated after the year 2000. Langley in-house studies of a range of potential concepts, technology levels, and mission requirements are coordinated with complimentary studies at Johnson Space Center, Marshall Space Flight Center, and Kennedy Space Center.

SPACE SHUTTLE (SPACE TRANSPORTATION OPERATIONS) **17**

The expendable launch vehicle program at Langley provides centralized procurement of the Scout launch vehicle. In 1989, civil service personnel will support a program which includes the procurement of launch vehicle hardware, launch services, engineering, and maintenance. Launches under this program will be conducted from sites located at the Western Space and Missile Center in California, Wallops Flight Facility in Virginia, and San Marco Equatorial Range, Kenya, Africa.

SPACE SCIENCE AND APPLICATIONS **180**

LIFE SCIENCES **4**

The space radiation effects and protection program at Langley supports existing and future manned space efforts including Space Station, lunar bases, and planetary exploration. Comprehensive studies of the physical interactions and transport of space radiation (proton, electrons, and galactic heavy ions) with matter will result in generating models that will be used to design advanced spacecraft and astronaut personal shielding and in addition to more accurate assessments of astronaut radiation exposures and body shielding factors. The objective of this work is to develop a space radiation protection handbook for future manned spaceflight.

SPACE APPLICATIONS 176

The space applications program at Langley provides a national research capability for understanding the environment and for developing related atmospheric sensing systems and techniques. The Center's technical expertise is widely recognized in the areas of remote sensing of the Earth's atmospheric trace species and of theoretical and empirical atmospheric modeling. In the area of upper atmospheric research, Langley civil service personnel will continue to study the Earth's atmosphere to assess any changes caused by man and to determine whether or not there is any associated change in the chemical composition of the stratosphere that would change the transmission of solar ultra violet radiation to the Earth's surface. Efforts will continue in defining and developing Shuttle and satellite experiments that will provide measurements of atmospheric constituents and other characteristics.

A significant improvement in the understanding of man's impact on the atmosphere and climate will be obtained from the combination of Langley developed statistical/theoretical models and the comprehensive global data set provided by spaceborne sensors such as Limb Infrared Monitor of the Stratosphere, Stratospheric Aerosol Measurements 11, and Stratospheric Aerosol and Gas Experiments, Measurements of Air pollution from Satellites, and Earth Radiation Budget Experiments. The Center's sensor development program encompasses the broadest possible range of advanced remote sensing techniques, including correlation of gas filter radiometry and interferometry, lidar, and active and passive microwave techniques.

Langley is managing the Global Tropospheric Experiment which is a coordinated program of theoretical modeling, field measurements, data analysis, and technology development to contribute to the enhanced understanding of the chemical and dynamic processes of the global troposphere.

Studies of the Earth's radiation budget are fundamental to the understanding of climate phenomena. Langley has the responsibility for data processing and analysis of the Earth Radiation Budget Experiment, a prime element in NASA's support of the National Climate Program. Major studies include analysis of other satellite data and theoretical models to examine the relationship of the radiation budget to such climatological parameters as cloudiness, snow and ice cover, and sea surface temperature.

Langley is currently managing the First International Satellite Cloud Climatology Project Regional Experiment (FIRE) which concentrates on improving the basic knowledge of clouds which are one of the least understood, yet highly influential, components of the climate system.

Langley is responsible for conducting basic research activities to establish scientific and engineering bases to evaluate the potential of crystal growth in space for advanced electronic and electro-optical devices. Laboratory results will be verified in planned Shuttle flight tests. The Center also has a key role in cooperation with other centers in developing microgravity science facilities for use on the Space Station.

Permanent Civil
Service Workyears

AERONAUTICS AND SPACE TECHNOLOGY

1.906

AERONAUTICAL RESEARCH AND TECHNOLOGY

1,216

The aeronautical and research technology program at Langley is characterized by the application of discipline research to specific technology requirements, demonstrations of particular technology applications, and the examination of future technology requirements. The unique wind tunnels, computing facilities, and flight operations capabilities at Langley complement the expertise of the technical staff to produce a broad cohesive program in aeronautical research.

The aerodynamics activity at Langley encompasses extensive theoretical and experimental activities. Basic work in fluid and flight mechanics involves theoretical and experimental determination of aerodynamic flows and complex aircraft motions. The program utilizes the many unique Langley capabilities and facilities, including the **VPS-32** computer and wind tunnel testing capability of the National Transonic Facility (NTF) which provides improved simulation of full flight scale conditions.

Research areas include airfoil and wing design, flow-field analysis, configuration design processes, aircraft noise prediction, control analysis, aircraft drag reduction, propulsion system integration, flight dynamics, and fighter and missile aerodynamics. The **VPS-32** computer will be used in the areas of far-field noise, three-dimensional (**3-D**) potential flow programs, and the solution of two-dimensional and **3-D** Navier-Stokes equations. Wind tunnel and flight tests will be continued on general aviation aircraft configurations with the potential for improve stall behavior or immunity and spin avoidance. Basic research on the conception and development of methods for reducing turbulent skin-friction drag and both passive and active laminar flow retention will be pursued. A goal of viscous drag reduction activities is to validate the various concepts to the level required for aircraft manufacturers to consider their use in future production aircraft. Application of advanced transonic theories to the design of improved **3-D** wings will be continued and evaluated by wind tunnel tests. The development of design methodology for high-performance aircraft at high angles of attack in the areas of aerodynamics, controls, and handling qualities will be accelerated. Technology options for realization of practical hypersonic and transatmospheric flight are being studied.

Activities in acoustics and noise reduction include research on jet noise, propeller noise, interior noise, rotor blade noise, atmospheric propagation, structure-borne noise, and system noise prediction.

The materials and structures effort is directed at the development of new and improved structural materials, fabrication processes, and structural design technology to improve the structural efficiency, reliability, and durability as well as reduce design costs of airframes and components. This activity is directed toward research on advanced composite materials, advanced metallic materials, computer-aided analysis and structural design technology, and development of life prediction methodology. Research in aeroelasticity emphasizes prediction and control of the dynamic stability of both fixed-wing aircraft and rotorcraft with theoretical studies and wind tunnel tests for validation. Aircraft safety research includes handling qualities, runway friction, aircraft tire mechanics, and crash worthiness of airframe structures.

Emerging technological advances in computer systems are being used to significantly increase Engineering Computational Capability and reduce the cost of engineering computations. The Langley research program in computer science is directed at systems for distributed computer networks, methods for concurrent systems design, software engineering, fault-tolerant software techniques for improved system reliability, and software development management. Investigations of advanced computer hardware applications will be continued with finite element structural analysis.

Controls and guidance work at Langley includes research programs to advance technology development in aircraft guidance and navigation, aircraft control systems, cockpit systems, integration and interfacing techniques, and performance validation and verification methods for fully integrated, highly reliable flight control systems. Also, major efforts in aircraft flight management, operating procedures technology and active controls technology for conventional takeoff and landing aircraft are being conducted. The work includes requirement analyses, design studies, ground simulations, and experimental flight research. The Langley expertise in the controls and guidance area is being applied to various aircraft classes, including intersystems communications networks for enhanced interfacing and integration of functions within an aircraft, flight path definitions, and advanced technology for pilot-system interfaces for both aircraft and spacecraft. Investigations will continue on the integration of aircraft with enhanced capabilities into the evolving air traffic control system in order to achieve benefits in capacity and efficiency while maintaining safety. Other efforts will include the definition of technology for enhanced functional integration to increase aircraft systems reliability and reduce operating cost, and the investigation of concepts and technology which will result in greatly improved aircraft displays and input/output capabilities. Other technology applications are found in research on advanced flight control systems, design procedures, handling and flying qualities criteria for advanced aircraft, and pilot modeling and assessment of pilot performance and workload. Research efforts in developing and applying artificial intelligence technology to aircraft cockpits are underway. The avionics integration research laboratory continues to be used for both NASA and industry research on fault-tolerant systems and software. The impact of lightning on inducing errors in digital aircraft systems will continue to be assessed and data disseminated.

Langley has traditionally received requests from other agencies and industry for test support of their aircraft, missiles, and systems development programs. The Aerostructures Directorate of the U.S. Army Aviation Research and Technology Activity, and the Avionics Technology Directorate, both under Aviation Systems Command, are located at Langley. These directorates, the primary investigators of Army rotorcraft structures and avionics, work on independent research and development projects and on projects of mutual

interest with a staff integrated into the NASA organization. Langley facilities are used extensively for these research activities. There are also a large number of joint programs with the Air Force Systems Command, the Naval Air Systems Command, other DOD components, and the Federal Aviation Administration.

Permanent Civil
Service Workyears

SPACE RESEARCH AND TECHNOLOGY 563

The space research and technology program at Langley is characterized by levels of effort in several discipline areas and the application of expertise to current and future technology requirements. Longer range studies are directed at defining the technology requirements for future space systems and missions including technology development for a second-generation Space Shuttle, Aeroassisted Orbital Transfer Vehicles (AOTV), permanently-manned Space Station, lunar bases, and Mars exploration. LaRC supports a number of programs in the civil space technology initiative (CSTI) and will be involved in operations technology and transfer vehicle technology in the pathfinder program.

The objective in the materials area is to establish and demonstrate the required technology for application of advanced materials to wide variety of space applications. Materials systems and applications include: high-temperature composites with long-life capability for use as structural materials in future space transportation systems; high-temperature metallic materials for thermal protection systems; and high-stiffness, low-weight, low-thermal expansion composites for large, long-life space structures. Environmental effects on the mechanical and physical properties of materials are being studied utilizing specialized facilities and laboratories. These studies include dimensional and radiation stability of composites and thermal control coating. An integral part of the research activity is the definition of new experimental testing and research facility requirements which will assure that the reliability and durability of future space structures can be adequately predicted and assessed.

The goal of the activities in the area of structures is to provide validated analysis and design methodology, design concepts, and dynamics and control methodology required for efficient long-life space transportation and payload structures. High-temperature metallic heat shield concepts and actively cooled structural and propulsion concepts for advanced space transportation systems are being developed and evaluated using specialized laboratories and wind tunnels. Analysis, design, and loads determination methodology for deployable and erectable large space platforms, antennas, and booms are being studied as

part of a multi-Center, multi disciplinary program for advanced technology. A technology program is being developed to demonstrate and validate the control of large flexible space structures through analysis and flight research experiments. An integrated structural-thermal analysis methodology is being developed and verified for spacecraft structures. Work will be initiated on integrated controls software that will require application of advanced numerical techniques and computer hardware.

An extensive program in electronic component technology, automation/robotics technology, and information systems technology is being conducted at Langley. Sensor research includes continuously tunable infrared laser techniques and high power/high pressure tunable gas lasers for the measurement of low concentration atmospheric constituents and transport phenomena (e.g., winds). Research will continue on the extension of microwave radiometer technology to large space systems. Onboard data management system concepts will be carried out in 1989. This work supports a broad objective of developing candidate architectures and associated systems technology for manned spacecraft onboard data management, with potential application to the Space Station. The demonstration of a wavelength division multiplexed fiber optic technology is underway at Langley. The objective of this research is to provide the component technology base for advanced local area networks used in the Space Station or other complex aerospace systems. The unique microgravity environment of space provides an opportunity to develop advanced materials processing concepts. Langley is investigating the potential of diffusion-limited crystal growth as a technique to provide large, uniform, lead-tin-telluride crystals with potential application in infrared sensors. The evaluation of solid-state data storage technology for Space Station applications has been initiated. The overall objective is to identify candidate technologies, evaluate their potential, and perform research necessary to demonstrate viability in a projected Space Station environment. Langley is evaluating advanced optical data processing techniques which take advantage of the parallelism of optics to perform complex mathematical operations such as a matrix arithmetic at high speed for potential application to complex aerospace systems. Automation technology efforts will focus on conducting systems level research on remote satellite servicing automated construction concepts and application of artificial intelligence technology. Other space electronics technology efforts are focused on spacecraft guidance and control, software development, verification and validation techniques, and special problems in large space structures pointing and figure control.

The Langley space vehicle and spacecraft technology program develops experimental and theoretical data bases to support: Space Shuttle enhancements, reduction and interpretation of Shuttle flight data, development of the Aeroassist Flight Experiment, future space transportation vehicles for the 1990's and beyond that employ advanced technologies other than those used for the Space Shuttle, lunar and planetary

exploration concepts, and large space systems. The objectives are met through the development and application of experimental and theoretical techniques employing Langley computers and wind tunnel facilities, and through comparative analyses with available flight data. Disciplines include aerodynamic and aerothermodynamic performance, configuration optimization, hypersonic computational fluid flow techniques which include the continuum and rarefied regimes, experimental fluid dynamic research primarily in the Langley Hypersonic Facilities Complex, flight control systems assessment, mission analysis, trajectory performance analyses, and conceptual design studies.

The Langley program in space energy conversion is focused on radiant energy conversion concepts which convert solar and laser radiation efficiently into electricity or other useful forms of energy. The objective of the energy conversion effort is to perform basic research on solar-pumped lasers for conversion of solar energy directly into electromagnetic radiation, laser power, and development of potential power generation, transmission, storage, and control for future space missions.

Permanent Civil
Service Workyears

TRANSATMOSPHERIC RESEARCH AND TECHNOLOGY 127

The activities at Langley include: development of fundamental processes and engineering feasibility of supersonic combustion of both ramjets and other advanced airbreathing propulsion systems; characterization of advanced materials for high temperature applications and the development of large, hot, reusable structures for aerospace vehicles, efforts in high-speed aerodynamics, configurations, and advanced computational methods for a variety of vehicle applications, and studies to define and understand the integration of advanced technologies into a future class of horizontal takeoff and landing aerospace plane vehicles for operation to orbit and/or hypersonic cruise within the atmosphere.

COMMERCIAL PROGRAMS 12

The objective of the Commercial Use of Space Program is to increase private sector awareness of space opportunities and encourage industry investment and participation in high technology space based research, application and development. This effort establishes an organizational focal point specifically intended to foster commercial access, use and development to space.

The NASA technology utilization program will contribute to the enhancement of economic growth and support state and local governments solution to public problems through the transfer of new technology, from aeronautical and space research and development efforts, to the nonaerospace segments of the economy.

Civil service personnel will provide support to define methods to expedite the application of new technology by compressing the time experiment in the generation of technology to its application, and encourage the use of aerospace technology in nonaerospace segments of the economy having problems amenable to technological solutions.

Permanent Civil
Service Workyears

CENTER MANAGEMENT AND OPERATIONS..... 643

Center Management and Operations provides services or support to all Langley organizations. The civil service personnel involved are:

Director and Staff - The Center Director, Deputy Director, Associate Director, and immediate staff; e.g., Chief Scientist, Equal Opportunity, and External Affairs.

Management Support - Provide information and control services supporting **all** levels of Center management, both program and functional. Specific functions include resources and financial management, program control, contracting and procurement, property management, personnel management, and management systems and analysis.

Operations Support - Provide for the operation and maintenance of institutional facilities, buildings, systems, and equipment, including those who manage or provide technical services such as automatic data processing, reliability and quality assurance, medical care, and photographic support.

SUMMARY OF RESOURCES REQUIREMENTS

FUNDING PLAN BY FUNCTION

	<u>1987</u> <u>Actual</u>	<u>1988</u> Revised <u>Estimate</u> (Thousands of Dollars)	Current <u>Estimate</u>	1987 Budget <u>Estimate</u>
I. Personnel and Related Costs.....	121,617	130,087	121,348	129,281
11. Travel.....	3,232	3,833	3,809	4,198
III. Operation of Installation.....	29,488	53,753	49,472	51,776
A. Facilities Services.....	(14,542)	(24,599)	(22,300)	(22,300)
B. Technical Services.....	(5,839)	(9,954)	(9,815)	(9,817)
C. Management and Operations....	<u>(9,107)</u>	<u>(19,200)</u>	<u>(17,357)</u>	<u>(19,659)</u>
Total, Fund Requirements.....	<u>154,337</u>	<u>187,673</u>	<u>174,629</u>	<u>185,255</u>

RESOURCES REOUREMENTS BY FUNCTION

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
I. <u>PERSONNEL AND RELATED COSTS</u>	<u>121.617</u>	<u>130.087</u>	<u>121.348</u>	<u>129.281</u>

Summary of Fund Requirements

A. Compensation and Benefits

1. Compensation

a. Full-time permanent....	103,393	104,948	101,126	107,950
b. Other than full-time permanent.....	1,756	1,794	1,758	1,882
c. Reimbursable detailees.....	83	81	87	0
d. Overtime and other compensation.....	<u>1,275</u>	<u>1,290</u>	<u>1,371</u>	<u>1,386</u>
Subtotal, Compensation.....	106,507	108,113	104,342	111,218
2. <u>Benefits</u>	<u>13.441</u>	<u>20.525</u>	<u>15.569</u>	<u>16.586</u>
Subtotal, Compensation and Benefits.....	<u>119,948</u>	<u>128.638</u>	<u>119,911</u>	<u>127,804</u>

	<u>1987 Actual</u>	<u>1988</u>		<u>1989</u>
		<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
(Thousands of Dollars)				
<u>B. Supporting Costs</u>				
1. Transfer of personnel.....	414	240	210	220
2. Personnel training.....	<u>1.255</u>	<u>1.209</u>	<u>1.227</u>	<u>1.257</u>
Subtotal, Supporting costs.....	<u>1.669</u>	<u>1.449</u>	<u>1.437</u>	<u>1.477</u>
Total, Personnel and Related Costs.....	<u>121.617</u>	<u>130.087</u>	<u>121.348</u>	<u>129.281</u>

Explanation of Fund Requirements

	<u>1987 Actual</u>	<u>1988</u>		<u>1989</u>
		<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
(Thousands of Dollars)				
<u>A. Compensation and Benefits.....</u>				
1. Compensation	<u>106,507</u>	<u>108.113</u>	<u>104.342</u>	<u>111.218</u>
a. Full-time permanent....	103,393	104,948	101,126	107,950
A. Compensation and Benefits.....	<u>119.948</u>	<u>128.638</u>	<u>119.911</u>	<u>127.804</u>

The decrease from the 1988 revised budget estimate to the 1988 current estimate is due to the January 1988 pay raises offset by LaRC's share of the \$42.0 million general reduction needed to reach 1988 authorized levels. The increase from 1988 current estimate to 1989 budget estimate reflects the full-year effect of the 1988 pay raises.

Basis of Cost for Permanent Workyears

In 1989, the cost of permanent workyears will be \$107,950. The increase from 1988 is calculated as follows:

Cost of permanent workyears in 1988.....	101,126
Cost increases in 1989.....	8,544
Restoration of 1988 general reduction.....	4,639
Within grade and career development advances:	
Full year effect of 1988 actions.....	1,348
Partial year effect of 1989 actions.....	1,921
Full year cost of the 1988 pay raise.....	516
Effect of 1989 decrease in offsetting reimbursements...	120
Cost decreases in 1989.....	-1,720
Turnover saving:	
Full year effect of 1988 actions.....	-557
Partial year effect of 1989 actions.....	-360
Two less paid days.....	-803
Cost of full-time permanent workyears in 1989.....	<u>107,950</u>

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
(Thousands of Dollars)				
b. Other than full-time permanent				
1. cost.....	1,756	1,794	1,758	1,882
2. Workyears.....	132	133	133	133

The distribution of 1989 workyears is as follows:

Distribution of Other Than Full-Time Permanent Workyears

<u>Program</u>	<u>Workyears</u>
Development programs.....	85
Youth Opportunity programs.....	34
Other temporary programs.....	14
Total.....	133

The decrease from the 1988 revised estimate to the 1988 current estimate reflects the 1988 pay raises offset by a reduction in salary mix due to a realignment of the workyears in the various programs. The 1989 revised estimate reflects the full year effect of the 1988 pay raises.

c. Overtime and other compensation.....	1,275	1,290	1,371	1,386
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The major cost in this area is overtime. **Also** included are Sunday and night-work differentials, holiday pay, incentive awards, and bonus awards. The use of overtime and other compensation is limited to emergency repairs and work that cannot be accomplished during normal duty hours. This includes the monitoring of on-site contracts during off-duty hours and wind tunnel work required at night to take advantage of off-peak electrical rates. The increase in the 1988 revised estimate reflects the 1988 pay raises.

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
2. <u>Benefits</u>	<u>13,441</u>	<u>20,525</u>	<u>15,569</u>	<u>16,586</u>

The following are the amounts of contribution by category:

Retirement Fund and				
Thrift Plan.....	7,682	15,348	9,340	10,076
Federal Group Life Ins.....	216	233	220	225
Employee health insurance.....	3,048	2,830	3,069	3,078
Workmen's compensation.....	580	580	580	580
FICA	596	194	1,025	1,284
Medicare.....	1,315	1,330	1,320	1,328
Other Benefits.....	<u>4</u>	<u>10</u>	<u>15</u>	<u>15</u>
Total.....	<u>13,441</u>	<u>20,525</u>	<u>15,569</u>	<u>16,586</u>

The decrease from the 1988 revised estimate to the 1988 current estimate reflects the actual number of employees switching from the civil service retirement system into the new Federal Employers Retirement System and the concomitant retirement changes related to the reduction in permanent compensation for the \$42.0 million general reductions. The 1989 increase reflects the full year effect of 1988 pay raises.

B. <u>Supporting Cost</u>	<u>1,669</u>	<u>1,449</u>	<u>1,437</u>	<u>1,477</u>
1. Transfer of personnel.....	414	240	210	220

Transfer of personnel includes actual expenses involved in the movement and temporary storage of employee's household goods, subsistence and temporary expenses, real estate costs, and miscellaneous moving expenses. The decrease from the 1988 revised estimate to the 1988 current estimate reflects a revised number of transfers. The 1989 estimate reflects the planned level of transfers at the anticipated cost levels.

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
2 Personnel training	1 255	1 209	1 227	1 257

The purpose of training is to continue the development and education of civil service employees to support Langley's roles and missions more efficiently.

The increase from the 1988 revised estimate to the 1988 current estimate reflects an increase in tuition costs, and development of new provisions for the state-of-the-art training programs to keep pace with current technology. The 1989 estimate is based on the current estimate of requirements.

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
II. <u>TRAVEL</u>	<u>3,232</u>	<u>3,833</u>	<u>3,809</u>	<u>4,198</u>

Summary of Fund Requirements

A. Program Travel.....	2,030	2,998	2,533	2,801
B. Scientific and Technical Development Travel.....	823	631	901	1,007
C. Management and Operations Travel.....	<u>379</u>	<u>204</u>	<u>375</u>	<u>390</u>
Total, Travel.....	<u>3,232</u>	<u>3,833</u>	<u>3,809</u>	<u>4,198</u>

Explanation of Fund Requirements

A. <u>Program Travel</u>	<u>2,030</u>	<u>2,998</u>	<u>2,533</u>	<u>2,801</u>
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Program travel is directly related to the accomplishment of the Center's mission. Travel for program purposes reflects the continuing effort in space research, aircraft technology, flight simulation, fluid mechanics, airborne science and applications, space applications, Space Station, and Shuttle support. The decrease from the 1988 budget estimate to the 1988 current estimate is the reallocation of travel at Langley to accommodate other high priority needs. The 1989 estimate reflects anticipated rate levels.

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised	Current	Budget
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
B. <u>Scientific and Technical</u>				
<u>Development Travel</u>	823	631	901	1,007

Scientific and technical development travel permits employees to participate in meetings and technical seminars with other representatives of the aero-space community. Participation allows staff to benefit from exposure to technological advances outside Langley, as well as to present both accomplishments and problems to their associates. Many of the meetings are working panels convened to solve certain problems for the benefit of the Government. The increase from the 1988 revised estimate to the 1988 current estimate is due to the technological advances resulting from current and new initiatives such as the Civil Space Technology Initiative, the High-speed Civil Transport Studies, the Crew and Escape Rescue Vehicle, Pathfinder, and Shuttle support activities. The 1989 estimate reflects anticipated rate levels.

C. <u>Management and Operations</u>				
<u>Travel</u>	379	204	375	390

Management and operations travel is used for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management, and procurement activities; travel of the Center's top management to NASA Headquarters and other NASA Centers; peer group reviews; and local transportation. The 1988 current estimate and 1989 budget estimate reflect a continuation of the 1987 level of effort.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u> (Thousands of Dollars)	<u>Current</u> <u>Estimate</u>	
11. <u>OPERATION OF INSTALLATION</u>	<u>29.488</u>	<u>53.753</u>	<u>49.472</u>	<u>51.776</u>
<u>Summary of Fund Reairements</u>				
A. Facilities Services.....	14,542	24,599	22,300	22,300
B. Technical Services.....	5,839	9,954	9,815	9,817
C. Management and Operations.....	<u>9.107</u>	<u>19.200</u>	<u>17.357</u>	<u>19.659</u>
Total, Operation of Installation.....	<u>29.488</u>	<u>53.753</u>	<u>49.472</u>	<u>51.776</u>

Explanation of Fund Reairements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Center's institutional activities. These are divided into three major functional areas: Facilities Services, the cost of maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; Technical Services, the cost of automatic data processing for management activities, and the cost of educational and informational programs and exhibits; and Management and Operations, the cost of administrative communications, reproduction, transportation, medical, and logistic services.

The decrease from the 1988 revised estimate to the 1988 current estimate reflects reduced energy prices and consumption. In 1989, utility costs will increase with planned Refuse Burner modifications and for expected increases in support contractor and utility rates as well as full year costs of support contracts.

	<u>1987</u>	<u>1988</u>		<u>1989</u>
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
A. <u>FACILITIES SERVICES</u>	<u>14.542</u>	<u>24.599</u>	<u>22.300</u>	<u>22.300</u>

The Langley complex encompasses approximately 3 million gross square feet of buildings and structures. Included are 17 major technical facilities. This physical plant houses an average daily on-Center population of about 4,400 personnel. Many of the test facilities are utilized on more than one shift or during off-peak hours.

Summary of Fund Requirements

1. Rental of Real Property.....	25	7	10	9
2. Maintenance and Related Services.....	500	6,087	5,736	4,193
3. Custodial Services.....	3,381	3,907	3,217	4,193
4. Utility Services.....	<u>10.636</u>	<u>14.598</u>	<u>13.337</u>	<u>13.905</u>
Total, Facilities Services.....	<u>14.542</u>	<u>24.599</u>	<u>22.300</u>	<u>22.300</u>

Explanation of Fund Reauirements

1. Rental of Real Property....	<u>25</u>	<u>-7</u>	<u>10</u>	<u>9</u>
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The estimate covers the cost of leasing rights of way for access to model drop zone areas at Plum Tree Island.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		Revised <u>Estimate</u>	Current <u>Estimate</u>	
		(Thousands of Dollars)		
2. Maintenance and Related Services.....	<u>500</u>	<u>6.087</u>	<u>5.736</u>	<u>4.193</u>

This estimate provides funds for maintenance and repair of administrative facilities, roads and utility lines, and grounds maintenance. The decrease from the 1988 revised estimate to the 1988 current and the 1989 budget estimate reflect austere maintenance levels.

3. <u>Custodial Services</u>	<u>3.381</u>	<u>3.907</u>	<u>3.217</u>	<u>4.193</u>
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This activity provides for janitorial and security services. Also included are funds for fire protection services provided by the City of Hampton. The decrease from the 1988 revised estimate to the 1988 current estimate reflects 1987 experience. The increase in the 1989 budget estimate is due to anticipated rate changes in support service contracts and the required enhancement of security and fire protection.

4. <u>Utility Services</u>	<u>10.636</u>	<u>14.598</u>	<u>13.337</u>	<u>13.905</u>
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Included in this item is the purchase of electric service from Virginia Power Company, fuel oil from a local supplier, and water and sewage charges. Also included are funds for heat and steam services from the Air Force for East Area facilities and the purchase of steam from the City of Hampton, Air Force, and NASA cooperative refuse burner for facilities located in the West Area of Langley. The net decrease from the 1988 revised estimate to the 1988 current estimate reflects less than anticipated increases in the cost of electricity, offset by a small increase in consumption and refuse burner costs. The 1989 budget estimate reflects anticipated rate increases along with an increase to support Refuse Burner modifications.

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
		(Thousands of Dollars)		
B. <u>TECHNICAL SERVICES</u>	<u>5.839</u>	<u>9.954</u>	<u>9.815</u>	<u>9.817</u>

Summary of Fund Requirements

1. <u>Automatic Data</u> <u>Processing</u>	<u>4.897</u>	<u>5.072</u>	<u>4.983</u>	<u>4.971</u>
2. <u>Scientific and Technical</u> <u>Information</u>	<u>942</u>	<u>4.882</u>	<u>4.832</u>	<u>4.846</u>
Total, Technical Services.....	<u>5.839</u>	<u>9.954</u>	<u>9.815</u>	<u>9.817</u>

Explanation of Fund Requirements

1. <u>Automatic Data</u> <u>Processing</u>	<u>4.897</u>	<u>5.072</u>	<u>4.983</u>	<u>4.971</u>
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This estimate provides for Langley's business data complex which provides the Center's accounting and management information data. Included are equipment lease, purchase, and maintenance; paper and other expendable supplies; and a contract for programming and operations. The decrease from the 1988 revised estimate to the 1988 current estimate reflects supports contractor workyear and rate increases offset by the deferral of equipment purchases. The 1989 Budget Estimate continues the 1988 level of operations.

2. <u>Scientific and Technical</u> <u>Information</u>	<u>942</u>	<u>4.882</u>	<u>4.832</u>	<u>4.846</u>
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This estimate provides support contract assistance in the operation of the Technical Library and Visitor Information Center. Funding for all the Center's public affairs activities is included. **Also** included is

coordination of tours and special events, construction and transportation of exhibits, and other educational and informational programs. The decrease from the 1988 revised estimate to the 1988 current estimate reflects deferral of exhibit refurbishment. The increase in 1989 reflects the current level of operations.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u> (Thousands of Dollars)	<u>Current</u> <u>Estimate</u>	
C. <u>MANAGEMENT AND OPERATIONS</u>	<u>9.107</u>	<u>19.200</u>	<u>17.357</u>	<u>19.659</u>

Summary of Fund Requirements

1. <u>Administrative</u> <u>Communications</u>	2,631	6,041	5,939	7,535
2. <u>Printing and</u> <u>Reproduction</u>	186	1,564	1,604	1,666
3. <u>Transportation</u>	1,949	4,210	2,055	2,296
4. <u>Installation Common</u> <u>Services</u>	<u>4.341</u>	<u>7.385</u>	<u>7.759</u>	<u>8.162</u>
Total, Management and Operations.....	<u>9.107</u>	<u>19.200</u>	<u>17.357</u>	<u>19.659</u>

Explanation of Fund Reaquirements

1. <u>Administrative</u> <u>Communications</u>	<u>2.631</u>	<u>6.041</u>	<u>5.939</u>	<u>7.535</u>
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Includes funds for local telephone and exchange costs, Federal Telecommunications Systems (FTS) services, and datafax and telegraph service. The 1989 estimate reflects the larger increment of a two year telecommunications upgrade.

	1987 <u>Actual</u>	<u>1988</u>		1989
		<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
(Thousands of Dollars)				
2. <u>Printing and Reproduction</u>	<u>186</u>	<u>1.564</u>	<u>1.604</u>	<u>1.666</u>

Provides for a support contractor and supplies for reproduction services. The increase from the 1988 revised estimate to the 1988 current estimate reflects contractor rate increases. The 1989 estimate reflects the same level of service as 1988, adjusted for anticipated contractor rates.

3. <u>Transportation</u>	<u>1.949</u>	<u>4.210</u>	<u>2.055</u>	<u>2.296</u>
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Includes the operation, maintenance, and purchase of motor vehicles; shipping, transportation, and freight charges. Also included are charges for local transportation, pickup and delivery of freight, and other bulk objects, and operation and maintenance of the administrative aircraft. This effort includes aircraft fuel, equipment, and expendable supplies. The decrease from the 1988 revised estimate to the 1988 current estimate reflects adjustments in the plan to upgrade NASA's administrative aircraft. The 1989 increase reflects vehicle replacements and anticipated rate increases for support contracts.

4. <u>Installation Common Services</u>	<u>4.341</u>	<u>7.385</u>	<u>7.759</u>	<u>8.162</u>
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Provides for medical services, mail delivery, stock issue and warehousing, and other general administrative support. Also included are the rental and maintenance of office copy machines and equipment, minority programs, and other administrative services and supplies. The increase from the 1988 revised estimate to the 1988 current estimate reflects a small increase in support contract workyears, additional office equipment maintenance costs, and support for additional office rehabilitation requirements. The 1989 estimate reflects a small increase to improve administrative support coupled with support contractor rate increases.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LANGLEY RESEARCH CENTER
ORGANIZATION AND STAFFING CHART

STAFFING SUMMARY		
	AS	GS
SES	34	35
GS/GM 16	1	1
GS/GM 15	176	176
GS/GM 14	336	335
OTHER GS/GM	2219	2219
WAGE	73	73
TOTAL	2838	2839

OFFICE OF THE DIRECTOR		
	AS	GS
SES	3	3
GS/GM 16	0	0
GS/GM 15	2	2
GS/GM 14	6	6
OTHER GS/GM	17	17
WAGE	0	0
TOTAL	28	28

OFFICE OF DIRECTOR FOR ELECTRONICS	OFFICE OF DIRECTOR FOR STRUCTURES	OFFICE OF DIRECTOR FOR AERONAUTICS	OFFICE OF DIRECTOR FOR MANAGEMENT OPERATIONS	OFFICE OF DIRECTOR FOR S&O	OFFICE OF DIRECTOR FOR SPACE	OFFICE OF DIRECTOR FOR FLIGHT SYSTEMS
SES 1 1	SES 1 1	SES 1 1	SES 1 2	SES 2 2	SES 1 1	SES 1 1
GS/GM 16 0 0	GS/GM 16 0 0	GS/GM 16 1 1	GS/GM 16 0 0	GS/GM 16 0 0	GS/GM 16 0 0	GS/GM 16 0 0
GS/GM 15 0 0	GS/GM 15 0 0	GS/GM 15 0 0	GS/GM 15 6 5	GS/GM 15 1 1	GS/GM 15 1 1	GS/GM 15 2 2
GS/GM 14 1 1	GS/GM 14 1 1	GS/GM 14 1 1	GS/GM 14 2 2	GS/GM 14 0 0	GS/GM 14 1 1	GS/GM 14 4 4
OTHER GS/GM 5 5	OTHER GS/GM 2 2	OTHER GS/GM 3 3	OTHER GS/GM 7 7	OTHER GS/GM 3 3	OTHER GS/GM 3 3	OTHER GS/GM 14 14
WAGE 0 0	WAGE 0 0	WAGE 0 0	WAGE 0 0	WAGE 0 0	WAGE 0 0	WAGE 0 0
TOTAL 7 7	TOTAL 2 2	TOTAL 6 6	TOTAL 28 28	TOTAL 6 6	TOTAL 6 6	TOTAL 21 21

ANALYSIS AND COMPUTATION DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 4 4 GS/GM 14 12 12 OTHER GS/GM 16 16 WAGE 0 0 TOTAL 103 103	STRUCTURES & DYNAMICS DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 9 9 GS/GM 14 11 11 OTHER GS/GM 40 40 WAGE 0 0 TOTAL 61 61	HYPERSONIC TECHNOLOGY OFFICE SES 1 1 GS/GM 16 0 0 GS/GM 15 2 2 GS/GM 14 2 2 OTHER GS/GM 9 9 WAGE 0 0 TOTAL 14 14	FINANCIAL MGMT. DIVISION SES 0 0 GS/GM 16 0 0 GS/GM 15 1 1 GS/GM 14 3 3 OTHER GS/GM 44 44 WAGE 0 0 TOTAL 48 48	SYSTEM SAFETY, QUALITY AND RELIABILITY OFFICE SES 0 0 GS/GM 16 0 0 GS/GM 15 1 1 GS/GM 14 2 2 OTHER GS/GM 23 23 WAGE 0 0 TOTAL 26 26	SPACE STATION OFFICE SES 3 3 GS/GM 16 0 0 GS/GM 15 4 4 GS/GM 14 8 8 OTHER GS/GM 16 16 WAGE 0 0 TOTAL 31 31	INFORMATION SYSTEMS DIVISION GS/GM 15 1 1 GS/GM 14 17 17 OTHER GS/GM 17 17 WAGE 0 0 TOTAL 37 37		
INSTRUMENT RESEARCH DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 5 5 GS/GM 14 15 15 OTHER GS/GM 116 116 WAGE 0 0 TOTAL 137 137	LOADS AND AERELASTICITY DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 9 9 GS/GM 14 11 11 OTHER GS/GM 47 47 WAGE 0 0 TOTAL 68 68	ADVANCED VEHICLES DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 4 4 GS/GM 14 7 7 OTHER GS/GM 21 21 WAGE 0 0 TOTAL 33 33	MANAGEMENT SUPPORT DIVISION SES 0 0 GS/GM 16 0 0 GS/GM 15 1 1 GS/GM 14 1 1 OTHER GS/GM 50 50 WAGE 0 0 TOTAL 52 52	FABRICATION DIVISION SES 0 0 GS/GM 16 0 0 GS/GM 15 2 2 GS/GM 14 2 2 OTHER GS/GM 273 273 WAGE 28 28 TOTAL 308 308	ATMOSPHERIC SCIENCES DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 19 19 GS/GM 14 24 24 OTHER GS/GM 47 47 WAGE 0 0 TOTAL 91 91	GUIDANCE & CONTROL DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 5 5 GS/GM 14 23 23 OTHER GS/GM 46 46 WAGE 0 0 TOTAL 75 75		
FLIGHT ELECTRONICS DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 8 8 GS/GM 14 14 14 OTHER GS/GM 67 67 WAGE 0 0 TOTAL 90 90	INTERDISCIPLINARY RESEARCH OFFICE SES 0 0 GS/GM 16 0 0 GS/GM 15 2 2 GS/GM 14 3 3 OTHER GS/GM 5 5 WAGE 0 0 TOTAL 10 10	TRANSONIC AERODYNAMICS DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 10 10 GS/GM 14 16 16 OTHER GS/GM 77 77 WAGE 0 0 TOTAL 104 104	PERSONNEL DIVISION SES 0 0 GS/GM 16 0 0 GS/GM 15 1 1 GS/GM 14 4 4 OTHER GS/GM 37 37 WAGE 0 0 TOTAL 42 42	FACILITIES PROGRAM DEVELOPMENT OFFICE SES 0 0 GS/GM 16 0 0 GS/GM 15 2 2 GS/GM 14 1 1 OTHER GS/GM 7 7 WAGE 0 0 TOTAL 10 10	PAGE SYSTEMS DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 11 11 GS/GM 14 24 24 OTHER GS/GM 60 60 WAGE 0 0 TOTAL 96 96	FLIGHT MANAGEMENT DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 2 2 GS/GM 14 4 4 OTHER GS/GM 70 70 WAGE 0 0 TOTAL 77 77		
PROJECTS DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 8 8 GS/GM 14 18 18 OTHER GS/GM 23 23 WAGE 0 0 TOTAL 50 50	MATERIALS DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 8 8 GS/GM 14 14 14 OTHER GS/GM 44 44 WAGE 0 0 TOTAL 67 67	LOW-SPEED AERODYNAMICS DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 9 9 GS/GM 14 11 11 OTHER GS/GM 72 72 WAGE 4 4 TOTAL 97 97	BUSINESS DATA SYSTEMS DIVISION SES 0 0 GS/GM 16 0 0 GS/GM 15 1 1 GS/GM 14 4 4 OTHER GS/GM 9 9 WAGE 0 0 TOTAL 14 14	SYSTEMS ENGINEERING DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 5 5 GS/GM 14 18 18 OTHER GS/GM 120 120 WAGE 0 0 TOTAL 144 144	ACOUSTICS DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 9 9 GS/GM 14 5 5 OTHER GS/GM 31 31 WAGE 0 0 TOTAL 46 46	HIGH-SPEED AERODYNAMICS DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 11 11 GS/GM 14 13 13 OTHER GS/GM 61 61 WAGE 0 0 TOTAL 76 76	ACQUISITION DIVISION SES 0 0 GS/GM 16 0 0 GS/GM 15 1 1 GS/GM 14 6 6 OTHER GS/GM 78 78 WAGE 0 0 TOTAL 85 85	FACILITIES ENGINEERING DIVISION SES 1 1 GS/GM 16 0 0 GS/GM 15 6 6 GS/GM 14 17 17 OTHER GS/GM 111 111 WAGE 0 0 TOTAL 136 136
PROGRAMS & RESOURCES DIVISION SES 0 0 GS/GM 16 0 0 GS/GM 15 1 1 GS/GM 14 2 2 OTHER GS/GM 18 18 WAGE 0 0 TOTAL 21 21	OPERATIONS SUPPORT DIVISION SES 0 0 GS/GM 16 0 0 GS/GM 15 1 1 GS/GM 14 4 4 OTHER GS/GM 380 380 WAGE 31 31 TOTAL 416 416	RESEARCH INFO. & APPLICATIONS DIVISION SES 0 0 GS/GM 16 0 0 GS/GM 15 1 1 GS/GM 14 3 3 OTHER GS/GM 70 70 WAGE 10 10 TOTAL 84 84						

LEWIS
RESEARCH CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1989 ESTIMATES

LEWIS RESEARCH CENTER

DESCRIPTION

The Lewis Research Center (LeRC) occupies two sites in north central Ohio. The original site, established in 1941, adjacent to the Cleveland-Hopkins International Airport, includes 366 acres, 14 of which are leased from the City of Cleveland. There are over 170 buildings and structures, including wind tunnels, test chambers, laboratories and other research facilities at the Cleveland location.

The Plum Brook Station, established in 1956, is located south of Sandusky, Ohio, about 50 miles west of Cleveland, on land formerly occupied by the Plum Brook Ordnance works. There are 5,853 acres owned by NASA and approximately 47 acres in easements. During 1975, consistent with future NASA research and technology needs, the principal facilities were placed in a standby mode except the use of selected facilities by federal, state and local government agencies or their contractors.

The total capital investment of LeRC and Plum Brook Station, including fixed assets in progress and contractor-held facilities at various locations, as of September 30, 1987, was \$513,510,000.

CENTER ROLES AND MISSIONS

Lewis was established as an aircraft engine research laboratory to develop superior aircraft propulsion systems. Since then, Lewis has developed and constructed many unique facilities for testing full-scale aircraft engines and engine components, chemical rocket engines, electric propulsion systems, space and terrestrial power generation systems, and space communication systems. The principal and supporting roles are:

PRINCIPAL

Aeronautical Research and Technology - develop and maintain a preeminent national capability in: fundamental aeropropulsion disciplines including internal computational fluid dynamics, internal unsteady aerodynamics and aeroelasticity, hot section technology, aircraft icing phenomena; aeronautical propulsion and power transfer technologies including engine materials and structures, propulsion system integration, propellers, instrumentation and controls; and the associated research facilities and techniques.

Transatmospheric Research and Technology - combine aeronautics and space disciplines to provide the technology for a future class of vehicles capable of flight to orbit and/or hypersonic cruise.

Space Station - manage the design and development of the Space Station Power System

Communications - develop the high-risk technology required to ensure continued U.S. preeminence in satellite communications and which will be applicable to a wide range of future communication systems required by NASA, other Government Agencies and U.S. Industry.

Expendable Launch Vehicles - management and operation of the intermediate and large class vehicles for the mixed fleet program.

Space Propulsion Svstems Technology - development and maintenance of the technology base for advanced primary and auxiliary space propulsion systems, including associated structures, materials and analytical technologies.

Space Energy Processes and Svstems Technology - development and maintenance of the technology base for space power and energy conversion systems, including associated structures, materials and analytical technologies.

In-Space Flight Experiments - develop and implement basic microgravity science experiments, especially in materials processing, and conduct flight experiments that contribute to technology developments for space power, propulsion and communications systems.

Commercialization of Space - promotes and facilitates the commercialization of space by increasing the awareness of U.S. industry to space opportunities and encouraging increased industry investment and participation in high technology space-based research, applications, and development.

Technology Utilization - plans, organizes and facilitates the transfer of NASA-developed technology to the non-aerospace community.

SUPPORTING

Energy Processes and Systems Technology - management of research and technology projects for terrestrial energy generation and conservation systems.

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM
LEWIS RESEARCH CENTER

	1987 ACTUAL	1988		1989 BUDGET ESTIMATE
		REVISED ESTIMATE	CURRENT ESTIMATE	
SPACE STATION.....	278	415	350	350
SPACE FLIGHT PROGRAMS.....	139	17	48	48
SPACE SHUTTLE.....	139	17	48	48
SPACE SCIENCE AND APPLICATIONS.....	221	180	221	216
SPACE APPLICATIONS.....	221	180	221	216
AERONAUTICS AND SPACE TECHNOLOGY.....	1,454	1,486	1,482	1,486
AERONAUTICAL RESEARCH AND TECHNOLOGY	924	916	911	905
SPACE RESEARCH AND TECHNOLOGY.....	409	400	436	446
TRANSATMOSPHERIC RESEARCH & TECH....	121	170	135	135
COMMERCIAL PROGRAMS.....	9	8	14	14
SUBTOTAL DIRECT.....	2,101	2,106	2,115	2,114
CENTER MANAGEMENT AND OPERATIONS.....	551	532	532	532
SUBTOTAL (FULL-TIME PERMANENTS)....	2,652	2,638	2,647	2,646
OTHER CONTROLLED FTE'S..... (PMI's/CO-OPS/OTFTP's)	44	56	47	48
GRAND TOTAL (FULL-TIME EQUIVALENTS)	2,696	2,694	2,694	2,694

PROGRAM DESCRIPTION

RESEARCH AND DEVELOPMENT

Permanent Civil
Service Workyears

SPACE STATION.....

350

In 1989, civil service personnel will manage the detail design and development activities associated with the generation, storage distribution and control of the power systems for Space Station. Civil service personnel will continue the activities associated with the power system test bed in the new Power Systems Facility. A major effort will include the integration of the power system with the other work package elements.

SPACE FLIGHT PROGRAMS

SPACE SHUTTLE (Space Transportation Operations).....

48

Lewis is responsible for implementation of the Mixed Fleet Program as it relates to procurement of launch services for intermediate (Atlas/Centaur and Titan 111) and large (Titan IV) class vehicles and the delivery to specified orbit of all spacecraft launched by these vehicles for NASA. In 1988, the project plans to have contracts in place for the launch of AC-68, the FLTSATCOM mission in September 1989, and for the launch of the GOES I, J and K mission on Atlas/Centaurs, beginning in 1990.

In addition, plans are being made to launch the CRRES mission on an Atlas/Centaur in June 1990, the TDRS-F mission on a Titan III/IUS in August 1991 and a planetary backup mission on a Titan IV/IUS vehicle in May 1991.

SPACE SCIENCE AND APPLICATIONS

SPACE APPLICATIONS.....

216

The Space Applications activity at Lewis consists principally of space communications research. In 1989, civil service personnel will continue to support studies of various advanced satellite communications systems concepts directed at providing additional frequency bands and improved

communications service. These studies are focused on the needs of NASA, the public and private sectors, both nationally and internationally. Lewis will continue to develop technology with application to both ground and space segments of future advanced communications systems required by NASA, civil and military users.

In 1989, Lewis will also continue to evolve its work in advanced design and development of experimental flight hardware and scientific flight experiments in basic science and technology associated with materials combustion and fluid dynamics phenomena in reduced gravity.

Permanent Civil
Service Workyears

<u>AERONAUTICS AND SPACE TECHNOLOGY</u>	<u>1.486</u>
<u>AERONAUTICAL RESEARCH AND TECHNOLOGY</u>	<u>905</u>

The aeronautics research and technology program at Lewis is planned to provide innovative propulsion concepts. The primary goal is to develop aeropropulsion technology which contributes significantly to the continuing preeminence of the U.S. civil and military aircraft industry. The approach is to provide the technology base for developing advanced aeronautical propulsion systems which will lead to higher speed, longer range, improvements in fuel efficiency, operating cost, reliability and durability, and/or which will operate with acceptable environmental impact. The Lewis' aeropropulsion program includes key generic discipline research, interdisciplinary research, and efforts focused on specific propulsion systems/vehicle applications. The Propulsion Directorate of the U.S. Army Aviation Research and Technology Activity under the Aviation Systems Command is co-located with Lewis Research Center. Both program offices share a mutual interest in independent research and technology development.

The generic discipline research includes internal computational fluid mechanics (ICFM), instrumentation and controls, materials, and computational structural mechanics. The objective of this research is to develop an understanding of the physical phenomena involved in these disciplines so that accurate analytical tools can be developed to predict and to improve propulsion system performance. The scope of the ICFM research includes computational methods, modeling and verification, and applications. The focus of the instrumentation and controls technology is the development of nonintrusive research instrumentation and engine sensors/controls for the "smart" adaptive propulsion systems of the future. The advanced

materials research is focused on super-alloys, intermetallics, coatings, ceramics and advanced composites for high temperature propulsion system applications. Computational structural mechanics involves the development and verification of advanced analytical methods for high temperature structures, structural dynamics, fracture mechanics, and the development of life prediction methodology.

The interdisciplinary propulsion Research and Technology includes systems analysis, icing technology, high temperature materials, and advanced propulsion technology. Icing research brings together disciplines such as fluid mechanics and heat transfer to improve the analytical tools required for predicting icing effects, and to develop advanced ice protection systems. The goal of the icing research is to develop the technology base required to provide improved all-weather capability for civil and military aircraft. High temperature materials technology is aimed at providing improved durability and reliability of higher temperature propulsion system components including ceramics through the development of advanced materials (including ceramics) and improved experimental and analytical tools, The advanced propulsion technology program is aimed at high efficiency gas turbine technology.

In engine systems research, Lewis is developing focused propulsion technology for specific engines and propulsion systems. Research and technology in this area involves small engines (gas turbines and intermittent combustion engines), advanced turboprops, and new, innovative propulsion systems, such as supersonic through-flow compression systems. Applications for this focused propulsion system research include subsonic transports, commuters, general aviation, rotorcraft, supersonic STOVL aircraft, supermaneuverability, and supersonic/hypersonic aircraft.

The Lewis aeropropulsion technology program is supported by advanced propulsion system studies and by propulsion facilities ranging from small research test rigs to large propulsion system altitude tanks and wind tunnels.

Permanent Civil
Service Workyears

SPACE TECHNOLOGY

446

The major roles of Lewis in space research and technology are to advance the state of the art and maintain a technology base for power systems, advanced primary and auxiliary propulsion and space communications and advanced electronics for these areas of emphasis. This includes associated materials

technology, structural analysis and life prediction technology, computational fluid dynamics, power management and distribution technology including fault tolerance and autonomy and advanced development work in support of a space station, its evolutionary growth, and other future space applications. In-space flight experiments are defined, developed and implemented in the context of the above technology areas and in the underlying basic sciences. LeRC will support civil space technology initiatives (CSTI) programs in power and propulsion and will also be involved in operations technology, transfer vehicle technology and exploration technology in support of the pathfinder program.

The Lewis primary propulsion programs emphasize the extension and advancement of the technologies of hydrogen- or hydrocarbon-fueled engines such as the Space Shuttle Main Engine toward long-life, reusable, serviceable systems for Earth-to-orbit applications. This concentrates on thrust chamber cooling and life, critical turbomachinery components, advanced structural analysis and life prediction, diagnostics and automated control via expert systems. Advanced propulsion concepts are also studied.

Another thrust is to provide the technology for improving cryogenic hydrogen/oxygen orbital transfer propulsion systems in the areas of performance, life and reusability and autonomy based on expert systems. Emphasis is on combustion and heat transfer, long-life lightweight reusable components and subsystem assemblies, high expansion area nozzles, and health monitoring and diagnostics. Cryogenic fluid management storage and transfer technologies for space based engines, cryogenic fluid depots in space and for the Aerospace Plane are investigated. Arcjets and high power magnetoplasmadynamics thrusters are also being developed.

The Lewis auxiliary propulsion programs are directed toward Space Station and satellite applications, Technologies for gaseous hydrogen-oxygen thrusters, resistojets capable of using various fuels, arcjets, inert gas ion, and storable chemical engines are being developed.

Lewis does basic science and technology work in addition to conducting in-space science and technology experiments in materials, combustion and fluid dynamics in reduced gravity. This activity is coordinated with the scientific community in universities, industry, and government. Critical space experiments in support of power and propulsion advancements in technology are also carried out under programs involving university, industry and NASA centers.

Space power programs are focused toward evolutionary space station, lunar/planetary surface and rover power and other future space mission needs. This includes solar photovoltaic, solar dynamic, electrochemical energy conversion and storage, nuclear energy conversion, and power component and circuit development. The photovoltaic program seeks improvement in solar cell efficiency and life with a potential reduction in cost. In solar dynamics a higher efficiency alternative that reduces weight and area to high power levels is sought, Electrochemical research supports extended operating life and improved energy density for batteries and fuel cells. The nuclear energy conversion program is directed toward the development of advanced static and dynamic thermal energy conversion technologies and associated subsystems. Major emphasis is placed on the free piston Stirling engine technology.

Fault tolerant, radiation hard power component, circuit and system autonomy technologies for hundred kilowatt and above power systems are being investigated and demonstrated at the system test bed level. Interactions between the space plasma environment and the power systems are also being studied.

The space communications program includes applied research and advanced development in microwave electron beam amplifiers, microwave solid-state devices, and antenna systems, The program consists of efforts to develop advanced concepts, techniques, and communications systems components which will enable growth in the utilization of the radio frequency spectrum to frequencies well beyond 100GHz.

The Lewis program in space materials and structures research and technology emphasizes the development of improved materials, advanced structural analysis and life prediction for advanced space power generation, propulsion and communications systems.

Permanent Civil
Service Workyears

TRANSATMOSPHERIC RESEARCH AND TECHNOLOGY.....

135

Activities at Lewis are directed toward understanding and defining a class of airbreathing propulsion systems, using hydrogen fuel, that are applicable to orbital accelerator, hypersonic cruise vehicles. These activities include advancements in variable geometry inlets and nozzles, characterizing a family of

materials and cooling concepts compatible with extremely hot reusable engine and airframe structures, development of the computational methods necessary to analyze and define the flow in complex internal ducts and passages; and conducting the studies necessary to integrate these components into an efficient and capable propulsion system.

COMMERCIAL PROGRAMS AND TECHNOLOGY UTILIZATION..... 14

The Space Commercialization program at Lewis will continue to assist industry in evaluating the commercial potential of space by providing the Lewis Research Center's ground-based facilities and microgravity aircraft, and technical expertise for evaluation and testing of ideas/concepts. Specific areas of microgravity research being pursued include processing of metals and alloys, glasses and ceramics, polymers, biological materials and semiconductor materials. Target industries are identified and explored to assure that U.S. industry is given the broadest opportunity possible to test new ideas or concept, and to determine whether the space environment can be utilized for profit-making purposes.

The 1989 technology utilization program at Lewis will continue to concentrate on the identification and evaluation of technology which can be transferred to the non-aerospace industry, and on the development of new methods to communicate and transfer NASA-developed technology.

Permanent Civil
Service Workyears

CENTER MANAGEMENT AND OPERATIONS..... 532

Center Management and Operations Support is defined as support or **services** being provided to all Lewis organizations which cannot be directly identified to a benefitting program or project. The Civil Service personnel involved are:

Director and Staff · The Center Director, Deputy Director, and immediate staff, e.g., the Comptroller, Equal Opportunity, Public Affairs, Chief Counsel, and Safety, Reliability and Quality Assurance.

Mananement Support - Those who provide information and control services supporting all levels of Center program and functional management. Specific functions include resources planning and management, contracting and procurement, personnel management, property management, financial management, and management information systems and analysis.

Operations Support - Those who provide for the operation and maintenance of institutional facilities, buildings, systems, and equipment, including those who manage or provide technical services such as general automatic data processing, medical care, and graphics support.

SUMMARY OF RESOURCES REOUIREMENTS

Funding Plan by Function

	1987	<u>1988</u>		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
I. Personnel and Related Costs.....	116,530	129,174	119,257	127,546
11. Travel.....	2,903	3,256	3,414	3,767
111. Operation of Installation.....	32,316	59,914	55,666	60,140
A. Facilities Services.....	(22,607)	(29,954)	(28,205)	(30,248)
B. Technical Services.....	(3,395)	(15,003)	(13,263)	(14,607)
C. Management and Operations....	<u>(6,314)</u>	<u>(14,957)</u>	<u>(14,198)</u>	<u>(15,285)</u>
Total, fund requirements...	<u>151,749</u>	<u>192,344</u>	<u>178,337</u>	<u>191,453</u>

RESOURCES REQUIREMENTS BY FUNCTION

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
I. <u>PERSONNEL AND RELATED COSTS</u>	116.530	<u>129,174</u>	119.257	<u>127,546</u>
		<u>Summary of Fund Reauirements</u>		
A. <u>ComDensation and Benefits</u>				
1. <u>Compensation</u>				
a. Full-time permanent.....	98,964	104,361	100,397	106,698
b. Other than full-time permanent	945	1,115	948	977
c. Overtime and other compensation	<u>1.586</u>	<u>1.942</u>	<u>1.755</u>	<u>1.808</u>
Subtotal, Compensation.....	101,495	107,418	103,100	109,483
2. <u>Benefits</u>	<u>13.314</u>	<u>20.105</u>	<u>14.378</u>	<u>16.217</u>
Subtotal, Compensation and	<u>114.809</u>	<u>127.523</u>	<u>117.478</u>	<u>125.700</u>
Benefits.....				
B. <u>Supporting Costs</u>				
1. Transfer of personnel.....	93	23	151	153
2. Personnel training.....	<u>1.628</u>	<u>1.628</u>	<u>1.628</u>	<u>1.693</u>
Subtotal, Supporting Costs	<u>1.721</u>	<u>1.651</u>	<u>1.779</u>	<u>1.846</u>
Total, Personnel and Related Costs	<u>116.530</u>	<u>129.174</u>	<u>119.257</u>	<u>127.546</u>

Explanation of Fund Reuirements

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u> (Thousands of Dollars)	<u>Current</u> <u>Estimate</u>	
A. <u>Compensation and Benefits</u>	<u>114.809</u>	<u>127.523</u>	<u>119.478</u>	<u>125.700</u>
1. <u>ComDensation</u>	<u>101.495</u>	<u>107.418</u>	<u>103.100</u>	<u>109.483</u>
a. Full-time permanent.....	98,964	104,361	100,397	106,698

The decrease from the 1988 budget to the 1988 current estimate reflects the January pay raise partially offset by increased reimbursements and L&RC's share of the \$42.0 million reduction needed to reach 1988 authorized levels .

Basis of Cost for Permanent Workyears

In 1989, the cost of permanent workyears will be \$106,698. The increase from 1988 is calculated as follows:

Cost of permanent workyears in 1988.....		100,397
Cost of increases in 1989.....		8,142
Restoration of 1988 general reduction.....	4,606	
Within grade and career advances:		
Full year effect of 1988 actions.....	1,384	
Partial year effect of 1989 actions.....	1,500	
Full year cost of 1988 pay raise.....	471	
Effect of 1988 decrease in offsetting reimbursements.	181	
Cost of decreases in 1989.....		-1,841
Turnover savings:		
Full year effect of 1988 actions.....	-872	
Partial year effect of 1989 actions.....	-165	
Two less paid days	-804	
Cost of permanent full-time workyears in 1989.....		<u>106.698</u>

	1987 <u>Actual</u>	1988		1989 Budget <u>Estimate</u>
		<u>Revised Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	
b. Other than full-time permanent				
1. Cost.....	945	1,115	948	977
2. Workyears.....	58	72	54	56

The distribution of 1989 workyears is as follows:

Distribution of Other Than Full-Time Permanent Workyears

<u>Program</u>	<u>Workyears</u>
Development programs.....	15
Youth opportunity programs.....	9
Other temporary programs.....	<u>32</u>
Total.....	<u>56</u>

The decrease from the 1988 revised estimate to the 1988 current estimate is due to a decrease in the youth opportunity and co-op programs. The increase in 1989 reflects the full year effect of the 1988 pay raises.

c. Overtime and other compensation	1,586	1,942	1,755	1,808
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Overtime and other compensation includes overtime, holiday pay, incentive awards, Sunday premium pay, and night work differential. The use of overtime and other compensation is primarily for off-peak operation of major facilities. The decrease reflected in the 1988 current estimate reflects 1987 experience. The 1989 increase reflects the full year effect of the 1988 pay raises.

	1987	<u>1988</u>		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
2. <u>Benefits</u>	<u>13,314</u>	<u>20,105</u>	<u>14,378</u>	<u>16,217</u>
The following are the amounts of contribution by category:				
Retirement Fund and Thrift Plan..	7,757	14,653	7,752	9,372
Employees Life Insurance.....	178	206	240	256
Employee Health Insurance.....	2,962	2,791	3,434	3,475
Workmen's compensation.....	471	510	510	550
FICA.....	704	698	1,008	1,118
Medicare.....	1,236	1,235	1,423	1,434
Other Benefits.....	<u>6</u>	<u>12</u>	<u>11</u>	<u>12</u>
Total.....	<u>13,314</u>	<u>20,105</u>	<u>14,378</u>	<u>16,217</u>

The decrease from the 1988 revised estimate to the 1988 current estimate reflects the actual number of personnel switching from the Civil Service Retirement System to FERS, and the concomitant retirement changes related to the reduction in permanent compensation for the \$42.0 million general reduction. The 1989 increase reflects the full year effect of the 1988 pay raises.

B. <u>Supporting Costs</u>	<u>1,721</u>	<u>1,651</u>	<u>1,779</u>	<u>1,846</u>
1. Transfer of personnel.....	<u>93</u>	<u>23</u>	<u>151</u>	<u>153</u>

The increase from the 1988 Current Estimate reflects greater activity than previously anticipated based on 1987 experience.

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
2. Personnel training.....	<u>1628</u>	<u>1.628</u>	<u>1.628</u>	<u>1.693</u>

The purpose of the training program is to provide for the development and education of civil service employees to more efficiently support Lewis roles and missions. The 1988 current estimate reflects Lewis' emphasis on the skills needed to support acquisition of the power system for the Space Station and additional training in the areas of office automation. The 1989 budget estimate increase reflects a continuation of the 1988 level at expected higher rates.

	<u>1987</u> <u>Actual</u>	<u>1988</u> Revised Estimate Current Estimate (Thousands of Dollars)		<u>1989</u> Budget Estimate
II. <u>TRAVEL</u>	<u>2.903</u>	<u>3.256</u>	<u>3.414</u>	<u>3.767</u>
<u>Summary of Fund Reaquirements</u>				
A. Program Travel.....	1,903	2,557	2,557	2,794
B. Scientific & Tech. Development Travel.....	497	354	513	530
C. Management & Operations Travel	<u>503</u>	<u>345</u>	<u>344</u>	<u>443</u>
Total, Travel.....	<u>2.903</u>	<u>3.256</u>	<u>3.414</u>	<u>3.767</u>
<u>Explanation of Fund Reaquirements</u>				
A. <u>Program Travel</u>	<u>1.903</u>	<u>2.557</u>	<u>2.557</u>	<u>2.794</u>

Program Travel is directly related to the accomplishment of the Center's mission. These funds are necessary for the management of major contractual programs in aeronautical research and technology, Space Station, space propulsion, materials research and development and space energy processes and systems technology. The 1989 estimate reflects approximately the same level of activity as in 1988 at expected higher rates.

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
		(Thousands of Dollars)		
B. <u>Scientific & Tech. Development</u> <u>Travel</u>	<u>497</u>	<u>354</u>	<u>513</u>	<u>530</u>

Scientific and technical development travel provides employees the opportunity to participate in meetings and seminars with other representatives of the aerospace community. The benefits derived from exposure to technological advances outside Lewis, as well as to present both accomplishments and problems to their associates is invaluable. Many of the meetings are working panels convened to solve problems for the benefit of the Government. The increase from the 1988 revised estimate to the 1988 current estimate for an increase in the number of presentations of technical papers to the scientific community than experienced in 1987. The 1989 estimate provides for continuation of travel at the 1988 current level of support with anticipated rate increases.

C. <u>Management & Operations Travel</u>	<u>503</u>	<u>345</u>	<u>344</u>	<u>443</u>
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Management and operations travel is required for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management, procurement, travel of the Center's top management to NASA Headquarters and other NASA Centers, training travel, and local transportation. The 1989 estimate reflects the 1988 level with anticipated rate increases.

	1987 <u>Actual</u>	1988		1989 Budget <u>Estimate</u>
		<u>Revised Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	
III, OPERATION OF INSTALLATION.....	<u>32,316</u>	<u>59,914</u>	<u>55,666</u>	<u>60,140</u>
	<u>Summary of Fund Requirements</u>			
A. Facilities Services.....	22,607	29,954	28,205	30,248
B. Technical Services.....	3,395	15,003	13,263	14,607
C. Management & Operations.....	<u>6,314</u>	<u>14,957</u>	<u>14,198</u>	<u>15,285</u>
Total, Operation of Installation	<u>32,316</u>	<u>59,914</u>	<u>55,666</u>	<u>60,140</u>

Explanation of Fund Requirements

Operation of Installation provides a broad range of services, supplies and equipment in support of the Center's institutional activities. These are divided into three major functional areas: (1) Facilities Services, the cost of maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; (2) Technical Services, the cost of automatic data processing for management activities and the cost of educational and informational programs and technical shops supporting institutional activities; and (3) Management and Operations, the cost of administrative communications, reproduction, printing, transportation, medical services and supplies.

The decrease from the 1988 revised estimate to the 1988 current estimate is due primarily to lower utility rates, equipment deferrals and lower support contractor rates than anticipated. The increase in 1989 includes rate increases for energy and support contracts coupled with equipment purchases.

	1987 <u>Actual</u>	1988		1989 <u>Budget Estimate</u>
		<u>Revised Estimate</u> (Thousands of Dollars)	<u>Current Estimate</u>	
A. <u>FACILITIES SERVICES</u>	<u>22.607</u>	<u>29.954</u>	<u>28.205</u>	<u>30,248</u>
<u>Summary of Fund Reuirements</u>				
1. <u>Maintenance & Related Services</u> .	4,038	8,842	8,557	9,043
2. <u>Custodial Services</u>	4,429	5,087	4,758	5,294
3. <u>Utility Services</u>	<u>14.140</u>	<u>16.025</u>	<u>14.890</u>	<u>15.911</u>
Total, Facilities Services	<u>22.607</u>	<u>29.954</u>	<u>28.205</u>	<u>30,248</u>

Explanation of Fund Requirements

1. <u>Maintenance & Related Services</u> .	<u>4.038</u>	<u>8.842</u>	<u>8.557</u>	<u>9.043</u>
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This activity provides for the operation and maintenance of facilities at the Cleveland site and at the Plum Brook Station. Facilities maintenance includes buildings and grounds maintenance and maintenance of heating, ventilating, and air-conditioning systems and equipment. The decrease from the 1988 revised estimate to the 1988 current estimate reflects the deferral of selected activities. The 1989 estimate reflects planned activity at anticipated service contractor rates.

2. <u>Custodial Services</u>	<u>4.429</u>	<u>5,087</u>	<u>4.758</u>	<u>5,294</u>
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Security and janitorial services are provided by support contractors. Other services include rubbish disposal and industrial cleaning of walls and lights on an as needed basis. The decrease from the 1988 revised estimate to the 1988 current estimate reflects adjusted requirements and adjustments to the support contractor funding plan. The increase in the 1989 revised estimate is due to anticipated rate changes in support contracts as well as full year funding of support contracts.

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
3. <u>Utility Services</u>	<u>14.140</u>	<u>16.025</u>	<u>14.890</u>	<u>15.911</u>

Electrical power is provided by the local utility company. Natural gas is the primary heating fuel with oil as a backup fuel. A support contractor operates the central heating plant. The decrease from the 1988 budget estimate to the 1988 current estimate is due to lower utility rates than originally anticipated. The increase from 1988 to 1989 is based on essentially the 1988 energy usage at expected utility and support contractor rates.

B. <u>TECHNICAL SERVICES</u>	<u>3,395</u>	<u>15,003</u>	<u>13,263</u>	<u>14,607</u>
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Summary of Fund Requirements

1. <u>Automatic Data Processing</u>	<u>2,649</u>	<u>10,310</u>	<u>8,859</u>	<u>10,023</u>
2. <u>Scientific and Technical Information</u>	<u>746</u>	<u>4,693</u>	<u>4,404</u>	<u>4,584</u>
Total, Technical Services	<u>3,395</u>	<u>15,003</u>	<u>13,263</u>	<u>14,607</u>

Explanation of Fund Requirements

1. <u>Automatic Data Processing</u>	<u>2,649</u>	<u>10,310</u>	<u>8,859</u>	<u>10,023</u>
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Funding provides for administrative data processing, including operations, maintenance, and periodic replacement of equipment. The 1988 current estimate reflects deferral of ADP equipment purchases until 1989. The FY 1989 estimate includes the purchase of disks and controllers for the administrative computer deferred from 1988.

	<u>1987</u> <u>Actual</u>	<u>1988</u> Revised <u>Estimate</u> Current <u>Estimate</u> (Thousands of Dollars)		<u>1989</u> Budget <u>Estimate</u>
2. <u>Scientific and Technical</u> <u>Information</u>	<u>746</u>	<u>4,693</u>	<u>4,404</u>	<u>4,584</u>

Included in this activity is the support of the Center's Library, educational programs, and public information services. Funding for operation of the Visitor Information Center (VIC), conduct of tours and special events, construction and transport of special exhibits, and related activities are also included. The decrease from the 1988 revised estimate to the 1988 current estimate reflects a revised VIC exhibit upgrading program. The 1989 budget continues the upgrading program.

C. <u>MANAGEMENT AND OPERATIONS</u>	<u>6,314</u>	<u>14,957</u>	<u>14,198</u>	<u>15,285</u>
	<u>Summary of Fund Reuirements</u>			
1 Administrative Communications..	722	2,413	1,715	1,721
2 Printing and Reproduction.....	0	755	718	784
3 Transportation.....	2,142	3,483	3,225	3,602
4 Installation Common Services...	<u>3,450</u>	<u>8,306</u>	<u>8,540</u>	<u>9,178</u>
Total, Management and Operations	<u>6,314</u>	<u>14,957</u>	<u>14,198</u>	<u>15,285</u>

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>

(Thousands of Dollars)

Explanation of Fund Reuirements

1. <u>Administrative Communications....</u>	<u>722</u>	<u>2.413</u>	<u>1.715</u>	<u>1.721</u>
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This estimate provides local and long distance telephone service and non-telephone communications. Local telephone service includes the leased lines and equipment to serve the Center population. Non-telephone communications include telex, advanced record system teletype, rapidfax, datafax, teleconference equipment, oceanic cable service, and usage charges for airline reservation service. The decrease in the 1988 current estimate is based on lower rates than originally anticipated and 1989 continues that rate estimate.

2. <u>Printing and Reproduction....</u>	<u>0</u>	<u>755</u>	<u>718</u>	<u>784</u>
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The estimate for administrative printing includes the operatng costs of the printing and reproduction facility as well as supplies, materials, and equipment. All common processes of duplication, including photostating, blueprinting and microfilming are included. The decrease from the 1989 revised estimate to the 1989 current reflects lower maintenance cost of copiers than anticipated. The increase from the 1988 current estimate to the 1989 reflects expected rate increases.

3. <u>Transportation.....</u>	<u>2.142</u>	<u>3.483</u>	<u>3.225</u>	<u>3,602</u>
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This activity includes the cost of the support contract for bus, mail and package delivery, stock issuance and administrative aircraft maintenance. It also includes moving and hauling services and motor vehicle purchase, lease and maintenance. The decrease from the 1988 revised budget estimate to the 1988 current estimate is due to a decrease in support contractor rates. The increase in 1989 represents anticipated contractor wage rates and an increase in flight hours on the administrative aircraft.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u>	<u>Current</u> <u>Estimate</u>	
		(Thousands of Dollars)		
4. <u>Installation Common Services....</u>	<u>3.450</u>	<u>8.306</u>	<u>8.540</u>	<u>9.178</u>

This funding provides minor administrative services for Center management and staff and administrative recordkeeping at Plum Brook Station. **Also** included is the cost of staff medical examinations, clinic support, medical supplies and equipment, special x-ray equipment for the in-house occupational health program, and equipment for the physical fitness facility. All of these services are provided by a support contractor. This function also includes funding for maintenance and periodic replacement of administrative equipment and supplies, and postage. The increase from the 1988 budget estimate to the 1988 current estimate is due to support contractor rates. The 1989 increase is due to anticipated **SSC** rate increases coupled with medical equipment purchases.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
ORGANIZATION AND STAFFING CHART

STAFFING SUMMARY		
	SES	GS
SES	27	28
GS/GM 16	2	2
GS/GM 15	161	161
GS/GM 14	294	296
OTHER GS/GM	1616	1641
WAGE	550	521
TOTAL	2650	2649

OFFICE OF THE DIRECTOR		
	SES	GS
SES	2	2
GS/GM 16	0	0
GS/GM 15	2	2
GS/GM 14	0	0
OTHER GS/GM	2	2
WAGE	0	0
TOTAL	6	6

OFFICE OF EXTERNAL AFFAIRS		OFFICE OF R&T ASSESSMENT		OFF. OF INTERAGENCY & INDUSTRY POWS.		OFFICE OF SAFETY, RELIABILITY & QA		OFFICE OF THE CHIEF COUNSEL		OFFICE OF EQUAL OPPORTUNITY W.M.S.	
	SES	GS		SES	GS		SES	GS		SES	GS
SES	0	0	SES	0	0	SES	0	0	SES	0	0
GS/GM 16	0	0	GS/GM 16	1	1	GS/GM 16	0	0	GS/GM 16	0	0
GS/GM 15	1	1	GS/GM 15	5	5	GS/GM 15	4	4	GS/GM 15	0	0
GS/GM 14	1	1	GS/GM 14	3	3	GS/GM 14	2	2	GS/GM 14	5	5
OTHER GS/GM	21	21	OTHER GS/GM	3	3	OTHER GS/GM	10	10	OTHER GS/GM	5	5
WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0
TOTAL	23	23	TOTAL	12	12	TOTN	16	16	TOTN	11	11

AERONAUTICS DIRECTORATE		AEROSPACE TECH. DIRECTORATE		SPACE STATION SYSTEMS DIRECTORATE		WAGE FLT SVSTYS DIRECTORATE		ENGINEERING DISCTORATE		TECHNICAL OPERANCES		ADMINISTRATION & COMPUTER SERVICES DIRECTORATE		OFFICE OF THE COMPTROLLER			
	Y I P		Y I P		Y I P		Y I P		Y I P		Y I P		Y I P		Y I P		
SES	1	1	SES	1	1	SES	2	2	SES	2	2	SES	1	1	SES	1	1
GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0
GS/GM 15	3	3	GS/GM 15	0	0	GS/GM 15	0	0	GS/GM 15	0	0	GS/GM 15	1	1	GS/GM 15	0	0
GS/GM 14	1	1	GS/GM 14	0	0	GS/GM 14	0	0	GS/GM 14	0	0	GS/GM 14	0	0	GS/GM 14	0	0
OTWERYW	2	2	OTHER	1	1	OTHER	2	2	OTHER GS/GM	2	2	OTHER GS/GM	1	1	OTHER GS/GM	1	1
WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0
TOTAL	5	5	TOTAL	2	2	TOTAL	4	4	TOTAL	4	4	TOTAL	3	3	TOTAL	2	2

ADVANCED PLANNING AND ANALYSIS OFFICE		MATERIALS DIVISION		PROJECT CONTROL OFFICE		ACTS PROJECT OFFICE		SOFTWARE ENGINEERING OFFICE		FACILITY PLANNING OFFICE		PERSONNEL DIVISION		RESOURCES ANALYSIS & MANAGEMENT OFFICE			
	SES	GS		SES	GS		SES	GS		SES	GS		SES	GS		SES	GS
SES	0	0	SES	1	1	SES	0	0	SES	0	0	SES	0	0	SES	0	0
GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0
GS/GM 15	4	4	GS/GM 15	10	10	GS/GM 15	2	2	GS/GM 15	1	1	GS/GM 15	1	1	GS/GM 15	1	1
GS/GM 14	3	3	GS/GM 14	14	15	GS/GM 14	2	2	GS/GM 14	2	2	GS/GM 14	3	3	GS/GM 14	6	6
OTHER GS/GM	15	16	OTHER GS/GM	70	71	OTHER GS/GM	10	10	OTHER GS/GM	8	8	OTHER GS/GM	3	3	OTHER GS/GM	44	45
WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0
TOTAL	22	23	TOTAL	95	97	TOTAL	14	14	TOTAL	46	48	TOTAL	47	48	TOTAL	31	32

INSTRUMENTATION & CONTROL TECH. OFFICE		STRUCTURES DIVISION		SYST. ENGINEERING & INTEGRATION OFFICE		SPACE EXPERIMENTS DIVISION		ENGINEERING SUPPORT OFFICE		TEST INSTALLATIONS DIVISION		COMPUTER SERVICES DIVISION		FINANCIAL MGMT. DIVISION			
	SES	GS		SES	GS		SES	GS		SES	GS		SES	GS		SES	GS
SES	0	0	SES	1	1	SES	1	1	SES	0	0	SES	1	1	SES	0	0
GS/GM 16	0	0	GS/GM 16	1	1	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0
GS/GM 15	3	3	GS/GM 15	11	11	GS/GM 15	4	4	GS/GM 15	0	0	GS/GM 15	5	5	GS/GM 15	1	1
GS/GM 14	12	12	GS/GM 14	8	8	GS/GM 14	6	7	GS/GM 14	2	2	GS/GM 14	13	13	GS/GM 14	1	1
OTHER GS/GM	26	27	OTHER GS/GM	40	42	OTHER GS/GM	28	29	OTHER GS/GM	6	6	OTHER GS/GM	109	110	OTHER GS/GM	39	40
WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0
TOTAL	41	42	TOTAL	61	63	TOTAL	39	41	TOTAL	8	8	TOTAL	380	365	TOTAL	41	42

INTERNAL FLUID MECHANICS DIVISION		SPACE PROPULSION TECHNOLOGY DIVISION		PHOTOVOLTAIC POWER MOWLE DIVISION		ADVANCED SPACE ANALYSIS OFFICE		ELECTRONIC & CONTROL SYSTEMS DIVISION		FACILITIES OPS. & MAINT. DIVISION		HEALTH, SAFETY AND SECURITY DIVISION		PROCUREMENT DIVISION			
	SES	GS		SES	GS		SES	GS		SES	GS		SES	GS		SES	GS
SES	1	1	SES	1	1	SES	1	1	SES	0	0	SES	0	0	SES	0	0
GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0
GS/GM 15	12	12	GS/GM 15	6	7	GS/GM 15	2	2	GS/GM 15	6	6	GS/GM 15	2	2	GS/GM 15	1	1
GS/GM 14	14	14	GS/GM 14	15	15	GS/GM 14	4	4	GS/GM 14	7	7	GS/GM 14	2	2	GS/GM 14	5	5
OTHER GS/GM	54	54	OTHER GS/GM	50	51	OTHER GS/GM	24	25	OTHER GS/GM	43	44	OTHER GS/GM	67	67	OTHER GS/GM	83	85
WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0
TOTAL	81	81	TOTAL	72	74	TOTAL	31	32	TOTAL	56	57	TOTAL	122	117	TOTAL	85	91

PROPULSION SYSTEMS DIVISION		POWER TECHNOLOGY DIVISION		\$OLAR DYNAH. POWER YOWLE DIVISION		SHUTTLE/CENTAUR PROJECT OFFICE		PROPULSION & FLUID SYSTEMS DIVISION		FABRICATION SUPPORT DIVISION		LOGISTICS MGMT. DIVISION		
	SES	GS		SES	GS		SES	GS		SES	GS		SES	GS
SES	1	1	SES	1	1	SES	0	0	SES	1	1	SES	0	0
GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0
GS/GM 15	13	13	GS/GM 15	11	11	GS/GM 15	2	2	GS/GM 15	3	3	GS/GM 15	0	0
GS/GM 14	29	29	GS/GM 14	21	21	GS/GM 14	6	6	GS/GM 14	7	7	GS/GM 14	1	1
OTHER GS/GM	85	85	OTHER GS/GM	66	66	OTHER GS/GM	23	23	OTHER GS/GM	47	48	OTHER GS/GM	23	23
WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0
TOTAL	129	129	TOTAL	98	98	TOTAL	31	31	TOTAL	58	59	TOTAL	130	121

AEROPROPULSION FAC & EXPTS DIVISION		SPACE COMM. DIVISION		ELECTRICAL SYSTEMS DIVISION		ATLAS/CENTAUR PROJECT OFFICE		STRUCTURAL SYSTEMS DIVISION		FACILITIES ENGINEERING DIVISION		TECHNICAL INFORMATION SERVICES DIVISION		
	SES	GS		SES	GS		SES	GS		SES	GS		SES	GS
SES	1	1	SES	1	1	SES	0	0	SES	0	0	SES	0	0
GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0	GS/GM 16	0	0
GS/GM 15	7	7	GS/GM 15	5	5	GS/GM 15	5	5	GS/GM 15	3	3	GS/GM 15	0	0
GS/GM 14	17	17	GS/GM 14	10	10	GS/GM 14	4	3	GS/GM 14	6	7	GS/GM 14	1	1
OTHER GS/GM	86	86	OTHER GS/GM	53	54	OTHER GS/GM	28	29	OTHER GS/GM	47	47	OTHER GS/GM	68	68
WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0	WAGE	0	0
TOTAL	91	91	TOTAL	69	70	TOTAL	37	37	TOTAL	56	57	TOTAL	90	90

OPS. & SPECIAL PROJECTS DIVISION	
	SES
SES	0
GS/GM 16	0
GS/GM 15	5
GS/GM 14	6
OTHER GS/GM	30
WAGE	0
TOTAL	41

NASA HEADQUARTERS



RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1989 ESTIMATES

NASA HEADQUARTERS

DESCRIPTION

NASA Headquarters is located at 400 Maryland Avenue, SW, Washington, D.C., and occupies other buildings in the District of Columbia and Maryland.

HEADQUARTERS ROLES AND MISSIONS

The mission of Headquarters is to plan and provide executive guidelines for the implementation of national space and aeronautics programs consistent with the objectives stated in the National Aeronautics and Space Act of 1958, as amended. These objectives are to:

- Extend our knowledge of the Earth, its environment, the solar system, and the universe;
- Expand practical applications of space technology;
- Develop, operate, and improve manned and unmanned space vehicles;
- Improve the civil and military usefulness of aeronautical vehicles, while minimizing their environmental effects and energy consumption;
- Disseminate pertinent findings to potential users; and
- Promote international cooperation in peaceful activities in space.

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

Office of Space Flight - Plans, directs, executes, and evaluates the research, development, acquisition, and operation of space flight programs. Included in these programs is the Space Shuttle, a key element of the National Space Transportation System (NSTS). The NSTS Director, located at Headquarters, and his two Deputies, located at the centers, have full responsibility and authority for operations and conduct of the NSTS including budget, schedule, program requirements, engineering, and performance. They report directly to the Associate Administrator for Space Flight. Also included in the NSTS are the orbiters, engines, external tanks, solid rocket boosters, and ground and flight systems. The Office of Space Flight develops and implements policy for all system users to interface with the NSTS, and promotes improvements in safety, reliability, and effectiveness of NSTS operational performance. Responsibilities also include the use of Expendable Launch Services for NASA and other civil government programs, Spacelab, upper stages, advanced programs, and other developmental space-based transportation programs. This office also maintains relationships with industry, international organizations, foreign entities, universities, the scientific community, and other government agencies with respect to space flight programs in coordination with the Office of External Relations.

Office of Space Station - Responsible for the development of the programmatic aspects of the Space Station as they evolve including mission analysis, requirements definition and program management.

Office of Space Science and Applications - Responsible for research and development efforts utilizing a variety of flight system and ground-based observations to increase man's knowledge of the universe. The Earth, Sun, Moon, the planets, interplanetary space, other stars and galaxies, and the interaction among those bodies and systems are all objects of these investigations, as well as assuring medical safety and understanding the basic mechanisms of biological processes using the unique capabilities of the space program. Responsibilities also include conducting research and development activities leading to demonstration and transfer of space-related technology and capabilities which can be effectively applied and used for practical benefits on Earth. These research and development activities involve the following program areas: earth observations, environmental observations, communications, material processing in space, and information systems.

Office of Aeronautics and Space Technology - Plans, directs, executes, and evaluates the aeronautical and space research and technology programs as well as the aero-space plane technology programs. The aeronautics program develops technology culminating in safer, more efficient, economical and environmentally acceptable air transportation systems which are

responsive to national needs. The space research and technology program provides a technology base which anticipates the technical needs and provides technology options for future space activities. The NASA portion of the National Aero-Space Plane program, a joint NASA/DOD program, will accelerate the development and validation of key technologies to form the critical data base required for the design and integration of complex aerothermo-dynamics, airbreathing propulsion, and structural systems for transatmospheric vehicles. The Office of Aeronautics and Space Technology is also responsible for coordinating the total NASA program of supporting research and technology related to specific programs and projects to insure a comprehensive, properly balanced agency research and technology program.

Office of Space Operations - Develops, implements, and operates tracking, data acquisition, command, communications, and data processing facilities, systems and services required for support of all NASA flight missions. This office also performs a management overview function for NASA administrative communications. Also responsible for developing a plan and organizational structure to manage NASA's spaceflight operations which would become effective when Shuttle recovery is complete.

Office of Safety, Reliability, Maintainability and Quality Assurance - Plans, directs, implements, and evaluates that part of the overall NASA program concerned with systems assurance (including the functions of safety, reliability, maintainability and quality assurance) and provides focus to those activities that will enhance operational success of NASA programs. The Office also provides for overall technical review of NASA programs and projects to ensure development efforts and mission operations are being conducted on a sound engineering basis with proper controls and attention to development risk.

Office of Commercial Programs - Provides a focus within NASA for an agencywide program supporting the expansion of U.S. private sector investment and involvement in civil space activities, for space commercial user development, for actively supporting new high technology commercial space ventures and for the commercial application of existing aeronautics and space technology.

The Headquarters responsibilities include providing a balanced Agency Headquarters workforce capable of:

- Planning, formulating, and advocating executive direction to national programs to implement the objectives stated in the National Aeronautics and Space Act of 1958, as amended.
- Administering, operational and logistical support to those Headquarters elements concerned with carrying out the mission of the National Aeronautics and Space Administration.
- Providing adequate facilities to house the workforce in Washington, D.C

The Headquarters workforce consists of professional and clerical staff organized into the program offices indicated above and appropriate supporting staff offices. Funding for salaries, travel and necessary support services are included in this portion of the budget submission. Each office is assigned a function consistent with the NASA mission. The number of personnel authorized to an office is determined by management based on the approved personnel ceiling for the Agency and the functions to be performed. The composition of the staff of an office is determined by the head of the office based on the office ceiling and the function to be performed. All personnel are appointed and paid consistent with classification standards established by the Office of Personnel Management. Overall Agency direction is provided by the Administrator, and his personal office staff. The Agency currently has eight installations, and the Jet Propulsion Laboratory, throughout the United States which perform Agency operational missions under direction of the Headquarters staff.

Technical support required by Headquarters is performed primarily by support contractors. Administrative support is provided by the in-house workforce assisted by miscellaneous contract services. Such support includes communications, printing, equipment, transportation, occupational medicine and health, and other administrative support services.

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM
HEADQUARTERS

	1988			1989 BUDGET ESTIMATE
	1987 ACTUAL	REVISED ESTIMATE	CURRENT ESTIMATE	
SPACE STATION.....	154	173	191	191
SPACE FLIGHT PROGRAMS.....	140	175	164	184
SPACE TRANSPORTATION CAPABILITY DEV.	43	23	46	47
SPACE SHUTTLE.....	97	152	118	137
SPACE SCIENCE AND APPLICATIONS.....	158	192	179	179
PHYSICS AND ASTRONOMY.....	47	55	53	53
LIFE SCIENCES.....	19	26	23	23
PLANETARY EXPLORATION.....	24	26	27	27
SPACE APPLICATIONS.....	68	85	76	76
AERONAUTICS AND SPACE TECHNOLOGY.....	97	122	115	115
AERONAUTICAL RESEARCH AND TECHNOLOGY	55	60	56	56
SPACE RESEARCH AND TECHNOLOGY.....	38	55	52	52
TRANSATMOSPHERIC RESEARCH & TECH....	4	7	7	7
COMMERCIAL PROGRAMS.....	26	39	35	35
SAFETY, RELIABILITY & QUALITY ASSURANCE.	46	60	60	60
TRACKING AND DATA PROGRAMS.....	44	60	56	56
SUBTOTAL DIRECT.....	665	821	800	820
CENTER MANAGEMENT AND OPERATIONS.....	622	691	689	739
SUBTOTAL (FULL-TIME PERMANENTS)..	1,287	1,512	1,489	1,559
OTHER CONTROLLED FTE'S..... (PMI'S/CO-OPS/OTFTP'S)	111	111	134	134
GRAND TOTAL [FULL-TIME EQUIVALENTS)	1,398	1,623	1,623	1,693

SUMMARY OF RESOURCES REQUIREMENTS

Funding Plan by Function

	1987 <u>Actual</u>	<u>1988</u> Revised <u>Estimate</u>	Current <u>Estimate</u>	1989 Budget <u>Estimate</u>
		(Thousands of Dollars)		
I. Personnel and Related Cost.....	81,223	93,357	90,968	102,027
11. Travel.....	6,638	8,385	8,499	9,833
III. Operation of Installation.....	51,533	112,989	115,345	136,311
A. Facilities Services.....	(14,186)	(21,010)	(22,111)	(26,051)
B. Technical Services.....	(21,869)	(57,499)	(58,296)	(66,667)
C. Management and Operations.....	<u>(15,478)</u>	<u>(34,480)</u>	<u>(34,938)</u>	<u>(43,593)</u>
Total, fund requirement.....	<u>139,394</u>	<u>214,731</u>	<u>214,812</u>	<u>248,171</u>

RESOURCES REQUIREMENTS BY FUNCTION

	1987	<u>1988</u>		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
I. <u>PERSONNEL AND RELATED COSTS</u>	<u>81.223</u>	<u>93.357</u>	<u>90.968</u>	<u>102.027</u>

Summary of Fund Reuirements

A. Compensation and Benefits

1. Compensation

a. Full-time permanent.....	60,664	66,598	67,245	74,242
b. Other than full-time permanent.....	3,254	3,154	3,865	3,865
c. Reimbursable detailees.....	603	700	650	700
d. Overtime and other compensation.....	<u>2.141</u>	<u>2.478</u>	<u>2.368</u>	<u>2.443</u>
Subtotal, Compensation	66,662	72,930	74,128	81,250

2. <u>Benefits</u>	<u>7.693</u>	<u>14.083</u>	<u>9.925</u>	<u>12.947</u>
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Subtotal, Compensation & Benefits..	<u>74.355</u>	<u>87.013</u>	<u>84.053</u>	<u>94.197</u>
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B. Supporting Costs

1. Transfer of personnel.....	2,769	2,206	2,771	1,492
2. Office of Personnel Management Svcs..	1,513	924	1,234	1,435
3. Personnel training.....	<u>2.586</u>	<u>3.214</u>	<u>2.910</u>	<u>4.903</u>
Subtotal, Supporting Costs.....	<u>6.868</u>	<u>6.344</u>	<u>6.915</u>	<u>7.830</u>

Total, Personnel and Related Costs.....	<u>81.223</u>	<u>93.357</u>	<u>90.968</u>	<u>102.027</u>
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Explanation of Fund Reuirements

	1987	1988		1989
	Actual	Revised Estimate	Current Estimate	Budget Estimate
		(Thousands of Dollars)		
A. <u>ComDensation and Benefits</u>	<u>74.355</u>	<u>87.013</u>	<u>84.053</u>	<u>94.197</u>
1. <u>ComDensation</u>	<u>66.662</u>	<u>72.930</u>	<u>74.128</u>	<u>81.250</u>
a. Full-time permanent.....	60,664	66,598	67,245	74,242

Basis of Cost for Permanent Positions

In 1989 the cost of permanent workyears will be \$74,242,000. The increase from 1988 results from the following:

Cost of full-time permanent workyears in 1988.....	67,245
Cost increases in 1989.....	+9,688
Restoration of 1988 general reduction.....	3,085
Within grade and career advances:	
Full year effect of 1988 actions.....	+2,935
Partial year effect of 1989 actions.....	+1,077
Full year effect of 1988 pay raises.....	+522
Cost of increased FTE in 1989.....	+2,069
Cost decreases in 1989.....	-2,691
Turnover savings and abolished positions:	
Full year effect of 1988 actions.....	-504
Partial year effect of 1989 actions.....	-1,696
Two less paid days	-491
Cost of full-time permanent workyears in 1989.....	74,242

1987 <u>Actual</u>	<u>1988</u>		1989
	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>

(Thousands of Dollars)

b. Other than full-time permanent

(1) cost.....	3,254	3,154	3,865	3,865
(2) Workyears.....	146	130	157	157

The distribution of 1989 workyears is as follows:

Distribution of Other Than Full-Time Permanent Workyears

<u>Program</u>	<u>Workyears</u>
Development programs.....	48
Opportunity programs.....	23
Other temporary.....	<u>86</u>
Total.....	<u>157</u>

The increase from the 1988 revised estimate to the 1988 current estimate and the 1989 estimate reflects increased workyears associated with the Presidential Management Intern Program and the 1988 pay raises.

c. Reimbursable detailees.....	603	700	650	700
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The services of a small group of military officers and civilian detailees from other government agencies are used by NASA Headquarters where such assignments are of mutual benefit. The decrease from the 1988 revised estimate to the current estimate is consistent with 1987 experience.

1987 <u>Actual</u>	<u>1988</u>		1989
	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>

(Thousands of Dollars)

d. Overtime and other compensation..... 2,141 2,478 2,368 2,443

The decrease from the 1988 revised estimate to the 1988 current estimate reflects 1987 experience, offset by the effects of 1988 pay raises.

2. Benefits..... 7,693 14,083 9,925 12,947

The following are the amounts of contribution by category:

Retirement and Thrift Plan Costs.....	4,445	10,710	5,198	6,598
Employee life insurance.....	121	153	137	153
Employee health insurance.....	1,316	1,413	1,512	1,687
Workmen's compensation.....	525	536	552	546
FICA.....	364	251	1,512	2,850
Medicare.....	685	870	864	963
Other benefits.....	<u>237</u>	<u>150</u>	<u>150</u>	<u>150</u>
Total.....	7,693	14,083	9,925	12,947

The decrease from the 1988 revised estimate to the 1988 current estimate is primarily due to the realization of fewer transfers from CSRS to FERS than originally projected and the concomitant retirement changes related to the reduction in permanent compensation for the \$42.0 million general reduction. The increase from the 1988 current estimate to the 1989 budget estimate is due to the changes in the Federal Employee Retirement System, the increased Headquarters Civil Service complement, and the 1988 pay raises.

B. <u>Supporting Costs</u>	<u>6.868</u>	<u>6.344</u>	<u>6.915</u>	<u>7.830</u>
1. Transfer of personnel.....	2,769	2,206	2,771	1,492

The costs associated with transfer of personnel include movement of household goods, subsistence and temporary expenses, real estate and miscellaneous moving expenses related to change of duty station. The increase from the 1988 revised estimate to the 1988 current estimate reflects a revised number of expected relocations associated with revising the Headquarters role in program management, an increased Headquarters complement, and 1987 experience. The 1989 estimate reflects the employment of relatively fewer individuals with eligibility for relocation benefits than is provided in the 1988 current estimate.

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised	Current	Budget
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
2. Office of Personnel Management Svcs..	1,513	924	1,234	1,435

Headquarters reimburses the Office of Personnel Management (OPM) for investigation of new hires for the entire Agency. The cost of investigations is a function of two variables, the number of investigations to be conducted, and the unit charge made by the Office of Personnel Management to other agencies. Also included is a payment to OPM for Federal wage system surveys. The increases from the 1988 revised estimate are based on 1987 experience, OPM mandated reinvestigations of current employees, and the increased Headquarters Civil Service FTE. The increase in 1989 reflects anticipated OPM cost factors and planned levels of agency personnel.

3. Personnel training.....	2,586	3,214	2,910	4,903
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The maintenance and expansion of skills is essential in carrying out the Agency's many complex technical programs. Part of the training consists of courses offered by other Government agencies, usually for a fee. The remainder of the training is provided through non-government sources. The costs are for tuition, fees and related costs for training at colleges, universities, technical institutions, and for the cost of seminars and workshops. The decrease from the 1988 revised estimate to the current estimate reflects 1987 experience. A significant new emphasis in 1989 will be a development of a Project Management Institute to provide more effective training of program and project personnel.

	<u>1987</u>	<u>1988</u>		<u>1989</u>
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
11. TRAVEL.....	<u>6.638</u>	<u>8.385</u>	<u>8.499</u>	<u>9.833</u>
<u>Summary of Fund Requirements</u>				
A. Program Travel.....	3,096	4,382	4,725	5,211
B. Scientific and Technical Development Travel.....	746	803	740	743
C. Management and Operations Travel....	<u>2.796</u>	<u>3.200</u>	<u>3.034</u>	<u>3.879</u>
Total, Travel.....	<u>6.638</u>	<u>8.385</u>	<u>8.499</u>	<u>9.833</u>
<u>Explanation of Fund Requirements</u>				
A. <u>Program Travel</u>	3,096	4,382	4,725	5,211

Program travel funds are used in support of NASA's research and development programs, such as the Space Station, the Space Transportation System, Aeronautics and Space Technology, Space Science and Applications, and other direct research and development programs. This category represents approximately 54 percent of the Headquarters travel requirements for 1989. The increase from the 1988 revised estimate to the 1988 current estimate reflects increased travel of the restructured Headquarters staff leading up to resumption of Space Shuttle flights. The 1989 estimate provides for a full year of increased programmatic travel in accordance with the return of the Shuttle to flight status and the planned level of activity in other program areas.

	1987	1988		1989
	<u>Actual</u>	Revised	Current	Budget
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
B. <u>Scientific and Technical Development</u>				
<u>Travel</u>	746	803	740	743

Scientific and technical development travel permits employees to participate in meetings and seminars with other representatives of the aerospace community. This participation allows personnel to benefit from exposure to technological advances in the field which arise outside NASA, as well as to present both accomplishments and problems to their associates. Many of these meetings are working panels convened to solve certain problems for the benefit of the Government. The 1988 Current and 1989 Budget estimates reflect 1987 experience.

C. <u>Management and Operations Travel</u>	2,796	3,200	3,034	3,879
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Management and operations travel is for the direction and coordination of general management matters, travel by senior officials to review Center requirements and operations and career development travel in order to broaden the experience of NASA employees. Travel by functional managers in such areas as personnel, financial management, and procurement to assure Agency policies and procedures are being implemented throughout the agency. Local transportation and Congressional travel are also included. The decrease to the 1988 current estimate from the 1988 revised estimate primarily reflects 1987 experience and the need to devote more travel funding to program oversight. The increase to the 1989 budget estimate is due to anticipated rate increases from 1988, the Headquarters staffing increase, and increased travel necessary to accomplish management and administrative oversight responsibilities of the various staff offices.

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
		(Thousands of Dollars)		
111. OPERATION OF INSTALLATION.....	<u>51.533</u>	<u>112.989</u>	<u>115.345</u>	<u>136.311</u>

Summary of Fund Reairements

A. Facilities Services.....	14,186	21,010	22,111	26,051
B. Technical Services.....	21,869	57,499	58,296	66,667
C. Management and Operations.....	<u>15.478</u>	<u>34.480</u>	<u>34.938</u>	<u>43.593</u>
Total, Operation of Installation.....	<u>51.533</u>	<u>112.989</u>	<u>115.345</u>	<u>136.311</u>

Explanation of Fund Reairements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Headquarters' institutional activities. These are divided into three major functional areas: Facilities Services, rental of real property, acquisition, maintenance and repair of institutional facilities and equipment, and the cost of custodial services; Technical Services, the cost of automatic data processing for management activities, and the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations, the cost of administrative communications, printing, transportation, medical supplies, and related services.

A. <u>FACILITIES SERVICES</u>	14,186	21,010	22,111	26,051
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NASA Headquarters is comprised of a complex of buildings in the District of Columbia, and Maryland. These are government-owned and leased buildings for which NASA must provide reimbursement to the General Services Administration in accordance with P.L. 92-313. In addition, the costs of the lease of the Space Station Program Office facilities in Reston, Va. are included in this category beginning in 1988. The costs of temporary use of off-site facilities is also included in this category.

Summary of Fund Reuirements

	<u>1987</u>	<u>1988</u>	<u>1989</u>	
	<u>Actual</u>	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
		(Thousands of Dollars)		
1. <u>Rental of Real Property</u>	<u>10.895</u>	<u>15.449</u>	16,264	17,477
2. <u>Maintenance and Related Services</u>	<u>2.491</u>	<u>4.745</u>	<u>5.002</u>	<u>7.684</u>
3. <u>Custodial Services</u>	<u>800</u>	<u>816</u>	<u>845</u>	<u>890</u>
Total, Facilities Services.....	14,186	21,010	22,111	26,051

Explanation of Fund Reuirements

	<u>1987</u>	<u>1988</u>	<u>1989</u>	
	<u>Actual</u>	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
		(Thousands of Dollars)		
1. <u>Rental of Real Property</u>	<u>10.895</u>	<u>15.449</u>	<u>16.264</u>	<u>17.477</u>

Public Law 92-313 requires that agencies be charged for space and related services provided by the General Services Administration (GSA) at approximate commercial-equivalent rates. These funds provide for the cost of office space used by NASA Headquarters personnel. Included in the estimates are the costs of facilities for the Space Station Program Office in Reston, VA. The 1989 Budget estimates reflects new rental rates, as projected by GSA for essentially the same amount of space.

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
		(Thousands of Dollars)		
2. <u>Maintenance and Related Services</u>	<u>2 491</u>	<u>4 745</u>	<u>5 002</u>	<u>7 684</u>

This estimate includes maintenance, repair and alterations of buildings such as partition changes, auxiliary air conditioning systems for ADP equipment, telephone changes and general buildings maintenance. The increase to the 1988 current estimate from the revised estimate reflects removal of asbestos discovered during normal renovation activities. The increase in 1989 reflects projected expenses to begin the consolidation of all NASA Headquarters personnel (except those at Reston, VA and those located outside the Washington metropolitan area) into one building.

3. <u>Custodial Services</u>	<u>800</u>	<u>816</u>	<u>845</u>	<u>890</u>
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These funds cover security guard services in the various Headquarters buildings. They also include reimbursement to GSA for the installation and maintenance of security alarm systems and equipment in the NASA Headquarters buildings. FY 1989 reflects GSA projected rates for essentially the same level of support as 1988.

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u>	<u>Current</u> <u>Estimate</u>	
(Thousands of Dollars)				
B. <u>TECHNICAL SERVICES</u>	<u>21.869</u>	<u>57.499</u>	<u>58.296</u>	<u>66.667</u>

Summary of Fund Requirements

1. <u>Automation Data Processing</u>	<u>16.933</u>	<u>29.055</u>	<u>28.852</u>	<u>36.992</u>
2. <u>Scientific and Technical</u> <u>Information</u>	<u>3.785</u>	<u>22.776</u>	<u>24.002</u>	<u>24.192</u>
3. <u>Support Services</u>	<u>1.151</u>	<u>5.668</u>	<u>5.442</u>	<u>5.483</u>
Total, Technical Services.....	<u>21.869</u>	<u>57.499</u>	<u>58.296</u>	<u>66.667</u>

Explanation of Fund Requirements

1. <u>Automatic Data Processing</u>	<u>16.933</u>	<u>29.055</u>	<u>28.852</u>	<u>36.992</u>
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This estimate provides for the lease, purchase, maintenance, programming and operations services of automatic data processing (ADP) equipment. The decrease from the 1988 revised estimate to the 1988 current estimate reflects partial rephasing of planned replacement costs for the Headquarters administrative computer which were originally planned for 1987 and 1988 but will mostly be accomplished in 1989. The 1989 estimate is for essentially level services from the 1988 current estimate, plus the computer replacement requirements rephased from 1988 and the initiation of revisions to the NASA Financial Management System.

2. <u>Scientific and Technical Information</u>	<u>3.785</u>	<u>22.776</u>	<u>24.002</u>	<u>24.192</u>
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The activities contained in this subfunction are educational-informational programs and the NASA Headquarters technical library.

The education and information programs provide for the gathering and dissemination of information about the Agency's programs to the mass communications media, the general public,

and to the educational community at the elementary and secondary levels. Assistance to the mass communications media includes the gathering and exposition of newsworthy material in support of their requests, and takes such form as press kits, news releases, television and radio information tapes and clips, and feature material. Increased research effort in TV transmission from space and distribution to the public on earth is included in this budget. This effort will continue for several years. Research, development, and operational missions in aeronautics and space provide substantive knowledge and serve as an educational stimulus to students and teachers. NASA responds to expressed needs of students by developing curriculum supplements in space-related areas such as physics, biology, chemistry, and math; assistance to over 1,000 teacher workshops and professional education meetings; and participation in science fairs. This program also provides for equal employment opportunity exhibits and films to relate to high schools, colleges and the public, and the key roles that women and minorities have in the United States space program.

The increase from the 1988 revised estimate to the current estimate is due to the start-up of extensive research into the uses of video technology for information transmission and the public information requirements associated with the first flight of the Shuttle since the Challenger accident. The 1989 estimate reflects the same level of services as in 1988.

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
		(Thousands of Dollars)		
3. <u>Support Services</u>	1.151	5.668	5.442	5.483

These funds provide for the continuation of studies on parts applications, NASA-wide safety, reliability, quality assurance standards, graphic and photo processing services. The decrease from the 1988 revised estimate to the 1988 current estimate and the 1989 estimate is based on 1987 experience and projections of level service requirements through 1988 and 1989.

	1987 <u>Actual</u>	<u>1988</u>		1989 <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u>	<u>Current</u> <u>Estimate</u>	
		(Thousands of Dollars)		
C. <u>MANAGEMENT AND OPERATIONS</u>	<u>15.478</u>	<u>34.480</u>	<u>34.938</u>	<u>43,593</u>

Summary of Fund Requirements

1. <u>Administrative Communications</u>	3,455	6,190	6,630	6,789
2. <u>Printing and Reproduction</u>	1,580	3,675	3,675	3,785
3. <u>Transportation</u>	690	950	952	7,108
4. <u>Installation Common Services</u>	<u>9,753</u>	<u>23.665</u>	<u>23.681</u>	<u>25.911</u>
Total, Management and Operations.....	<u>15.478</u>	<u>34.480</u>	<u>34.938</u>	<u>43,593</u>

Explanation of Fund Requirements

1. <u>Administrative Communications</u>	<u>3.455</u>	<u>6.190</u>	<u>6.630</u>	<u>6.789</u>
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Included in this category are the costs of leased lines, long distance tolls, telephone exchange services, and other communications. The increase from the 1988 revised estimate to the 1988 current estimate reflects 1987 experience and expected rate changes. The 1989 estimate is based on 1988 service levels.

2. <u>Printing and Reproduction</u>	<u>1.580</u>	<u>3.675</u>	<u>3.675</u>	<u>3.785</u>
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Administrative printing includes funds for contractual printing and the related composition and binding operations. This includes services performed by other agencies, chiefly the Government Printing Office, or by commercial printing firms. All common processes of duplicating including photostating, blueprinting, microfilming, and other reproductions are included. The 1989 estimate reflects essentially the same effort as 1988 at expected 1989 rates.

	1987	<u>1988</u>		1989
	<u>Actual</u>	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>
		(Thousands of Dollars)		
3. <u>Transportation</u>	<u>690</u>	<u>950</u>	<u>952</u>	<u>7,108</u>

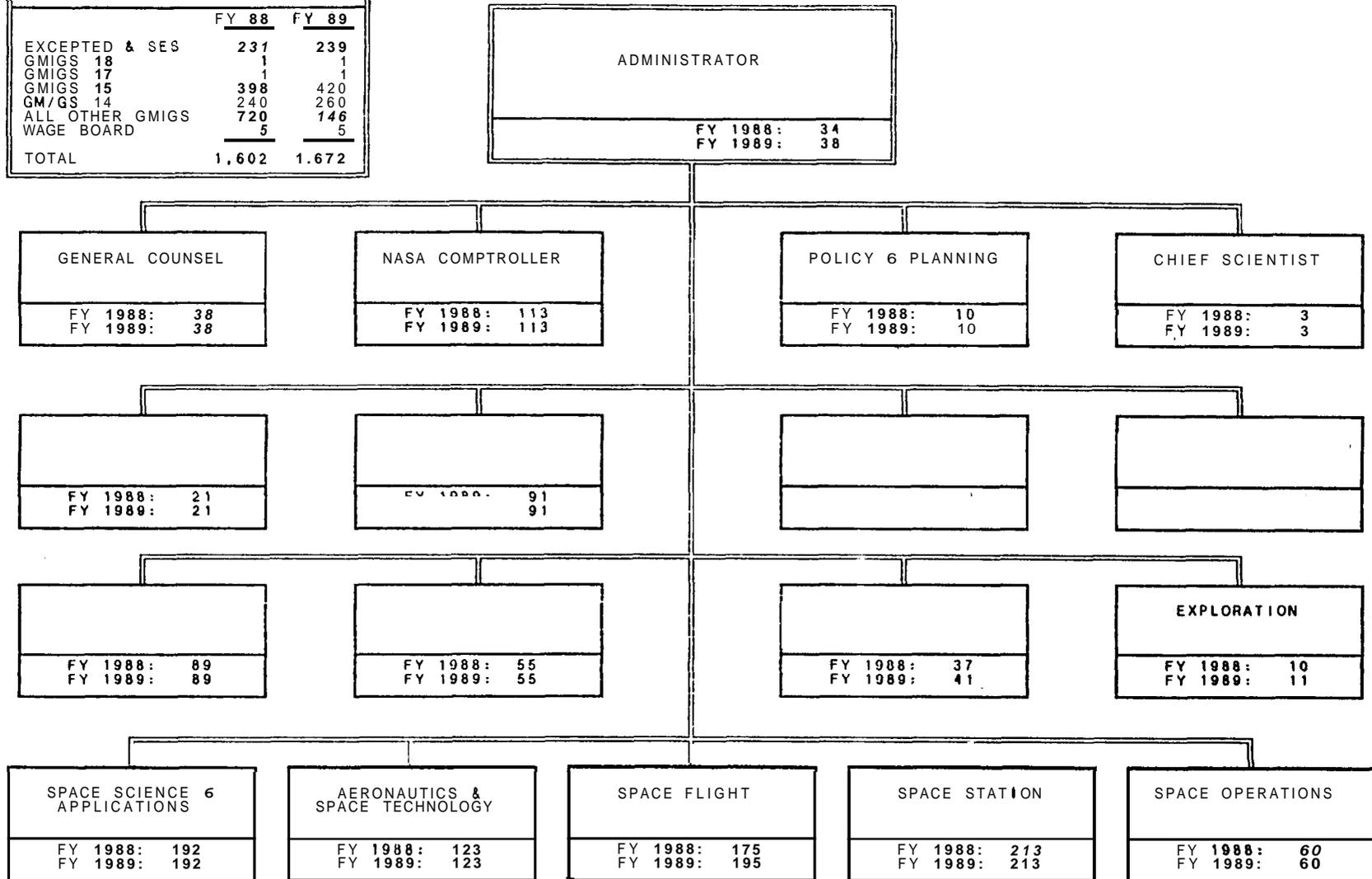
Transportation services include rental of trucks, as well as the movement of supplies, materials, equipment and related items. Also included is the cost of operating and maintaining the administrative aircraft which is assigned to the Jet Propulsion Laboratory. The increase in 1989 is based on proposed upgrading of NASA administrative aircraft fleet capability.

4. <u>Installation Common Services</u>	<u>9,753</u>	<u>23,665</u>	<u>23,681</u>	<u>25,911</u>
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This function provides for those services which support the Headquarters, such as: patent services, maintenance and repair of office equipment and vehicles; minor Government services; contract histories; trucking and labor services; medical services; contractor incentive awards; Equal Opportunity community relations and fellowships; Administrator's representation allowance; overseas administration support and documentation; and administrative supplies, materials and equipment. The 1989 estimate provides the additional installation services necessary to support the increased level of staffing at Headquarters.

SUMMARY STAFFING		
	FY 88	FY 89
EXCEPTED & SES	231	239
GMIGS 18	1	1
GMIGS 17	1	1
GMIGS 15	398	420
GM/GS 14	240	260
ALL OTHER GMIGS	720	146
WAGE BOARD	5	5
TOTAL	1,602	1,672

ORGANIZATION AND STAFFING
NASA HEADQUARTERS



INSPECTOR GENERAL

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1989 ESTIMATES

NASA OFFICE OF INSPECTOR GENERAL

DESCRIPTION

The NASA Office of Inspector General (OIG) is located at 400 Maryland Avenue, SW, Washington, D.C.. OIG field locations include offices at Ames Research Center, California; Goddard Space Flight Center, Maryland; Jet Propulsion Laboratory, California; Johnson Space Center, Texas; Kennedy Space Center, Florida; Langley Research Center, Virginia; Lewis Research Center, Ohio, and Marshall Space Flight Center, Alabama.

OFFICE OF INSPECTOR GENERAL ROLES AND MISSIONS

The NASA OIG was created in 1978 by an Act of Congress (P.L. 95-452) as an independent and objective unit within the Agency. The purposes and mission of the OIG are to:

- Conduct and supervise audits and investigations relating to NASA's programs and operations;
- Promote economy, efficiency, and effectiveness in the administration of these programs and operations;
- Prevent and detect fraud and abuse in these programs and operations; and
- Keep the NASA Administrator and the Congress fully and currently informed about NASA programs, deficiencies relating to the administration of such programs, and the necessity for and progress of corrective actions.

DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM
INSPECTOR GENERAL

	1987 ACTUAL	1988		1989 BUDGET ESTIMATE
		REVISED ESTIMATE	CURRENT ESTIMATE	
CENTER MANAGEMENT AND OPERATIONS	108	126	126	151
SUBTOTAL (FULL-TIME PERMANENTS)	108	126	126	151
OTHER CONTROLLED FTE'S (PMI's/CO-OPS/OTFTP's)	8	10	10	10
GRAND TOTAL (FULL-TIME EQUIVALENTS)	116	136	136	161

SUMMARY OF RESOURCES REOUIREMENTS

Funding Plan by Function

	1987	<u>1988</u>		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
	(Thousands of Dollars)			
I. Personnel and Related Cost.....	5,791	7,161	6,862	8,801
II. Travel.....	246	368	317	345
III. Operation of Installation.....	<u>300</u>	<u>420</u>	<u>280</u>	<u>301</u>
A. Facilities Services.....	(---)	(---)	(---)	(---)
B. Technical Services.....	(265)	(350)	(210)	(221)
C. Management and Operations.....	<u>(35)</u>	<u>(70)</u>	<u>(70)</u>	<u>(80)</u>
Total, fund requirement.....	<u>6.337</u>	<u>7.949</u>	<u>7.459</u>	<u>9.447</u>

RESOURCES REQUIREMENTS BY FUNCTION

	<u>1987</u>	<u>1988</u>	<u>1989</u>	
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
	(Thousands of Dollars)			
I. <u>PERSONNEL AND RELATED COSTS</u>	<u>5.791</u>	<u>7.161</u>	<u>6.862</u>	<u>8.801</u>
<u>Summary of Fund Requirements</u>				
A. <u>Compensation and Benefits</u>				
1. <u>Compensation</u>				
a. Full-time permanent.....	4,538	5,706	5,242	6,523
b. Other than full-time permanent...	148	171	185	185
c. Overtime and other compensation..	80	5	85	85
Subtotal, Compensation.....	4,766	5,882	5,512	6,793
2. Benefits.....	<u>550</u>	<u>823</u>	<u>755</u>	<u>928</u>
Subtotal, Compensation & Benefits..	<u>5.316</u>	<u>6.705</u>	<u>6.267</u>	<u>7.721</u>
B. <u>Supporting Costs</u>				
1. Transfer of personnel.....	430	415	550	1,025
2. Personnel training.....	<u>45</u>	<u>41</u>	<u>45</u>	<u>55</u>
Subtotal, Supporting Costs.....	<u>475</u>	<u>456</u>	<u>595</u>	<u>1.080</u>
Total, Personnel and Related Costs...	<u>5.791</u>	<u>7.161</u>	<u>6.862</u>	<u>8.801</u>

Explanation of Fund Requirements

	1987	1988		1989
	Actual	Revised Estimate	Current Estimate	Budget Estimate
A. <u>ComDensation and Benefits</u>	5,316	6,705	6,267	7,721
1. <u>Compensation</u>	4,766	5,882	5,512	6,793
a. Full-time permanent.....	4,538	5,706	5,242	6,523

Basis of Cost for Permanent Positions

In 1989 the cost of permanent workyears will be \$6,523,000. The increase from 1988 results from the following:

Cost of full-time permanent workyears in 1988.....		\$5,242
Cost Increases in 1989.....	+1,438	
Restoration of 1988 general reduction.....	241	
Within-grade and career advances:		
Full year cost of 1988 actions.....	+66	
Part year cost of 1989 actions.....	+122	
FY 1989 FTE increase	+968	
Full Year Cost of 1988 Pay Raise.....	+41	
Cost Decreases in 1989.....	-157	
Turnover savings and abolished positions:		
Full year cost of 1988 actions.....	-80	
Part year cost of 1989 actions.....	-36	
Two less paid days	-41	
Cost of full-time permanent workyears in 1989.....		6,523

1987 <u>Actual</u>	<u>1988</u>		1989
	Revised <u>Estimate</u>	Current <u>Estimate</u>	Budget <u>Estimate</u>

(Thousands of Dollars)

b. Other than full-time permanent

(1) cost.....	148	171	185	185
(2) Workyears.....	8	10	10	10

The 1989 estimate is level with 1988.

c. Overtime and other compensation..	80	5	85	85
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The increase from the 1988 budget estimate reflects incentive awards previously budgeted by NASA Headquarters.

2. <u>Benefits</u>	550	823	<u>755</u>	<u>928</u>
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The following are the amounts of contribution by category

Retirement and Thrif Plan Costs.....	325	554	492	617
Employee life insurance.....	9	11	11	13
Employee health insurance.....	97	110	110	132
Workmen's compensation.....	42	64	48	54
FICA.....	27	22	32	38
Medicare.....	<u>50</u>	<u>62</u>	<u>62</u>	<u>74</u>
Total.....	<u>550</u>	<u>823</u>	<u>755</u>	<u>928</u>

The increase from the 1988 estimate to the 1989 estimate is due to the expanded OIG staff and the increasing cost of Federal Employee Retirement Benefits as new civil service employees in FERS replace leaving employees in CSRS and the concomitant retirement changes related to the reduction in permanent compensation for the \$42.0 million reduction.

	<u>1987</u>	<u>1988</u>		<u>1989</u>
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
B. <u>Supporting Costs</u>	<u>475</u>	<u>456</u>	<u>595</u>	<u>1,080</u>
1. Transfer of personnel.....	430	415	550	1,025

The costs associated with transfer of personnel include movement of household goods, subsistence and temporary expenses, and real estate and miscellaneous moving expenses related to change of duty station. The increase from the 1988 revised estimate to the current estimate reflects current hiring and personnel management plans. The 1989 budget estimate reflects increasing OIG employment levels.

2. Personnel training.....	45	41	45	55
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The maintenance and expansion of skills, through various training and educational activities, is essential in carrying out the Inspector General's Mission. Part of the training program consists of courses offered by other Government agencies, usually for a fee. The remainder of the training is provided through nongovernment sources. The costs are for tuition, fees and related costs for training at colleges, universities, technical institutions, and for the cost of seminars and workshops. The 1989 budget estimate increases from 1988 to support the larger OIG staff.

	1987	1988		1989
	Actual	Revised Estimate	Current Estimate	Budget Estimate
11. TRAVEL.....	<u>246</u>	<u>368</u>	<u>317</u>	<u>345</u>

(Thousands of Dollars)

Summary of Fund Reairements

Travel funding is required to carry out audits, investigation and management duties. The decrease from the FY 1988 revised estimate to the current estimate is based on FY 1987 experience.

	1987	1988		1989
	<u>Actual</u>	<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>
	(Thousands of Dollars)			
111. <u>OPERATION OF INSTALLATION</u>	300	420	280	301
<u>Summary of Fund Reuirements</u>				
Technical Services.....	265	350	210	221
Management and Operations.....	<u>35</u>	<u>70</u>	<u>70</u>	<u>80</u>
Total, Operation of Installation...	<u>300</u>	<u>420</u>	<u>280</u>	<u>301</u>

Explanation of Fund Requirements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Inspector General's activities.

The decrease from the 1988 revised estimate to the 1988 current estimate is due to maturation of the automation effort which has been underway for several years.

A. Technical Services.....	265	350	<u>210</u>	<u>221</u>
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Summary of Fund Reuirements

This estimate provides for the lease, purchase, maintenance, programming and operations services of automated data processing (ADP) equipment. The decrease from the 1988 revised estimate to the current estimate reflects the effort accomplished in 1987 to modernize and automate the OIG audit capabilities. The classification of these expenditures as equipment purchases in 1988 and 1989 reflects current planning based on 1987 experience and accomplishments. Equipment acquisitions for the cadre of new people has caused the slight increased requirement in 1989.

	1987	1988		1989
	Actual	Revised Estimate	Current Estimate	Budget Estimate
B. <u>Management and Operations</u>	<u>35</u>	<u>70</u>	<u>70</u>	<u>80</u>

Summary of Fund Requirements

1. <u>Administrative Communications</u> ...	25	25	25	31
2. <u>Printing and Reproduction</u>	3	3	3	4
3. <u>Installation Common Services</u>	<u>7</u>	<u>42</u>	<u>42</u>	<u>45</u>
Total, Management and Operations	35	70	70	80

Explanation of Fund Requirements

1. <u>Administrative Communications</u> ...	<u>25</u>	<u>25</u>	<u>25</u>	<u>31</u>
---------------------------------------------	-----------	-----------	-----------	-----------

Included in this category are the costs of local telephone services for the Inspector General's office at NASA Headquarters.

2. <u>Printing and Reproduction</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>4</u>
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Costs of printing and reproduction services used by the Office of Inspector General at NASA Headquarters are included.

3. <u>Installation Common Services</u>	<u>7</u>	<u>42</u>	<u>42</u>	<u>45</u>
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The Inspector General's direct use of administrative supplies, materials and equipment is covered in this subcategory. These requirements are essentially level from 1988 to 1989, reflecting only a slight increase in 1989 due to a larger OIG staff.

ORGANIZATION AND STAFFING
OFFICE OF INSPECTOR GENERAL

INSPECTOR GENERAL SUMMARY		
	FY 88	FY 89
EXCEPTED & SES	6	6
GM/GS-15	20	23
GM/GS-14	24	28
ALL OTHER GM/GS	76	94
TOTAL	126	151

INSPECTOR GENERAL	
FY 1988 :	7
FY 1989 :	8

ASSISTANT INSPECTOR GENERAL FOR AUDITING	
FY 1988 :	6
FY 1989 :	7

ASSISTANT INSPECTOR GENERAL FOR INVESTIGATIONS	
FY 1988 :	5
FY 1989 :	6

ASSISTANT INSPECTOR GENERAL FOR MANAGEMENT SERVICES	
FY 1988 :	10
FY 1989 :	11

ASSISTANT INSPECTOR GENERAL FOR TECHNICAL SERVICES	
FY 1988 :	7
FY 1989 :	8

CENTER OIG OFFICES	
FY 1988 :	91
FY 1989 :	111

APPROPRIATION
REALIGNMENT

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1989 ESTIMATES

APPROPRIATION REALIGNMENT

In accordance with direction of the Committees on Appropriation, NASA has realigned its appropriation structure to move certain institutional costs from the Research and Development and Space Flight, Control and Data Communications accounts to the Research and Program Management account beginning in **FY 1988**. (House HUD-Independent Agencies Subcommittee report dated June 25, 1987 and Senate HUD-Independent Agencies Subcommittee report dated October 6, 1987.)

The Appropriation Realignment effort in NASA began after the House Appropriations Committee Surveys and Investigations (\$&I) report on operation of salaries and expenses appropriations in the HUD-Independent Agencies Appropriation. A study team was appointed, which met with senior congressional staff and NASA institutional and program management officials to define the problem. The result was to revise the NASA budgetary and accounting system based upon use of the existing Financial Management Functional Classification System in order to establish standardized classifications of functional activities across all NASA installations, and enact strict appropriation barriers emphasizing accountability and auditability within the functional classifications.

On September 30, 1987, the NASA Administrator forwarded to the Chairmen of the Subcommittees on the HUD-Independent Agencies the NASA estimate of appropriation realignments necessary to implement the results of the NASA study. These data are depicted on the following pages.

The implementation of these changes are now underway in 1988. No major problems have yet been encountered, although minor adjustments will be necessary in the future.

The 1988 and 1989 columns of the 1989 Budget reflect Appropriation Realignment. Legislation to transfer the relevant amounts from the R&D and SFCDC appropriations to R&PM has been requested. In addition, NASA as directed in the 1988 Appropriation Act, is operating under the new Appropriation Realignment structure.

APPROPRIATION REALIGNMENT
SUMMARY OF BUDGET PLAN BY FUNCTION

NASA TOTAL

	FY 1988 Budget <u>Estimate</u>	Appropriation <u>Realignment</u>	FY 1988 Revised <u>Budget</u>
I. Personnel and Related Costs	1,111,631	0	1,111,631
II. Travel	43,312	0	43,312
111. Operation of Installation	443,057	242,438	685,495
<u>Facilities Services</u>	<u>232,548</u>	<u>41,396</u>	<u>273,944</u>
Rental of Real Property	13,762	3,156	16,918
Maintenance and Related	49,300	25,155	74,455
Custodial Services	57,983	5,872	63,855
Utility Services	111,503	7,213	118,716
<u>Technical Services</u>	<u>89,980</u>	<u>88,008</u>	<u>177,988</u>
Automatic Data Processing	69,245	34,185	103,430
Scientific and Technical Information	12,826	33,543	46,369
Shop and Support Services	7,909	20,280	28,189
<u>Management and Operations</u>	<u>120,529</u>	<u>113,034</u>	<u>233,563</u>
Administrative Communications	29,118	42,968	72,086
Printing and Reproduction	3,625	15,264	18,889
Transportation	22,827	6,334	29,161
Installation Common Services	64,959	48,468	113,427
TOTAL	<u>1,598,000</u>	<u>242,438</u>	<u>1,840,438</u>

APPROPRIATION REALIGNMENT
CHANGES BY BUDGET LINE ITEM

	<u>FY 1988</u> <u>Budget</u> <u>Estimate</u>	<u>Change</u>	<u>FY 1988</u> <u>Revised</u> <u>Budget</u>
		<u>(Millions of Dollars)</u>	
<u>RESEARCH AND DEVELOPMENT</u>	<u>3623.2</u>	<u>-144.8</u>	<u>3478.4</u>
Space Station	767.0	-32.7	734.3
Space Transportation Capability Development	568.6	-4.9	563.7
<u>Space Science and Applications</u>	<u>1508.3</u>	<u>-49.5</u>	<u>1458.8</u>
Physics and Astronomy	567.1	-24.3	542.8
Life Sciences	74.6	-4.6	70.0
Planetary Exploration	307.3	-3.0	304.3
Space Applications	559.3	-17.6	541.7
Commercial Programs	54.0	-1.3	52.7
Aeronautical Research and Technology	375.0	-42.2	332.8
Space Research and Technology	250.0	-11.4	238.6
Transatmospheric Research and Technology	66.0	-0.5	65.5
Safety, Reliability and Quality Assurance	16.2	-2.1	14.1
Tracking and Data Acquisition Advanced Sys	18.1	-0.2	17.9
<u>SPACE FLIGHT, CONTROL, AND DATA COMMUNICATION</u>	<u>4092.3</u>	<u>-97.6</u>	<u>3994.7</u>
Shuttle Production and Capability Development	1131.8	-12.3	1119.5
<u>Space Transportation Operations</u>	<u>2011.6</u>	<u>-75.8</u>	<u>1935.8</u>
Shuttle Operations	1977.5	-75.8	1901.7
Expendable Launch Vehicle Operations	34.1	0.0	34.1
Space and Ground Network, Communications and Data Systems	948.9	-9.5	939.4
<u>RESEARCH AND PROGRAM MANAGEMENT</u>	<u>1598.0</u>	<u>242.4</u>	<u>1840.4</u>
<u>CONSTRUCTION OF FACILITIES</u>	<u>195.5</u>	<u>0.0</u>	<u>195.5</u>
<u>TOTAL FOR NASA</u>	<u>9509.0</u>	<u>0.0</u>	<u>9509.0</u>

RESEARCH AND PROGRAM MANAGEMENT APPROPRIATION

APPROPRIATION REALIGNMENT

SUMMARY OF BUDGET PLAN BY FUNCTION

	FY 1988 Budget <u>Estimate</u>	Appropriation Realignment	FY 1988 Revised <u>Budget</u>
	(Thousands of Dollars)		
I. Personnel and Related Costs...	1,111,631	0	1,111,631
11. Travel	43,312	0	43,312
III. Operation of Installation.....	443,057	242,438	685,495
A. Facilities Services.....	(232,548)	(41,396)	(273,944)
B. Technical Services.....	(89,980)	(88,008)	(177,988)
C. Management and Operations.	(120,529)	(113,034)	(233,563)
Total	<u>1.598.000</u>	<u>242.438</u>	<u>1.840.438</u>

APPROPRIATION REALIGNMENT

SUMMARY OF BUDGET PLAN BY FUNCTION

JOHNSON SPACE CENTER

	<u>FY 1988</u> Budget <u>Estimate</u>	Appropriation <u>Realianment</u> (Thousands of Dollars)	FY 1988 Revised <u>Budget</u>
I. Personnel and Related Costs	178,707	0	178,707
11. Travel	6,835	0	6,835
111. Operation of Installation	63,504	51,823	115,327
<u>Facilities Services</u>	<u>34,084</u>	<u>5,529</u>	<u>39,613</u>
Rental of Real Property	0	523	523
Maintenance and Related	13,715	1,139	14,854
Custodial Services	6,363	-663	5,700
Utility Services	14,006	4,530	18,536
<u>Technical Services</u>	<u>13,696</u>	<u>19,036</u>	<u>32,732</u>
Automatic Data Processing	9,425	13,647	23,072
Scientific and Technical In	3,090	1,341	4,431
Support Services	1,181	4,048	5,229
<u>Management and Operations</u>	<u>15,724</u>	<u>27,258</u>	<u>42,982</u>
Administrative Communicatio	2,897	11,106	14,003
Printing and Reproduction	189	2,121	2,310
Transportation	2,826	4,254	7,080
Installation Common Service	9,812	9,777	19,589
	<u>249,046</u>	<u>51,823</u>	<u>300,869</u>

APPROPRIATION REALLIGNMENT
SUMMARY OF BUDGET PLAN BY FUNCTION
MARSHALL SPACE FLIGHT CENTER

	FY 1988 Budget <u>Estimate</u>	Appropriation <u>Reallianment</u>	FY 1988 Revised <u>Budeet</u>
		(Thousands of Dollars)	
I. Personnel and Related Costs	172,856	0	172,856
II. Travel	7,326	0	7,326
III. Operation of Installation	52,330	14,527	66,857
<u>Facilities Services</u>	<u>26.208</u>	<u>1.113</u>	<u>27.321</u>
Maintenance and Related	6,768	165	6,933
Custodial Services	4,883	599	5,482
Utility Services	14,557	349	14,906
<u>Technical Services</u>	<u>10.412</u>	<u>1.549</u>	<u>11.961</u>
Automatic Data Processing	7,318	-13	7,305
Scientific and Technical Information	1,026	454	1,480
Support Services	2,068	1,108	3,176
<u>Management and Operations</u>	<u>15.710</u>	<u>11.865</u>	<u>27.575</u>
Administrative Communications	4,318	10,569	14,887
Printing and Reproduction	824	-71	753
Transportation	4,017	236	4,253
Installation Common Services	6,551	1,131	7,682
	<u>232,512</u>	<u>14,527</u>	<u>247.039</u>

APPROPRIATION REALLIGNMENT
SUMMARY OF BUDGET PLAN BY FUNCTION
KENNEDY SPACE CENTER

	<u>FY 1988</u> Budget <u>Estimate</u>	Appropriation <u>Realignment</u>	FY 1988 Revised <u>Budget</u>
		(Thousands of Dollars)	
I. Personnel and Related Costs	106,673	0	106,673
11. Travel	3,464	0	3,464
III. Operation of Installation	110,506	22,425	132,931
<u>Facilities Services</u>	<u>66,298</u>	<u>7,614</u>	<u>73,912</u>
Maintenance and Related	10,407	5,614	16,021
Custodial Services	27,474	2,000	29,474
Utility Services	28,417	0	28,417
<u>Technical Services</u>	<u>15,490</u>	<u>2,528</u>	<u>18,018</u>
Automatic Data Processing	12,140	-644	11,496
Scientific and Technical Information	1,384	0	1,384
Support Services	1,966	3,172	5,138
<u>Management and Operations</u>	<u>28,718</u>	<u>12,283</u>	<u>41,001</u>
Administrative Communications	2,742	4,399	7,141
Printing and Reproduction	710	5,579	6,289
Transportation	4,807	-202	4,605
Installation Common Services	20,459	2,507	22,966
	<u>220,643</u>	<u>22,425</u>	<u>243,068</u>

APPROPRIATION REALLIGNMENT

SUMMARY OF BUDGET PLAN BY FUNCTION

NATIONAL SPACE TECHNOLOGY LABORATORIES

	FY 1988 Budget <u>Estimate</u>	Appropriation <u>Realignment</u>	FY 1988 Revised <u>Budget</u>
	(Thousands of Dollars)		
I. Personnel and Related Costs	6,885	0	6,885
11. Travel	355	0	355
111. Operation of Installation	6,676	7,341	14,017
<u>Facilities Services</u>	<u>3,493</u>	<u>2,859</u>	<u>6,352</u>
Rental of Real Property	21	10	31
Maintenance and Related	751	1,242	1,993
Custodial Services	372	1,607	1,979
Utility Services	2,349	0	2,349
<u>Technical Services</u>	<u>938</u>	<u>2,352</u>	<u>3,290</u>
Automatic Data Processing	7	1,170	1,177
Scientific and Technical Information	164	107	271
Support Services	767	1,075	1,842
<u>Manaeement and Operations</u>	<u>2,245</u>	<u>2,130</u>	<u>4,375</u>
Administrative Communications	1,132	1,500	2,632
Printing and Reproduction	48	46	94
Transportation	935	37	972
Installation Common Services	130	547	677
	<u>13,916</u>	<u>7,341</u>	<u>21,257</u>

APPROPRIATION REALIGNMENT
SUMMARY OF BUDGET PLAN BY FUNCTION
GODDARD SPACE FLIGHT CENTER

	FY 1988 Budget <u>Estimate</u>	Appropriation <u>Realignment</u>	FY 1988 Revised <u>Budget</u>
	(Thousands of Dollars)		
I. Personnel and Related Costs	179,868	0	179,868
11. Travel	5,575	0	5,575
111. Operation of Installation	45,582	24,806	70,388
<u>Facilities Services</u>	<u>24,631</u>	<u>3,980</u>	<u>28,611</u>
Rental of Real Property	817	0	817
Maintenance and Related	7,024	2,421	9,445
Custodial Services	5,395	689	6,084
Utility Services	11,395	870	12,265
<u>Technical Services</u>	<u>7,871</u>	<u>6,501</u>	<u>14,372</u>
Automatic Data Processing	6,852	1,319	8,171
Scientific and Technical Information	691	2,377	3,068
Support Services	328	2,805	3,133
<u>Management and Operations</u>	<u>13,080</u>	<u>14,325</u>	<u>27,405</u>
Administrative Communications	5,256	3,728	8,984
Printing and Reproduction	78	1,547	1,625
Transportation	1,920	82	2,002
Installation Common Services	5,826	8,968	14,794
	<u>231,025</u>	<u>24,806</u>	<u>255,831</u>

APPROPRIATION REALLIGNMENT
SUMMARY OF BUDGET PLAN BY FUNCTION
AMES RESEARCH CENTER

	FY 1988 Budget <u>Estimate</u>	Appropriation <u>Realignment</u>	FY 1988 Revised <u>Budget</u>
	(Thousands of Dollars)		
I. Personnel and Related Costs	106,a63	0	106,a63
11. Travel	3,915	0	3,915
III. Operation of Installation	34,469	24,430	58,a99
<u>Facilities Services</u>	<u>19,126</u>	<u>3,446</u>	<u>22,572</u>
Rental of Real Property	21	70	91
Maintenance and Related	3,403	2,132	5,535
Custodial Services	4,082	1,244	5,326
Utility Services	11,620	0	11,620
<u>Technical Services</u>	<u>5,a71</u>	<u>8,938</u>	<u>14,809</u>
Automatic Data Processing	4,683	2,739	7,422
Scientific and Technical Information	613	2,771	3,384
Support Services	575	3,428	4,003
<u>Manaaement and Operations</u>	<u>9,472</u>	<u>12,046</u>	<u>21,518</u>
Administrative Communications	3,518	6,252	9,770
Printing and Reproduction	198	1,623	1,a21
Transportation	1,130	476	1,606
Installation Common Services	4,626	3,695	a,321
	<u>145,247</u>	<u>24,430</u>	<u>169,677</u>

APPROPRIATION REALIGNMENT
SUMMARY OF BUDGET PLAN BY FUNCTION
LANGLEY RESEARCH CENTER

	FY 1988 Budget <u>Estimate</u>	Appropriation <u>Realignment</u>	FY 1988 Revised <u>Budget</u>
		(Thousands of Dollars)	
I. Personnel and Related Costs	130,087	0	130,087
11. Travel	3,833	0	3,833
111. Operation of Installation	34,288	19,465	53,753
<u>Facilities Services</u>	<u>17.612</u>	<u>6.987</u>	<u>24.599</u>
Rental of Real Property	7	0	7
Maintenance and Related	829	5,258	6,087
Custodial Services	3,636	271	3,907
Utility Services	13,140	1,458	14,598
<u>Technical Services</u>	<u>5.822</u>	<u>4.132</u>	<u>9.954</u>
Automatic Data Processing	4,594	478	5,072
Scientific and Technical Information	1,228	3,654	4,882
<u>Management and Operations</u>	<u>10.854</u>	<u>8.346</u>	<u>19.200</u>
Administrative Communications	2,941	3,100	6,041
Printing and Reproduction	187	1,377	1,564
Transportation	4,049	161	4,210
Installation Common Services	3,677	3,708	7,385
	<u>168,208</u>	<u>19,465</u>	<u>187,673</u>

APPROPRIATION REALIGNMENT
SUMMARY OF BUDGET PLAN BY FUNCTION

LEWIS RESEARCH CENTER

	FY 1988 Budget <u>Estimate</u>	Appropriation Realignment	FY 1988 Revised <u>Budget</u>
		(Thousands of Dollars)	
I. Personnel and Related Costs	129,174	0	129,174
11. Travel	3,256	0	3,256
111. Operation of Installation	37,565	22,349	59,914
<u>Facilities Services</u>	<u>24,840</u>	<u>5,114</u>	<u>29,954</u>
Maintenance and Related	3,859	4,983	8,842
Custodial Services	4,962	125	5,087
Utility Services	16,019	6	16,025
<u>Technical Services</u>	<u>4,142</u>	<u>10,861</u>	<u>15,003</u>
Automatic Data Processing	3,023	7,287	10,310
Scientific and Technical Information	1,119	3,574	4,693
<u>Management and Operations</u>	<u>8,583</u>	<u>6,374</u>	<u>14,957</u>
Administrative Communications	2,413	0	2,413
Printing and Reproduction	0	755	755
Transportation	2,478	1,005	3,483
Installation Common Services	3,692	4,613	8,306
	<u>169,995</u>	<u>22,349</u>	<u>192,344</u>

APPROPRIATION REALLIGNMENT

SUMMARY OF BUDGET PLAN BY FUNCTION

NASA HEADQUARTERS

	<u>FY 1988</u> Budget <u>Estimate</u>	Appropriation <u>Realignment</u>	FY 1988 Revised <u>Budget</u>
		(Thousands of Dollars)	
I. Personnel and Related Costs	93,357	0	93,357
II. Travel	8,385	0	8,385
III. Operation of Installation	57,717	55,272	112,989
<u>Facilities Services</u>	<u>16,256</u>	<u>4,754</u>	<u>21,010</u>
Rental of Real Property	12,896	2,553	15,449
Maintenance and Related	2,544	2,201	4,745
Custodial Services	816	0	816
<u>Technical Services</u>	<u>25,388</u>	<u>32,111</u>	<u>57,499</u>
Automatic Data Processing	20,853	8,202	29,055
Scientific and Technical Information	3,511	19,265	22,776
Support Services	1,024	4,644	5,668
<u>Management and Operations</u>	<u>16,073</u>	<u>18,407</u>	<u>34,480</u>
Administrative Communications	3,876	2,314	6,190
Printing and Reproduction	1,388	2,287	3,675
Transportation	665	285	950
Installation Common Services	10,144	13,521	23,665
	<u>159,459</u>	<u>55,272</u>	<u>214,731</u>

APPROPRIATION REALLOCATION
SUMMARY OF BUDGET PLAN BY FUNCTION
INSPECTOR GENERAL

	FY 1988 Budget <u>Estimate</u>	Appropriation <u>Realignment</u>	FY 1988 Revised <u>Budget</u>
(Thousands of Dollars)			
I. Personnel and Related Costs	7,161	0	7,161
11. Travel	368	0	368
III. Operation of Installation	420	0	420
<u>Technical Services</u>	<u>350</u>	<u>0</u>	<u>350</u>
Automatic Data Processing	350	0	350
<u>Management and Operations</u>	<u>70</u>	<u>0</u>	<u>70</u>
Administrative Communications	25	0	25
Printing and Reproduction	3	0	3
Installation Common Services	42	0	42
	<u>7,949</u>	<u>0</u>	<u>7,949</u>

SPECIAL ANALYSES

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1989 ESTIMATES

JET PROPULSION LABORATORY

(Simulated R&PM Budget)

DESCRIPTION

The Jet Propulsion Laboratory (JPL) is located in Pasadena, California, approximately 20 miles north of downtown Los Angeles with subsidiary facilities located at Goldstone, California (tracking and data acquisition), Edwards Air Force Base, California (hazardous testing), and Table Mountain, California (open air testing and astronomy).

At Pasadena, the Laboratory occupies 176 acres of land of which 156 acres are owned by NASA and 20 acres are leased. At Goldstone, facilities are located on land occupied under permit from the Army. At Edwards Air Force Base, facilities are located on land occupied under permit from the Air Force. The facilities at Table Mountain are located on land occupied under permit from the Forest Service of the Department of Agriculture. The capital investment of the Jet Propulsion Laboratory, including the Deep Space Network, fixed assets in progress, and contractor-held facilities, as of September 30, 1987, was \$671,157,000.

The Jet Propulsion Laboratory is a Government-owned installation that is staffed and managed by the California Institute of Technology. Contract NAS7-918 between NASA and Caltech governs research, development, and related activities at the Laboratory with facilities being provided under a separate facilities contract **NAS7-920(F)**. The cost of operating JPL for NASA activities is borne by the Research and Development and the Space Flight, Control, and Data Communications Appropriations, except for the lease or purchase administrative aircraft and the purchase of passenger motor vehicles, which are funded from the Research and Program Management (R&PM) appropriation. Accordingly, the R&PM costs presented in this special analysis for JPL are for purposes of comparison only and are not a part of the NASA R&PM budget.

CENTER ROLES AND MISSIONS

The Jet Propulsion Laboratory is principally responsible for the conduct of NASA automated missions concerned with scientific exploration of the solar system and deep space; for spacecraft tracking and data acquisition; for research and analysis; and for the development of advanced spacecraft technologies including propulsion, guidance and control systems, electronics, and others. The Laboratory is also assigned responsibility for selected automated Earth-orbital projects and for the development and application of earth remote sensing technology and instruments. Implicit in these assignments is a broad range of engineering, scientific, and management functions devoted to:

1. The conduct of complete spaceflight projects, including overall project management and all phases of project activity beginning with mission design and following with spacecraft design, development, testing, flight operations, and data analysis.
2. The development and operation of the Deep Space Network (DSN) which provides tracking and data acquisition services for all NASA projects involving missions beyond near-Earth orbits.
3. Continuing programs of scientific investigation, research and analysis, and technology development.

In more specific terms, the principal Laboratory activities in support of NASA can be categorized as follows:

Solar System Exploration - Since the beginning of the Nation's space activities, JPL has devoted a major part of its efforts to exploration of the planets, their satellites, and the interplanetary medium. The Laboratory has had project management responsibility for all of the Mariner missions, including design, fabrication, assembly, and testing of the spacecraft. During more than two decades, beginning with the Mariner 2 flight to Venus in 1962, these missions have produced enormous scientific returns.

The Jet Propulsion Laboratory was a major participant in the Viking project by carrying out, among other assignments, the development of the two orbiters, each carrying a lander, which reached Mars during the summer of 1976. The Viking mission operations were repeatedly extended as the spacecraft far out-lived their design lifetimes. Operations were completed in 1983 when Viking Lander I, the last operating unit of the four, ceased functioning.

In the continuing series of planetary missions, JPL has management responsibility for the Voyager mission. The two Voyager spacecraft were launched in 1977 and made close flybys of Jupiter and its major satellites in 1979. In 1980 and 1981, the Voyager spacecraft encountered Saturn. Each of these four

Voyager planetary encounters resulted in major scientific discoveries and obtained unique data. It became evident the spacecraft would remain in good operating condition following the Saturn encounters, and, as a result, the Voyager mission was extended considerably beyond its original objectives. Voyager 2 was targeted to a flyby of Uranus, which occurred in January 1986, with highly satisfactory scientific results. Voyager 2 is now on a trajectory which will carry it to the planet Neptune in 1989. Meanwhile, Voyager 1 continues to collect and transmit data on the interplanetary space environment as it proceeds out of the solar system.

The Laboratory also has project management responsibility for the Galileo mission, which is planned to orbit Jupiter and send an instrument probe into the planet's atmosphere. The probe will make direct measurements of the physical and chemical properties of the Jovian atmosphere. During its in-orbit lifetime of about 22 months, the orbiter will observe Jupiter and its system of satellites at close range. JPL is the management center for the Galileo project and is developing the orbiter in-house. The Ames Research Center is responsible for the probe development.

The Ulysses Project is a cooperative effort between NASA and the European Space Agency (ESA) to study the sun at high solar latitudes. JPL is managing the development of the United States instruments, which will fly on ESA spacecraft, plus the corresponding data analysis. In addition, JPL is providing mission support to ESA. ESA is developing the spacecraft and a set of its own instruments.

The Magellan mission will obtain high resolution global radar imagery and altimetric and gravity data from spacecraft orbiting Venus. The objectives are to address fundamental questions regarding the origin and evolution of the planet. The primary data gathering period will extend over one Venusian year equal to 243 earth days. JPL is managing the project, including responsibility for mission design and operations. Industry will develop the spacecraft and synthetic aperture radar under contract to JPL.

The Mars Observer mission will undertake planet-wide studies of the composition and physical state of Martian materials, examine the major-surface forming processes and their time scales, and explore the structure and circulation aspects of the atmosphere. The Jet Propulsion Laboratory is the management center with responsibility for the scientific payload, and will contract with industry for development of the spacecraft bus.

Astrophysics - Consistent with its role as a center for Earth-orbital spacecraft development, JPL managed the Infrared Astronomical Satellite (IRAS) project which was launched in January 1983. This was a cooperative mission with the Netherlands and the United Kingdom. The spacecraft itself was designed and built in the Netherlands. JPL was responsible for the infrared telescope development, system testing activities, and data analysis. Flight operations were completed in November 1983. IRAS has been a highly

successful scientific undertaking, producing a database comprised of photometric observations of asteroids, stars, and galaxies in four wavelength bands from near to far infrared. This totally unique database is of such size that analysis will continue for many years.

Earth Science and Applications - In the area of space applications, JPL is a principal center for work in oceanographic applications of space technology. Development was initiated in FY 1987 on the Ocean Topography Experiment (TOPEX), a cooperative effort with France, to develop and launch an ocean-observing satellite which will map the circulation of the Earth's oceans. JPL has project management responsibility for the TOPEX, as well as responsibility for mission operations and science data processing. Another JPL-managed program in this discipline is the NASA Scatterometer instrument, which will provide global measurements of ocean surface winds, provide data on oceanic effects on the atmosphere, and contribute to improved marine forecasting.

The Laboratory also conducts significant activities in upper atmospheric research and in development and implementation of remote sensing techniques for Earth resources observations. Major flight instruments and experiments, already flown and to be re-flown, include the Shuttle Imaging Radar (SIR) and the Atmospheric Trace Molecule Spectroscopy (ATMOS) experiment. A third major instrument, the Shuttle Imaging Spectrometer Experiment (SISEX), is under development.

Other important areas of research in space applications include geodynamics and plate tectonics

Space Station - JPL performs a program requirements and assessment function for the Office of Space Station (OSS). This support consists of developing and implementing staffing and program requirements necessary for the accomplishment of the OSS mission and assessing the performance of NASA center activities in meeting those requirements. To accomplish this goal, JPL has been tasked with the responsibility of developing, maintaining and updating a program requirements document which details the staffing and management requirements of each program, the responsibilities of each program on a day to day basis, and outlines how the various systems and subsystems integrate.

JPL is also responsible for providing Flight Test Telerobotics Servicer systems engineering support to the Goddard Space Flight Center (GSFC). This support consist of JPL assisting GSFC in systems support definition of FTS flight test and in-house phasing activity, and the integration of JPL products into the GSFC Demonstration Integration and Test Facility. Additionally, the systems group at JPL is tasked with the responsibility of developing hardware control algorithms and software for delivery to GSFC in support of Flight Test Telerobotics Servicer.

Spacecraft Flight Operations - The Jet Propulsion Laboratory is responsible for the design, development, maintenance, and operation of NASA's worldwide Deep Space Network (DSN) and the Flight Project Support Office (FPSO) which provides ground support for all deep space missions. The DSN tracking stations are located in California, Spain, and Australia, and support projects involving flights beyond near-Earth orbit. The Space Flight Operations Center is located at JPL, and is the facility for actual day-to-day operations of deep-space missions. JPL has also implemented the Network tracking stations with the three DSN stations. These consolidated facilities are managed by JPL and provided an efficient, technically advanced, and cost effective means of operation.

Research and Analysis - The Jet Propulsion Laboratory maintains an effective program of advanced technical development to provide sound technologies for present and prospective project assignments and to further the general capabilities of NASA. Areas of involvement include spacecraft advance development, automation and robotics, space power and propulsion systems, microelectronics, information systems, and basic research in such fields as fluid physics, polymer materials, and applied mathematics. The Laboratory participates in scientific experiments on both JPL-managed and non-JPL-managed flight projects. This participation includes not only the performance of scientific investigations, but also major commitments to the development of scientific instruments for use in space missions. Ground-based research programs are carried out in the planetary sciences, physics and astronomy, and Earth and ocean physics. These activities involve broad collaboration with the scientific and academic communities and with staff members from other NASA field installations.

JET PROPULSION LABORATORY
 FY 1989 SIMULATED R&PM BUDGET
 DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

	1987 <u>Actual</u>	1988		1989 Budget <u>Estimate</u>
		<u>Revised Estimate</u>	<u>Current Estimate</u>	
		(Thousands of Dollars)		
<u>Space Station</u>	<u>65</u>	<u>66</u>	<u>33</u>	<u>33</u>
<u>Space Flight Programs</u>	<u>22</u>	<u>19</u>	<u>20</u>	<u>25</u>
Space Transportation Capability Development.....	14	12	14	14
Space Shuttle.....	8	7	6	11
<u>Space Science and Applications</u>	<u>1.605</u>	<u>1.528</u>	<u>1.718</u>	<u>1.739</u>
Physics and Astronomy.....	90	158	141	141
Life Science.....	12	25	11	11
Planetary Exploration.....	994	956	1,028	1,066
Space Applications.....	509	389	538	521
<u>Commercial Programs</u>	<u>3</u>	<u>7</u>	<u>4</u>	<u>4</u>
<u>Aeronautics and Space Technology</u>	<u>128</u>	<u>162</u>	<u>162</u>	<u>169</u>
Aeronautics R&T.....	2	--	2	2
Space R&T.....	126	162	160	167
<u>Safety, Reliability, Maintainability & Quality Assurance</u>	<u>7</u>	<u>0</u>	<u>10</u>	<u>10</u>
<u>Tracking and Data Advanced Systems</u>	<u>405</u>	<u>399</u>	<u>392</u>	<u>387</u>
<u>Direct Support</u>	481	473	508	533
<u>Center Management and Operations</u>	<u>1.157</u>	<u>1.144</u>	<u>1.264</u>	<u>1.325</u>
Total, Permanent Workyears.....	<u>3.873</u>	<u>3.798</u>	<u>4.111</u>	<u>4.225</u>

**JET PROPULSION LABORATORY
 FY 1989 SIMULATED R&PM BUDGET
 FUNDING PLAN BY FUNCTION**

	1987	<u>1988</u>		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousand of Dollars)		
I. Personnel and Related Costs.....	228,843	235,731	251,727	276,900
11. Travel.....	11,281	11,071	12,506	14,172
III. Operation of Installation.....	61,783	59,529	64,809	69,650
A. Facilities Services.....	(28,014)	(32,268)	(28,349)	(29,901)
B. Technical Services.....	(11,086)	(10,242)	(12,305)	(13,659)
C. Management and Operations....	<u>(22,683)</u>	<u>(17,019)</u>	<u>(24,155)</u>	<u>(26,090)</u>
Total, Fund Requirements.	<u>301,907</u>	<u>306,331</u>	<u>329,042</u>	<u>360,722</u>

EXPLANATION OF FUND REQUIREMENTS

I. PERSONNEL AND RELATED COSTS....	228,843	235,731	251,727	276,900
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The increase from the 1988 Revised Estimate to the 1988 Current Estimate is due to the change in estimated workforce levels, revised salary estimates based on 1987 experience, and related benefit costs. The increase from the 1988 Current Estimate to the 1989 Budget estimate is due to normal salary increases, associated increases in personnel benefits, and the change in the estimated workforce level.

JET PROPULSION LABORATORY
 FY 1989 SIMULATED R&PM BUDGET
 FUNDING PLAN BY FUNCTION

	1987	1988		1989
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>
		<u>Estimate</u>	<u>Estimate</u>	<u>Estimate</u>
		(Thousands of Dollars)		
11. TRAVEL.....	11,281	11,071	12,506	14,172

The increase from the 1988 Revised Estimate to the 1988 Current Estimate is due to increased workforce and the reassessment of travel requirements based on current programmatic activities and anticipated travel associated with preparation for Magellan and Galileo launches. The increase from the 1988 Current Estimate to the 1989 Budget Estimate reflects an increased workforce level and FY 1989 launch activities.

111. OPERATION OF INSTALLATION.....	61,783	59,529	64,809	69,650
A. Facilities Services.....	(28,014)	(32,268)	(28,349)	(29,901)

The decrease from the 1988 Revised Estimate to the 1988 Current Estimate is primarily attributable to a reassessment of applicable costs and a decrease in equipment costs. The net increase from the 1988 Current Estimate to the 1989 Budget Estimate is due to higher utilities costs offset by reduced building lease costs.

B. Technical Services.....	(11,086)	(10,242)	(12,305)	(13,659)
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The increase from the 1988 Revised Estimate to the 1988 Current Estimate reflects a reassessment of applicable technical services which are expected to continue in future fiscal years. The increase from the 1988 Current Estimate to the 1989 Budget Estimate results from expected price changes.

C. Management and Operations.....	(22,683)	(17,019)	(24,155)	(26,090)
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The increase from the 1988 Revised Estimate to the 1988 Current Estimate is due to revised estimates for supplies and materials and equipment. The increase from the 1988 Current Estimate to the 1989 Budget estimate is due to increased overall JPL business volume and workforce, and anticipated price increases.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1989 ESTIMATES

SUMMARY OF AIR TRANSPORTATION

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

	<u>1987</u>	<u>1988</u>		<u>1989</u>	<u>Page</u>
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>	<u>Number</u>
		<u>Budget</u>	<u>Estimate</u>	<u>Estimate</u>	
		(Thousands of Dollars)			
Research and Development.....	396,500	365,550	361,100	456,400	
Construction of Facilities.....	18,800	29,900	42,800	63,800	
Research and Program Management.....	<u>261.300</u>	<u>329.697</u>	<u>319.500</u>	<u>351.800</u>	
Total.....	<u>676.600</u>	<u>725.147</u>	<u>723.400</u>	<u>872.000</u>	
Number of direct workyears associated with air transportation.....	3,246	3,355	3,310	3,278	

The goal of the NASA aeronautical research and technology program is to conduct aeronautical research which contributes to a technology base that enables preeminence of U.S. civil and military aviation. This goal is supported by five comprehensive program objectives: (1) emphasize emerging technologies with potential for order-of-magnitude advances in capacity or performance which will enhance the U.S. defense and economic competitiveness; (2) maintain NASA's laboratory strength by repairing and modernizing critical aging national facilities, ensuring that necessary advanced scientific and engineering computational capabilities are available, and enhancing staff technical excellence by selecting highly qualified personnel and providing them with challenging career opportunities; (3) ensure the timely transfer of research results to the U.S. aeronautics community through reports, conferences, workshops, and active participation of industry in cooperative research programs; (4) ensure the strong involvement of universities in NASA's program to broaden the nation's base of technical expertise and innovation; and (5) provide technical expertise and facility support to the Department of Defense (DoD), other government agencies, and U.S. industry for major aeronautical programs. These objectives require a broad program of fundamental research that focuses on critical technologies and accelerates technology readiness for future

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1989 ESTIMATES

SUMMARY OF AIR TRANSPORTATION

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

	1987	<u>1988</u>		1989	Page
	<u>Actual</u>	<u>Revised</u>	<u>Current</u>	<u>Budget</u>	<u>Number</u>
		<u>Budget</u>	<u>Estimate</u>	<u>Estimate</u>	
		(Thousands of Dollars)			
Research and Development.....	396,500	365,550	361,100	456,400	
Construction of Facilities.....	18,800	29,900	42,800	63,800	
Research and Program Management.....	<u>261.300</u>	<u>329.697</u>	<u>319.500</u>	<u>351.800</u>	
Total.....	<u>676.600</u>	<u>725.147</u>	<u>723.400</u>	<u>875.000</u>	
Number of direct workyears associated with air transportation.....	3,246	3,355	3,310	3,278	

The goal of the NASA aeronautical research and technology program is to conduct aeronautical research which contributes to a technology base that enables preeminence of U.S. civil and military aviation. This goal is supported by five comprehensive program objectives: (1) emphasize emerging technologies with potential for order-of-magnitude advances in capacity or performance which will enhance the U.S. defense and economic competitiveness; (2) maintain NASA's laboratory strength by repairing and modernizing critical aging national facilities, ensuring that necessary advanced scientific and engineering computational capabilities are available, and enhancing staff technical excellence by selecting highly qualified personnel and providing them with challenging career opportunities; (3) ensure the timely transfer of research results to the U.S. aeronautics community through reports, conferences, workshops, and active participation of industry in cooperative research programs; (4) ensure the strong involvement of universities in NASA's program to broaden the nation's base of technical expertise and innovation; and (5) provide technical expertise and facility support to the Department of Defense (DoD), other government agencies, and U.S. industry for major aeronautical programs. These objectives require a broad program of fundamental research that focuses on critical technologies and accelerates technology readiness for future

vehicles. The program is based on a strong commitment to revitalize American competitiveness in the world aviation marketplace, enhance the safety and capacity of the national airspace system, and assure the U.S. superiority for national security.

The NASA aeronautical research and technology program is intended to develop and validate emerging technologies for use by the aviation industry well in advance of specific applications through long-term independent research and technology development which is not driven by the development and operational pressures often encountered by the DoD and industry. Fundamental research in the traditional aeronautical disciplines is pursued concurrently with systems research and technology validation.

With the U.S. superiority in aeronautics challenged as never before, the FY 1989 estimate reflects the need to accelerate technologies which are vital to long-term U.S. competitiveness, to continue a strong program in fundamental disciplines and in key areas of systems research, and to revitalize critical NASA wind tunnels. NASA's FY 1989 aeronautics program is focused on achieving the bold objectives established in the report, "National Aeronautical R&D Goals: Technology for America's Future," by the Office of Science and Technology Policy (OSTP), and by its sequel reports, "Agenda for Achievement," which enunciates an eight-point action plan for achieving the goals.

The FY 1989 research and technology program is committed to developing the technology basis for improving the nation's competitiveness and clear-cut product superiority in the international marketplace, enhancing the safety of aviation, and increasing the margin of the country's preeminence in aviation for national security. Technologies are being pursued that offer an order-of-magnitude increase in vehicle capabilities and substantial positive impact on U.S. competitiveness. Research efforts have been expanded in composite materials, advanced propulsion and aviation safety. The demands for NASA's unique wind tunnels are growing with the emergence of the National Aero-Space Plane (NASP) program, research on high-speed civil transports, and a new generation of military aircraft. In order to ensure wind tunnel availability to meet these demands, a major revitalization program is required over the next five years to modernize NASA's major wind tunnels for productive use for the next decade and into the 21st century. This program is included in the FY 1989 Construction of Facilities appropriation.

NASA, in conjunction with DoD, is developing the technology for future aerospace vehicles in the joint National Aero-Space Plane (NASP) program. The objective of the NASA transatmospheric research and technology program is to accelerate the development of the critical enabling technologies for a revolutionary new class of hypersonic/transatmospheric vehicles for the future. Such vehicles could be capable of horizontally taking off from and landing on conventional runways, using airbreathing propulsion up to, or near, orbital speed, and providing rapid and lower cost access to space.

In the contracted portion of the program during FY 1987, the five original airframe contractors were reduced to three and the engine contractors were reduced to two in a fully competitive selection process. The three remaining airframe contractors will further refine their proposed vehicle concepts, and each will also design, construct and test a wing leading edge, a wing-body structural component, and a cryogenic tank to demonstrate and verify design concepts. The two engine contractors will conduct an extensive component design and test activity and then initiate proof-of-concept engine module design and fabrication for future testing in government-furnished engine test facilities.

In the companion technology maturation portion of the NASP program, where NASA's technical activities, facilities and manpower are highly concentrated, the work will continue to focus on the critical technologies necessary to assure the full flight test potential and to enable the design and fabrication of the X-30 aircraft in the early 1990's. Major ongoing activities are directed to high-speed (scramjet) propulsion technology and performance, low-speed propulsion system integration, inlet and nozzle configuration development and testing, slush hydrogen and thermal management, advanced materials concepts and characterization, and thermal structural design concepts and testing.

NASA's comprehensive and extensive capabilities in large computational systems, including Numerical Aerodynamic Simulation (NAS) and other large Class VI computers, are fully integrated into all aspects of the government and industrial contractor activities in support of the NASP program. Design and analysis programs covering the complete speed and altitude range and the in-flight thermal environment are being developed, tested, and applied to vehicle design methods.

Additional effort will be directed to technology for advanced in-flight instrumentation systems and data acquisition methods required for the conduct of the flight testing program. Thermal loads, extremely high aerodynamic heating temperatures on the engine and airframe, and the internal cryogenic hydrogen tank conditions require instrumentation precision and reliability beyond that which is currently available. Activities at all three of the research centers will concentrate on improved and advanced instrumentation techniques.

The research and program management funding in FY 1989 provides for the salaries and travel of 3278 direct civil service workyears, for the utilities necessary to conduct wind tunnel operations, and for other general operation of installation costs necessary to conduct the NASA aeronautics and transatmospheric research and technology programs.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND DEVELOPMENT

ESTIMATED FY 1989 OBLIGATIONS FOR EQUIPMENT TO BE PLACED AT NASA INSTALLATIONS

<u>Program Budget Line Item</u>	<u>1989</u> <u>(Thousands of Dollars)</u>
<u>Research and Development</u>	<u>315.565</u>
Space Station	(200,000)
Space Transportation Capability Development	(31.084)
Physics and Astronomy	(490)
Planetary Exploration	(3.629)
Life Sciences	(1.621)
Space Applications	(9.295)
Aeronautical Research and Technology	(60.805)
Space Research and Technology	(8.441)
Safety, Reliability, and Quality Assurance	(200)
<u>Space Flight, Control, and Data Communications</u>	<u>221.248</u>
Shuttle Production and Capability Development	(147.262)
Space Transportation Operations	(50.561)
Space and Ground Network, Communication and Data Systems	(23.425)
GRAND TOTAL	<u>536,813</u>

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 NASA ADP BUDGET SYSTEM
 SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS IN FY1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY(89) OBLIGATIONS (\$ IN THOUSANDS)
SPACE STATION	MARSHALL SPACE FLIGHT CENTER LOCATION 6206-BP. 890102	DATA MANAGEMENT SYSTEMS- ANALOG/DIGITAL SIMUL FOR SPACE STATION TEST BED	PRESSURIZED MODULES	700.0
SPACE STATION	MARSHALL SPACE FLIGHT CENTER LOCATION 6208-XX. 890130	MATERIALS & PROCESSES LABORATORY-SPACE STATION ASSEMBLY AND OPERATIONS SIMULATOR	PRESSURIZED MODULES	450.0
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7200-EA. 890012	ENGINEERING DIRECTORATE-ACTION W 1 YR COSTS < \$250K & CUM COSTS < \$1M	ASSEMBLY HARDWARE/ SUBSYSTEMS	465.0
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7205-FA. 890056	SPACE STATION SUPPORT CENTER- SPACE STATION GROUND OPERATION FACILITIES	OPERATIONS CAPABILITY/ UTILIZATION	6700.0
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7210-EA. 890062	AVIONICS SYSTEMS-GUIDANCE, NAVIGATION & CONTROL-RESEARCH RESIREO	ASSEMBLY HARDWARE/ SUBSYSTEMS	688.0
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7210-EA. 890064	AVIONICS SYSTEMS-SPACE TRANSP SYSTEM FLIGHT DATA SYSTEM UPGRADE	ASSEMBLY HARDWARE/ SUBSYSTEMS	900.0
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7244-SA. 890104	MAN-SYSTEMS LABORATORIES- MANIPULATOR DEVELOPMENT FACILITY REMOTE SYSTEM	ASSEMBLY HARDWARE/ SUBSYSTEMS	1500.0
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7257-EA. 890112	ENGINEERING SIMULATIONS LABORATORY-SYSTEM ENGR MANAGER FOR WP-2 AUTOMAT	ASSEMBLY HARDWARE/ SUBSYSTEMS	600.0

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NASA ADP BUDGET SYSTEM
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS IN FY1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY(89) OBLIGATIONS (\$ IN THOUSANDS)
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7257-EA, 890116	ENGINEERING SIMULATIONS LABORATORY-SPACE STATION AUTO INTEG & ASSEM FACILITY SYS	ASSEMBLY HARDWARE/ SUBSYSTEMS	1014.0
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7257-EA, 890118	ENGINEERING SIMULATIONS LABORATORY-HARDWARE PURCHASES	ASSEMBLY HARDWARE/ SUBSYSTEMS	730.0
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7257-EA, 890180	ENGINEERING SIMULATIONS LABORATORY-ADVANCED SYSTEM DEVELOPMENT LAB	ASSEMBLY HARDWARE/ SUBSYSTEMS	1500.0
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7266-DA, 890662	FLIGHT TRAINING & PLANNING FACILITIES MOD SPACE STATION SUPPORT SYSTEMS PURCHASE	OPERATIONS CAPABILITY/ UTILIZATION	978.0
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7285-FA, 890284	SOFTWARE SUPPORT ENVIRONMENT- SSE/DF HOST SYSTEM	MANAGEMENT AND INTEGRATION	13231.0
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7285-FA, 890288	SOFTWARE SUPPORT ENVIRONMENT- HARDWARE FOR SSE/DF	MANAGEMENT AND INTEGRATION	8433.0
SPACE STATION	KENNEDY SPACE CENTER LOCATION 7601-FB, 890088	GROUND DATA MANG SYS, SPACE STATION(GDMS)-GDMS DEVELOPMENT	OPERATIONS CAPABILITY/ UTILIZATION	7005.0
SPACE STATION	KENNEDY SPACE CENTER LOCATION 7603-EA, 890088	COMPUTER AIDED DEV/ENG-SPACE STATION COMPUTER AIDED DEV/COMPUTER AIDED ENG-DEVELOPMENT	OPERATIONS CAPABILITY/ UTILIZATION	1528.0
SPACE STATION	KENNEDY SPACE CENTER LOCATION 7600-FD, 890058	SS SOFTWARE DEVELOPMENT FACILITY-SOFTWARE DEVELOPMENT FACILITY - DEVELOPMENT	OPERATIONS CAPABILITY/ UTILIZATION	8878.0
SPACE STATION	KENNEDY SPACE CENTER LOCATION 7603-FA, 890060	LOGISTICS MANAGMENT INFOR SYS -SPACE STA-LOGISTICS MANAGEMENT INFO SYS - DEVELOPMENT	OPERATIONS CAPABILITY/ UTILIZATION	2163.0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY89 OBLIGATIONS (\$ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE STATION	KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-89-17	COVERED SHIPPING FIXTURE	TRANSPORTS SPACE STATION MODULES/ELEMENTS TO AND FROM MANUFACTURING SITES, WORK PACKAGE CENTERS, AND LAUNCH SITE	3324.0	
SPACE STATION	KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-89-18	TRANSPORT AND DOLLIES	TRANSPORTS/POSITIONS SPACE STATION ELEMENTS/MODULES WITHIN THE PROCESSING FACILITY	1337.0	
SPACE STATION	KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-89-19	CASEOUS HELIUM DISTRIBUTION SYSTEM	PROVIDES SPACE STATION MODULES/ELEMENTS WITH LEAK CHECKS AND BOTTLE FILL DURING THE INTEGRATION, TESTING, AND PROCESSING OPERATIONS	1296.0	
SPACE STATION	KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-89-20	60 HZ ELECTRICAL POWER SYSTEM	DISTRIBUTES ELECTRIC POWER THROUGHOUT THE SPACE STATION PROCESSING FACILITY	4108.0	
SPACE STATION	KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-89-21	DIGITAL OPERATION INTERFACILITY COMMUNICATION SYSTEM	INFORMS ALL PERSONNEL INVOLVED IN PROCESS/TESTING OF SPACE STATION ELEMENTS/MODULES OF THE HEALTH AND STATUS OF THE SYSTEMS BEING OPERATED	608.0	
SPACE STATION	KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-89-22	WATER COOLANT SYSTEM	PROVIDES A LOW PRESSURE COOLANT LOOP TO ALL ON-BOARD SPACE STATION MODULES/ELEMENTS OPERATED DURING THE TESTING AND PROCESSING OPERATIONS	401.0	
SPACE STATION	KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-89-23	ELECTRONIC SECURITY SYSTEM	PROTECTS VITAL ASSETS AGAINST DAMAGE, SABOTAGE, THEFT, AND ASSURES THEY ARE AFFORDED THE DEGREE OF SURVIVABILITY AND PROTECTION REQUIRED FOR A CRITICAL NATIONAL SPACE RESOURCE	512.0	
SPACE STATION	KENNEDY SPACE CENTER, SPACE STATION PROCESSING FACILITY, 76-89-24	PROGRAMMABLE UNIVERSAL CHECK-OUT SYSTEM	SUPPORTS THE INTECRATIO. TEST, AND PROCESSING OPERATIONS	273.0	

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 NASA ADP BUDGET SYSTEM
 SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS IN FY1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY(89) OBLIGATIONS (\$ IN THOUSANDS)
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER LOCATION 6201- , 890012	HUNTSVILLE COMPUTER COMPLEX	OPERATIONS SUPPORT	3836.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER LOCATION 6204- , 890084	INFORMATION & ELECTRONICS SYS LAB -ACTION WITH 1 YR COST <\$250K & CUM COST <\$1M	RESEARCH & TEST OPERATIONS	600.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER LOCATION 6205- , 890088	MISSION COMPUTERS AND SOFTWARE -ACTION WITH 1 YR COST <\$250K & CUM COST <\$1M	RESEARCH & TEST OPERATIONS	368.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER LOCATION 6206- , 890090	DATA MANAGEMENT SYSTEMS OPERATIONS-INTERACTV GRAPHIC DESIGN SYS CENTRL SYS REQUIREM	RESEARCH & TEST OPERATIONS	310.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER LOCATION 6206- , 890092	DATA MANAGEMENT SYSTEMS OPERATIONS-ACTION WITH 1 YR COST <\$250K & CUM COST <\$1M	RESEARCH & TEST OPERATIONS	693.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER LOCATION 6206-CU. 890104	DATA MANAGEMENT SYSTEMS- INTERACTIVE GRAPHICS DESIGN SYS MODIF BLOC 4487	RESEARCH & TEST OPERATIONS	325.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER LOCATION 6207- , 890124	STRUCTURES & DYNAMICS LABORATORY-ACTION WITH 1 YR COST <\$250K & CUM COST <\$1M	RESEARCH & TEST OPERATIONS	300.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER LOCATION 6208- , 890128	MATERIALS & PROCESSES LABORATORY-ACTION WITH 1 YR COST <\$250K & CUM COST <\$1M	RESEARCH & TEST OPERATIONS	278.0

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 NASA ADP BUDGET SYSTEM
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PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY(89) OBLIGATIONS (\$ IN THOUSANDS)
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	KENNLLOY SPACE CENTER, HIGH ENERGY X-RAY FACILITY. 76-89-01	X-RAY MACHINE	X-RAY PAYLOAD SOLID ROCKET MOTORS PRIOR TO FLIGHT.	1100.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER, INDUSTRIAL AREA, 76-69-16	OPERATIONAL INTERCOM SYSTEM (OIS-D)	REPLACES EXISTING AUDIO/RF SYSTEM FOR COMPATIBILITY WITH NEW OIS-D SYSTEM	3500.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER LOCATION 6209- . 890138	SYSTEMS ANALYSIS & INTEGRATION LAB -ACTION WITH 1 YR COST <\$250K & CUM COST <\$1M	RESEARCH & TEST OPERATIONS	350.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER LOCATION 6909-GO. 890144	SYSIEMS ANALYSIS & INTEGRATION INTERACTIVE GRAPHICS DESIGN SVSIEM MODS BLOC 4610	RESEARCH & TEST OPERATIONS	310.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER LOCATION 6210-GD, 890154	PROPIIUSION-INTERACTIVE GRAPHICS DESIGN SVS MODS BLDG 4610	RESEARCH & TEST OPERATIONS	300.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER LOCATION 6211- 890156	SPACE SCIENCE LABORATORY- ACTION WITH 1 YR COST <\$250K & CUM COST <\$1M	RESEARCH & TEST OPERATIONS	350.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER LOCATION 6212- 890160	TEST LABORATORY-ACTION WITH 1 YR COST <\$250K & CUM COST <\$1M	RESEARCH & TEST OPERATIONS	304.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER LOCATION 6201-01, 890178	ENGINEERING ANALYSIS & DATA SYSTEM. EADS-ENGINEERING ANALYSIS & DATA SVSIEM	RESEARCH & TEST OPERATIONS	16160.0
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	JOHNSON SPACE CENTER LOCATION 7257-EA. 890128	ENGINEERING SIMULATIONS LABORATORY-CLASS VI	FLIGHT OPERATIONS	2000.0

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PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY(89) OBLIGATIONS (\$ IN THOUSANDS)
PHYSICS AND ASTRONOMY	AMES RESEARCH CENTER LOCATION 210M-00, 890242	AIRBORNE DATA ACQUISITION SYSTEMS-SYSTEM REPLACEMENT OMMAOA	AIRBORNE RESEARCH	490.0
PLANETARY EXPLORATION	JET PROPULSION LABORATORY LOCATION 5505-MC, 890056	MISSION CONTROL 6 COMP CTR COMPUTING-REPLACE 3032 6 4341 CPU'S	MISSION OPERATIONS 6 DATA ANALYSIS	515.0
PLANETARY EXPLORATION	JET PROPULSION LABORATORY LOCATION 5505-MC, 890058	MISSION CONTROL E COMP. CTR COMPUTING-UPGR OF 2ND FL PRJ UNIVAC	GALILEO	470.0
PLANETARY EXPLORATION	JET PROPULSION LABORATORY LOCATION 5505-MC, 890060	MISSION CONTROL E COMP CTR COMPUTING-UPGR OF 1S FL PRJ UNIVAC CPU'S	GALILEO	539.0
PLANETARY EXPLORATION	JET PROPULSION LABORATORY LOCATION 5506-SS, 890068	MISSION CONTROL E COMP CTR SP FL OPS-BASELINE VOYAGER ADAPTATION	MISSION OPERATIONS 6 DATA ANALYSIS	500.0
PLANETARY EXPLORATION	JET PROPULSION LABORATORY LOCATION 5506-SS, 890074	MISSION CONTROL 8 COMP CTR SP FL OPS-GALILEO ADAPTATION	MISSION OPERATIONS 6 DATA ANALYSIS	890.0
PLANETARY EXPLORATION	JET PROPULSION LABORATORY LOCATION 5506-SS, 890078	MISSION CONTROL 8 COMP. CTR SP, FL OPS-GROUND DATA SYSTEM	MISSION OPERATIONS 6 DATA ANALYSIS	285.0
PLANETARY EXPLORATION	JET PROPULSION LABORATORY LOCATION 5507-IP, 890082	GEN PURPOSE IMAGE PROCESSING- MULTI IMAGE PROCESSING IMPLEMENTATION	MISSION OPERATIONS 6 DATA ANALYSIS	362.0
LIFE SCIENCES	AMES RESEARCH CENTER LOCATION 21ED-00, 890040	INFORMATION SYSTEMS-BENDIX/ NAS2-11578 EQUIP/MIRLS/MAINI EDOCS	LIFE SCI FLIGHT EXPERIMENTS	1121.8
LIFE SCIENCES	AMES RESEARCH CENTER LOCATION 21SP-00, 890420	LSFEP, LIFE SCIENCE PROJECT OFFICE OPERATIONAL GROUND DATA SYSTEM V059	LIFE SCI FLIGHT EXPERIMENTS	500.0

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PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAO CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY(89) OBLIGATIONS (\$ IN THOUSANDS)
SPACE APPLICATIONS	GODDARD SPACE FLIGHT CENTER LOCATION 5101-AA, 890014	SCIENCE AND APPLICATIONS COMPUTING SYSTEM-SCIENCE COMPUTING FACILITY	DATA SYSTEMS	515.0
SPACE APPLICATIONS	GODDARD SPACE FLIGHT CENTER LOCATION 5101-AM, 890028	NASA HIGH SPEED COMPUTING SYSTEM-VECTOR PROCESSING FACILITY	DATA SYSTEMS	1589.0
SPACE APPLICATIONS	JET PROPULSION LABORATORY LOCATION 5503-LN, 890050	INSTITUTIONAL LOCAL AREA NETWORK-INST LOCAL AREA NET SUPPORT	APPL SYSTEMS ANALYSES AND STUDIES	237.0
SPACE APPLICATIONS	JET PROPULSION LABORATORY LOCATION 5503-MS, 890052	SCIENCE & ENGR MSN CONI /COM 6 COMM -MICRO H/W PURCHASES USER SERVICES	APPL SYSTEMS ANALYSES AND STUDIES	2613.3
SPACE APPLICATIONS	JET PROPULSION LABORATORY LOCATION 5507-TR, 890096	TRAINING RESEARCH & DEVELOPMENT-SATELLITE TRACKING TRAINER	APPL SYSTEMS ANALYSES AND STUDIES	1310.0
SPACE APPLICATIONS	JET PROPULSION LABORATORY LOCATION 5507-WG, 890104	CCN PURPOSE WAR GAMING-JT EXER SUP SYS DEVELOP SITE SYSTEM	APPL SYSTEMS ANALYSES AND STUDIES	400.0
SPACE APPLICATIONS	JET PROPULSION LABORATORY LOCATION 5508-IG, 890106	DEDICATED PROC INTERACTIVE GRAPHICS COMPUTER-AIDED ENGINEERING, DESIGN & MANUFACTURING	APPL SYSTEMS ANALYSES AND STUDIES	395.0

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY89 OBLIGATIONS (\$ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
AERONAUTICAL RESEARCH AND TECHNOLOGY	AHES RESEARCH CENTER, BUILDING 258, 21-84-03	NUMERICAL AERODYNAMIC SIMULATION	PROVIDES A LARGE-SCALE HIGH-PERFORMANCE COMPUTATIONAL RESOURCE FOR SOLVING THREE-DIMENSIONAL VISCOUS FLUID FLOW EQUATIONS SPECIFICALLY ORIENTED TOWARD THE SOLUTION OF AERODYNAMIC AND FLUID DYNAMIC PROBLEMS	23580.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	AHES RESEARCH CENTER, BUILDING N-243 21-87-04	SIMULATION CWUTER REPLACEMENT	UPGRADES SIMULATION CAPABILITIES TO SUPPORT ONGOING AND FUTURE PROGRAMS, REPLACING EXISTING EQUIPMENT	1450.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	AHES RESEARCH CENTER, BUILDING 257 21-87-06	AIRCRAFT SYSTEM MODELING AND CONTROL/ADVANCED CONCEPTS SIMULATOR	REPLACES AIRCRAFT SYSTEMS MODELING CONTROL CWUTER USED TO DRIVE THE ADVANCED CONCEPTS FLIGHT SIMULATOR TO PROVIDE INCREASED SPEED WITH WHICH COCKPIT DISPLAY AND CONTROL SYSTEMS RESPOND TO PILOT INPUTS AND SIMULATED EXTERNAL EVENTS FOR BETTER SIMULATION OF A REAL-TIME FLIGHT ENVIRONMENT	200.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	AHES RESEARCH CENTER, 40x80-FT. WIND TUNNEL HIGH BAY BUILDING N 221 21-88-02	LARGE ROTOR TEST APPARATUS	ALLOWS TESTING OF LARGE ROTOR SYSTEMS FOR TECHNOLOGY DEVELOPMENT OF ROTORCRAFT IN THE AREAS OF IMPROVED AERODYNAMIC PERFORMANCE, LOU NOISE AND VIBRATION. AND ENHANCED STABILITY	800.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	AHES RESEARCH CENTER, 40x80-, 80x120-, AND 7x10-FOOT WIND TUNNELS AND OUTDOOR AERONAUTICS RESEARCH FACILITY. 21-89-01	UPGRADE NATIONAL FULL-SCALE AERODYNAMIC COMPLEX DATA SUPPORT SYSTEM	REPLACES CURRENT DATA SUPPORT SVSTEM IN NFAC FACILITIES TO PROVIDE REAL TIME. NEAR REAL TIME, AND DATA DELIVERY FUNCTIONS FOR ALL TESTS CONDUCTED IN THESE FACILITIES	677.0	

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY89 OBLIGATIONS (\$ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
AERONAUTICAL RESEARCH AND TECHNOLOGY	AMES RESEARCH CENTER, 40x80-FOOT WIND TUNNEL. BUILDING N-221 21-89-02	ROTOR DATA ACQUISITION SYSTEM	SYSTEM WILL ALLOW DATA ACQUISITION OF ROTOR SYSTEMS IN NFAC FACILITIES FOR TECHNOLOGY DEVELOPMENT OF ROTORCRAFT IN THE AREAS OF ACOUSTIC ANALYSIS, AERODYNAMIC PERFORMANCE, AND ROTORCRAFT VIBRATION	1250.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	AMES RESEARCH CENTER, BUILDING N-257 21-89-03	SIDE WINDOW VISUAL DISPLAYS TO ADVANCED CONCEPTS FLIGHT SIMULATOR	ENHANCES EXISTING COMPUTER GENERATOR NIGHT AND VISUAL SYSTEM TO PROVIDE VIDEO SIGNALS TO THE PILOT AND COPILOT WITH SIDE VIEWS. AND VIDEO MONITORS TO DISPLAY THESE SIDE VIEWS WILL BE ADDED TO THE SIMULATOR COCKPIT	350.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER, BUILDING 1299 23-87-01	COMPUTER-AIDED DESIGN/ ENGINEERING CAPACITY FOR ELECTRONIC SYSTEMS	PROVIDES FOR ELECTRONIC DESIGN/ INSTRUMENTATION IN SUPPORT OF OVER 30 PROJECTS IN AIRCRAFT FLIGHT, SPACE FLIGHT, AND AERODYNAMIC RESEARCH	116.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER, BUILDING 1268 23-87-02	MIDRANGE COMPUTERS	UPGRADES 6 MIDRANGE PROCESSORS TO REPLACE EXISTING EQUIPMENT AND PROVIDE A 50-PERCENT INCREASE IN COMPUTING POWER TO ACCOMMODATE PRESENT AND FUTURE AEROSPACE RESEARCH REQUIREMENTS	1541.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER, BUILDING 1220 23-87-04	AVIONICS INTEGRATION RESEARCH LABORATORY UPGRADE	UPGRADES EXISTING SYSTEM TO PROVIDE ADDITIONAL STORAGE CAPACITY	160.0	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY89 OBLIGATIONS (\$ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER, BUILDING 1268 23-88-01	REAL-TIME SIMULATION SYSTEM	PROVIDES ADVANCED FIBER OPTIC DIGITAL NETWORK AND SWITCHING SYSTEM TO REPLACE EXISTING ANTIQUATED SIMULATION COMMUNICATIONS SYSTEM LINKING SIMULATOR COCKPITS WITH HOST COMPUTERS	154.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER, CENTERWIDE 23-88-02	SUPERCOMPUTER WORKSTATION SUBSYSTEM	PROVIDES MODERN WORKSTATIONS TO SUPPORT COMPUTATIONAL FLUID DYNAMICS TECHNOLOGY DEVELOPMENT	325.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER, BUILDING 1268A 23-88-03	COMPUTER-GENERATED IMAGERY (CGI) SYSTEM	PROVIDES VISUAL SCENES FOR PILOTED SIMULATORS NECESSARY TO CONDUCT RESEARCH PROGRAMS. INCLUDING AREAS SUCH AS FLIGHT MANAGEMENT, SUPERMNEUVEUBLE AIRCRAFT, AND SPACE ROBOTICS APPLICATIONS	1079.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER, BUILDINGS 1268A AND 1220. 23-88-04	VISUAL SYSTEMS FOR FLIGHT SIMULATORS	PROVIDES FOR SCENE PROJECTION AND COCKPIT WINDOW DISPLAY EQUIPMENT COMPATIBLE WITH THE CGI SYSTEM TO SUPPORT PILOTED FLIGHT SIMULATOR RESEARCH EFFORTS	400.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER, BUILDING 1268 23-88-06	MASS STORAGE	AUGMENTS MASS STORAGE CAPABILITY OF THE CENTRAL SCIENTIFIC COMPUTER COMPLEX TO PROVIDE INCREASED CAPACITY TO MEET RESEARCH NEEDS	231.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER, BUILDING 1268 23-88-08	SUPERCOMPUTER AUGMENTATION	ACQUISITION OF SUPERCOMPUTER CENTRAL PROCESSING UNIT TO PROVIDE INCREASED CAPACITY TO SUPPORT RESEARCH IN SUCH AREAS AS COMPUTATIONAL FLUID DYNAMICS, STRUCTURES, AND MATERIALS	7282.0	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY89 OBLIGATIONS (\$ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER. BUILDING 1229 23-89-01	COMPUTATIONAL STRUCTURES MINI-SUPERCOMPUTER	SUPPORTS COMPUTATIONALLY INTENSIVE STRUCTURAL ANALYSIS PROBLEMS AND ENABLES THE STUDY OF PARALLEL PROCESSING COMPUTATIONAL METHODS ON LARGE-SCALE PROBLEMS	280.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER. BUILDING 1268 23-89-02	LASER PRINTER/PLOTTER SYSTEM	REPLACES 17 IMPACT PRINTERS AND 4 ELECTROSTATIC PLOTTERS IN THE CENTRAL SCIENTIFIC COMPUTER COMPLEX WHICH GENERATES 3 MILLION PAGES OF PRINTED OUTPUT AND WORKING PLOTS PER MONTH	247.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER. BUILDING 142 22-84-03	TRADAR III HARDWARE	REPLACES OBSOLETE TRANSIENT DATA RECORDING HARDWARE AND PROVIDES A CENTRAL SYSTEM WITH 200-CHANNEL CAPACITY	106.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER. BUILDING 142 22-88-01	CLUSTER CENTRAL PROCESSING UNIT	EXPANDS CAPABILITY TO MEET INCREASED RESEARCH DEMANDS	518.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, BUILDING 142 22-88-02	ESCORT III AUGMENTATION	PROVIDES FOR REPLACEMENT OF CENTRAL PROCESSING UNIT AND GRAPHICS PERIPHERALS TO IMPROVE RESPONSE TIME BY PROVIDING FASTER UPDATE RATE AND MORE EXTENSIVE CALCULATIONS	435.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, BUILDING 142 22-88-03	SHARLD MASS STORAGE	PROVIDES ADDITIONAL HIGH CAPACITY DISK STORAGE TO MEET INCREASING DEMANDS	210.0	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND) ADP/EAB-CONTROL-NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY89 OBLIGATIONS (\$ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, BUILDING 142 22-88-04	CRAY XMP HARDWARE	PROVIDES FOR CONTINUED USE OF CRAY HARDWARE TO SUPPORT MATHEMATICAL ANALYSIS	603.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, BUILDING 142 22-88-05	IBM 3031 REPLACEMENT	REPLACES OBSOLETE SYSTEM NO LONGER SUPPORTED BY THE VENDOR AND PROVIDES FOR NUMERICAL ANALYSIS OF AEROSPACE RESEARCH DATA	1260.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER BUILDING 142 22-89-01	AMDAHL 5860/MVS REPLACEMENT	REPLACES EXISTING SYSTEM WITH MORE SPEED AND MAIN MEMORY TO MEET INCREASED DEMANDS	1680.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, BUILDING 142 22-89-02	PARALLEL PROCESSOR	ALLOWS FOR PARALLEL PROCESSING WITH EXISTING CODES AND THE DEVELOPMENT AND EVALUATION OF NEW PARALLEL ALGORITHMS IN SUPPORT OF FLUID DYNAMICS RESEARCH	64.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, BUILDING 51 22-89-03	HOT ISOSTATIC PRESS	SUPPORTS HIGH-TEMPERATURE MATERIALS ACTIVITIES AND WILL BE USED TO FABRICATE METAL MATRIX AND INTERMETALLIC MATRIX COMPOSITES	400.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, CENTERWIDE 22-89-04	LEWIS INFORMATION MANAGEMENT SYSTEM	PROVIDES SCIENTIFIC AND ENGINEERING WORKSTATIONS AND PRINTERS	1222.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, BUILDING 77 22-89-05	REAL TIME SIMULATOR	UPGRADE REAL-TIME SIMULATION SUPPORT FOR VARIOUS RESEARCH PROJECTS TO ENHANCE PRODUCTIVITY	500.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, BUILDING 142 22-89-06	COMMUNICATIONS CONTROL PROCESSOR	PROVIDES GATEWAY INTERFACE SECURITY PROCESSOR FOR MONITORING, ACCESS CONTROL, AND TRACKING PURPOSES	115.0	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, CENTERWIDE 22-89-07	INTERACTIVE COMPUTER-ASSISTED RESEARCH ENGINEERING (ICARE)	PROVIDES FOR HIGH RESOLUTION COLOR GRAPHICS TERMINALS, WORKSTATIONS, AND HARD COPY UNIT TO ENHANCE ICARE CAPABILITIES OF THE GRAPHICS AND CAD/CAM BASE WHICH SUPPORT THE RESEARCH PROGRAMS	420.0	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/LEAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY89 OBLIGATIONS (\$ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER, BUILDING 1268 23-87-02	MIDRANGE COMPUTERS	UPGRADES 6 MIDRANGE PROCESSORS TO REPLACE EXISTING EQUIPMENT AND PROVIDE A 50-PERCENT INCREASE IN COMPUTING POWER TO ACCOMMODATE PRESENT AND FUTURE AEROSPACE RESEARCH REQUIREMENTS	315.0	
SPACE RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER, BUILDING 1268 23-88-08	SUPERCOMPUTER AUGMENTATION	ACQUISITION OF SUPERCOMPUTER CENTRAL PROCESSING UNIT TO PROVIDE INCREASED CAPACITY TO SUPPORT RESEARCH IN SUCH AREAS AS COMPUTATIONAL FLUID DYNAMICS, STRUCTURES, AND MATERIALS	836.0	
SPACE RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER, BUILDING 1262 23-88-09	SECURE COMPUTER-AIDED DESIGN FACILITY	PROVIDES FOR A 32-BIT SUPER-MINICOMPUTER, WORKSTATIONS, AND ASSOCIATED PERIPHERALS IN A SECURE ENVIRONMENT TO SUPPORT MULTIDISCIPLINARY ADVANCED TRANSPORTATION CONCEPTUAL DESIGN PROGRAMS	150.0	
SPACE RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, BUILDING 142 22-88-01	CLUSTER CENTRAL PROCESSING UNIT	EXPANDS CAPABILITY TO MEET INCREASED RESEARCH DEMANDS	272.0	
SPACE RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, BUILDING 142 22-88-04	CRAY XMP HARDWARE	PROVIDES FOR CONTINUED USE OF CRAY HARDWARE TO SUPPORT MATHEMATICAL ANALYSIS	317.0	
SPACE RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, BUILDING 142 22-88-05	IBM 3033 REPLACEMENT	REPLACES OBSOLETE SYSTEM NO LONGER SUPPORTED BY THE VENDOR AND PROVIDES FOR NUMERICAL ANALYSIS OF AEROSPACE RESEARCH DATA	660.0	
SPACE RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, BUILDING 142 22-89-01	AMDARI 5360/MVS REPLACEMENT	REPLACES EXISTING SYSTEM WITH MORE SPEED AND MAIN MEMORY TO MEET INCREASED DEMANDS	880.0	
SPACE RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, CENTERWIDE 22-89-04	LEWIS INFORMATION MANAGEMENT SYSTEM	PROVIDES SCIENTIFIC AND ENGINEERING WORKSTATIONS AND PRINTERS	640.0	
SPACE RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, BUILDING 142 22-89-06	COMMUNICATIONS CONTROL PROCESSOR	PROVIDES GATEWAY INTERFACE SECURITY PROCESSOR FOR MONITORING, ACCESS CONTROL, AND TRACKING PURPOSES	91.0	
SPACE RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER, CENTERWIDE 22-89-07	INTERACTIVE COMPUTER-ASSISTED RESEARCH ENGINEERING	PROVIDES FOR HIGH RESOLUTION COLOR GRAPHICS TERMINALS, WORKSTATIONS, AND HARD COPY UNIT TO ENHANCE CARE CAPABILITIES OF THE GRAPHICS AND CAD/CAM BASE WHICH SUPPORT THE RESEARCH PROGRAMS	220.0	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY89 OBLIGATIONS (\$ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SAFETY, RELIABILITY, AND QUALITY ASSURANCE	LANGLEY RESEARCH CENTER, BLDG. 1230. 23-88-11	NONDESTRUCTIVE EVALUATION (NDE) EQUIPMENT	DEVELOPS REAL ACCEPT/PROJECT CRITERIA FOR AEROSPACE COMPONENTS	200.0	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01, 890036	SLIDELL COMPUTER COMPLEX. SCC-UNISYS 1100/92 PURCHASE	EXTERNAL TANK	1345.0	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01, 890060	SLIDELL COMPUTER COMPLEX. SCC-ACTION WITH 1 YR COST <\$250K & CUM COST <\$1M	EXTERNAL TANK	295.0	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	MARSHALL SPACE FLIGHT CENTER LOCATION 6208-46, 890134	MATERIALS AND PROCESSES-UPGRADE VAX FOR MATERIALS OAITA BASE	SPACE SHUTTLE MAIN ENGINE (SSME)	150.0	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	MARSHALL SPACE FLIGHT CENTER LOCATION 6213-XX, 890168	PROPULSION TEST LABORATORY-HIGH SPEED DATA TRANSFER SYSTEM	SPACE SHUTTLE MAIN ENGINE (SSME)	650.0	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	JOHNSON SPACE CENTER LOCATION 7200-FA. 890022	MISSION SUPPORT DIRECTORATE-ACTION WITH 1 YR COSTS < \$250K & CUM COSTS < \$1M	LAUNCH AND MISSION SUPPORT	254.0	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
 NASA AOP BUDGET SYSTEM
 SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS IN FY1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND AOP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY(89) OBLIGATIONS (\$ IN THOUSANDS)
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	JOHNSON SPACE CENTER LOCATION 7203-DA. 890044	MISSION CONTROL CENTER-MCC HOST COMPUTER AUGMENTATION	LAUNCH AND MISSION SUPPORT	1750.0
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	JOHNSON SPACE CENTER LOCATION 7203-FA. 890048	MISSION CONTROL CENTER-MCC UPGRADE EQUIPMENT	LAUNCH AND MISSION SUPPORT	3253.0
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	JOHNSON SPACE CENTER LOCATION 7208-FA. 890060	SHUTTLE MISSION SIMULATOR UPGRADES REPLACE SHUTTLE MISSION SIMULATOR COMPUTERS	LAUNCH AND MISSION SUPPORT	1633.0
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	JOHNSON SPACE CENTER LOCATION 7257-EA. 890138	ENGINEERING SIMULATIONS LABORATORY-MANIPULATOR EMULATION AUGMENTATION	ORBITER	389.0
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	JOHNSON SPACE CENTER LOCATION 7218-FA. 890202	SOFTWARE DEVELOPMENT FACILITY- FLIGHT EQUIP INTERFACE DEVICE BASE/UPG OPTIONS	ORBITER	1230.0
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	JOHNSON SPACE CENTER LOCATION 7278-FA. 890208	SOFTWARE DEVELOPMENT FACILITY- FLT EQUIP INTERFACE DEV GPC UPGRADE	ORBITER	1027.0
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	JOHNSON SPACE CENTER LOCATION 7281-FA. 890212	INTEGRATED MANAGEMENT INFORMATION CENTER-INTEGRATE	LAUNCH AND MISSION SUPPORT	800.0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION AND APP/EAB CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY89 OBLIGATIONS (\$ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	JOHNSON SPACE CENTER, BUILDING 30/35, 12-81-05	MISSION CONTROL CENTER/SHUTTLE MISSION SIMULATOR (MCC/SMS) REPLACEMENT/UPGRADE	REPLACES EQUIPMENT ENDING LIFE CYCLE AND UPGRADES CAPABILITY	27631.0	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	JOHNSON SPACE CENTER LOCATION 7108-OA. 890284	SHUTTLE MISSION SIMULATOR- SHUTTLE MISSION SIMULATOR COMPUTER LEASE	LAUNCH AND MISSION SUPPORT	5104.7	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	KENNEOV SPACE CENTER LOCATION 7602-FC. 890034	CENTRAL DATA SYSTEM OF LAUNCH PROC SYS	ORBITER	480.0	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	KENNEDY SPACE CENTER LOCATION 7602-F1. 890036	CENTRAL DATA SYSTEM OF LAUNCH PROC SYS LAUNCH PROCESSING SYSTEM(LPS) MISC EQUIP	LAUNCH SITE EQUIPMENT	4385.0	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	KENNEOV SPACE CENTER LOCATION 7602-F1. 890038	CENTRAL DATA SYSTEM OF LAUNCH PROC SYS-HONEYWELL CENTRAL DATA SUBSYS	LAUNCH SITE EQUIPMENT	20250.0	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	KENNEDY SPACE CENTER LOCATION 1602 M1. 890040	CHECKOUT, CONTROL & MONITOR SUBSYS, LPS CCHS SURVIVABILITY	ORBITER	886.0	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	KENNEDY SPACE CENTER LOCATION 7602-ME. 890042	CHECKOUT, CONTROL & MONITOR SUBSYS, LPS-CHECKOUT CONT 1 MON SUBSYS I(CCMS) SURVIVAL	LAUNCH SITE EQUIPMENT	3314.0	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	KENNEDY SPACE CENTER LOCATION 7601 P6. 800044	LPS II CHECKOUT, CONTROL & MON SW DEV-CHECKOUT CONT & MON. SUBSYS I(CCMS) H/W UPGR	LAUNCH SITE EQUIPMENT	300.0	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY89 OBLIGATIONS (\$ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER. LCC, PADS, MLP, VAB, OPF. VFF ■ SAEF-1 ■ O&C, 76-89-08	DIGITAL OPERATIONAL INTERCOM SYSTEM (OIS-D)	PROVIDES COMMUNICATIONS FOR SHUTTLE AND PAYLOAD PROCESSING AND REPLACES AGENCY OIS-A COMMUNICATION SYSTEM	6601.0	
SHUTTLE PRODUCTION AND UPABILITY DEVELOPMENT	KENNEDY SPACE CENTER, LAUNCH EQUIPMENT TEST FACILITY ■ 76-89-09	LOX AND LH2 TAIL SERVICE MASTS	PROVIDES THE LOX AND LH2 TAIL SERVICE MASTS, GROUND UMBILICAL PLATES, AND TOOLS TEST BED FOR FUTURE SHUTTLE REQUIREMENTS	2800.0	
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER, PAD 39. 76-89-10	ADVANCE HAZARDOUS GAS DETECTION SYSTEM	MONITORS HYDROGEN AND OXYGEN LEAKAGE IN THE TSM AND ORBITER PAYLOAD MY, MID-BODY AND ENGINE AFT, AND THE EXTERNAL TANK INTERTANK AREA	250.0	
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER. MATERIAL SCIENCE LABORATORY, 76 89-11	MULTI-SPECTRAL H2 F L M DETECTION	DISPLAYS NORMALLY INVISIBLE HYDROGEN FIRES ON CRT	450.0	
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER. MATERIAL SCIENCE LABORATORY, 76-89-12	HYDROGEN MASS SPECTROMETER	MONITORS ORBITER L7* DISCONNECT FOR HYDROGEN LEAKAGE IN A HELIUM BACKGROUND	1022.0	
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER. ORBITER PROCESSING FACILITY, 76-89-13	RF COMMUNICATIONS MODERNIZATION	MODERNIZES TWO-WAY VOICE COMMUNICATIONS BETWEEN PERSONNEL AWAY FROM WIRED COMMUNICATIONS FACILITIES	600.0	
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER. LC-39, SHUTTLE LANDING FACILITY, AND INDUSTRIAL AREA, 76-89-14	PHOTO OPTICS SYSTEM MODERNIZATION	PROVIDES IMPROVED QUALITY OF ENGINEERING MOTION PICTURE PHOTOGRAPHY AND ANALYSIS OF CHECKOUT AND LAUNCH OF THE SHUTTLE VEHICLE	3400.0	
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER, LC -39, 76-89-15	REPLACEMENT SOLID ROCKET MOTOR (SRM) PALLETS	REPLACES SRM PALLETS THAT HAVE BEEN STRUCTURALLY MODIFIED	1600.0	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY89 OBLIGATIONS (\$ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER, KSC LANDING SITE, 76-88-01	PRECISION LASER TRACKING SYSTEM (PLTS)	PROVIDES PRECISION MEASUREMENT SYSTEM TO CERTIFY THE SHUTTLE MICROWAVE SCANNING BEAM LANDING SYSTEMS	1699.0	
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER, LC-39, MLP-1, -2, AND -3, 76-89-02	MOBILE LAUNCH PLATFORM (MLP) ENVIRONMENTAL CONTROL SYSTEM (ECS) STATIONS	REPLACES PORTABLE PURGE UNITS WITH FIXED ECS UNITS IN EACH MLP	2000.0	
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER, OMRF, 76-89-03	ORBITER SAFING AND DESERVICING CAPABILITY	UPGRADES SAFING AND DESERVICING CAPABILITIES TO SUPPORT PROGRAM REQUIREMENTS AND FLIGHT RATES	20000.0	
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER, LC-39, 76-89-01	REDUNDANT ORBITAL PROCESSING FACILITY (OPF) AND ORBITER MAINTENANCE AND REFURBISHMENT FACILITY (OMRF) ENVIRONMENTAL CONTROL SYSTEM (ECS) STATIONS	PROVIDES FULLY REDUNDANT ECS STATIONS AT THE OPF AND OMRF	2258.0	
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEOV SPACE CENTER, LC-39, 76-89-05	FIXED ORBITER COOLANT SVSTEM STATIONS AT LAUNCH PADS	REPLACES PERMANENTLY MOUNTED MOBILE COOLANT UNITS WITH FIXED STATIONS	1900.0	
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER, LC-39, 76-89-06	SODIUM SULFITE SECOND STAGE SCRUBBER	PROVIDES SECOND STAGE TO EXISTING NO _x SCRUBBERS FOR MORE EFFICIENT ABATEMENT PROCESS	925.0	
SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER, KSC FACILITIES, 76-89-07	WIDEBAND FIBER OPTIC TRANSMISSION SVSTEH	TRANSMITS SHUTTLE PAVLOAD DATA, CARGO PAVLOAD DATA, OPERATION TV, OIS-RF, AND OTHER DATA IN KSC FACILITIES	3074.0	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	KENNEDY SPACE CENTER LOCATION 7601-SA, 890046	LAUNCH TEAM TEST SYSTEM(LTTS)-	LAUNCH SITE EQUIPMENT	8900.0	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	KENNEOV SPACE CENTER LOCATION 7602-WA, 890048	SHUTTLE PROCESSING DATA MANAG (SPDMGIT)	LAUNCH SITE EQUIPMENT	11500.0	
SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY	KENNEDY SPACE CENTER LOCATION 7602-WI, 890050	TILE PROCESSING WORK CONTROL SYS(IPWCS)-THERMAL PROTECTION SYSTEM (TPS) FAC YK AUTO CONTR	ORBITER	646.0	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
 NASA ADP BUDGET SYSTEM
 SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS IN FY1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY(89) OBLIGATIONS (\$ IN THOUSANDS)
SPACE TRANSPORTATION OPERATIONS	MARSHALL SPACE FLIGHT CENTER LOCATION 6201-XX. 890022	DATA REDUCTION FACILITY - HCC- DATA REDUCTION EQUIPMENT	FLIGHT HARDWARE	631.0
SPACE TRANSPORTATION OPERATIONS	MARSHALL SPACE FLIGHT CENTER LOCATION 6201-27. 890030	HUNTSVILLE COMPUTER COMPLEX. HCC-SHUTTLE NODE AUGMENTATION	FLIGHT HARDWARE	1045.0
SPACE TRANSPORTATION OPERATIONS	MARSHALL SPACE FLIGHT CENTER LOCATION 6201-01. 890180	ENGINEERING ANALYSIS 6 OAI SVSIEM. EADS-CONTINUED LEASE OF HIGH CAPACITY MASS STORAGE	FLIGHT HARDWARE	600.0
SPACE TRANSPORTATION OPERATIONS	MARSHALL SPACE FLIGHT CENTER LOCATION 6201-26. 890186	HUNTSVILLE COMPUTER COMPLEX. HCC-MGMT INFORMATION SVS HOST AND AUGMENTATION	FLIGHT HARDWARE	1223.0
SPACE TRANSPORTATION OPERATIONS	MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01. 890190	SLIDELL COMPUTER COMPLEX. SCC- UNISERVO SUBSYSTEM REPLACEMENT	FLIGHT HARDWARE	340.0
SPACE TRANSPORTATION OPERATIONS	MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01. 890192	SLIDELL COMPUTER COMPLEX. SCC- UNISYS 1100/70 REPLACEMENT	FLIGHT HARDWARE	346.0
SPACE TRANSPORTATION OPERATIONS	MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01. 890194	SLIDELL COMPUTER COMPLEX, SCC- XERUX 9700 PRINTER REPLACEMENT	FLIGHT HARDWARE	302.0
SPACE TRANSPORTATION OPERATIONS	MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01. 890196	SLIDELL COMPUTER COMPLEX, SCC- ACTION WITH 1 YR COST <\$250K & CUM COST <\$1M	FLIGHT HARDWARE	262.0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
 NASA APP BUDGET SYSTEM
 SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS IN FY1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY(89) OBLIGATIONS (\$ IN THOUSANDS)
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7200-FA, 890020	MISSION SUPPORT DIRECTORATE- ACTION W/ VR COSTS < \$250K & CUM COSTS < \$1M	FLIGHT OPERATIONS	791.9
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7200-RD, 890028	WHITE SANDS TEST FACILITY- ACTION W/ VR COSTS < \$250K & CUM COSTS < \$1M	FLIGHT OPERATIONS	1196.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7201-FA, 890030	CENTRAL COMPUTING FACILITY-IBM PERIPHERAL UPGRADE	FLIGHT OPERATIONS	350.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7201-FA, 890034	CENTRAL COMPUTING FACILITY- CENTER INFORMATION SYSTEM AUGMENTATION	FLIGHT OPERATIONS	753.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7201-FA, 890038	CENTRAL COMPUTING FACILITY- COMMUNICATIONS SUPPORT EQUIPMENT	FLIGHT OPERATIONS	300.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7201-FA, 890040	CENTRAL COMPUTING FACILITY- CENTER INFORMATION NETWORK REPLACEMENT	FLIGHT OPERATIONS	575.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7256-DA, 890110	SHUTTLE AVIONICS INTEGRATION LABORATORY; SHUTTLE AVIONICS INTEGRATION LAB HARDWARE	FLIGHT OPERATIONS	1400.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7257-EA, 890126	ENGINEERING SIMULATIONS LABORATORY	FLIGHT OPERATIONS	1250.0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
 NASA ADP BUDGET SYSTEM
 SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS IN FY1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND AUP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY(89) OBLIGATIONS (\$ IN THOUSANDS)
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7257-EA. 890130	ENGINEERING SIMULATIONS LABORATORY-ADV SYS DEVELOPMENT LAB HARDWARE PUR	FLIGHT OPERATIONS	1000.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7257-EA. 890134	ENGINEERING SIMULATIONS LABORATORY-HARDWARE UPGRADES FOR ISL	FLIGHT OPERATIONS	494.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7257-EA. 890136	ENGINEERING SIMULATIONS LABORATORY ARRAY PROCESSOR	FLIGHT OPERATIONS	1500.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 1265-EA. 890156	ADVANCED PROGRAMS SYSTEMS- PERIPHERAL UPGRADES	FLIGHT OPERATIONS	400.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 1266-DA. 890166	FLIGHT TRAINING & PLANNING FACILITIES-SMALL SCALE APPLICATION OF ADVANCED TECHNOLOGY	FLIGHT OPERATIONS	2232.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7266-DA. 890168	FLIGHT TRAINING & PLANNING FACILITIES-MISSION SUPPORT DATA BASE*	FLIGHT OPERATIONS	400.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7266 DA. 890172	FLIGHT TRAINING & PLANNING FACILITIES-AUTOMATION EQUIPMENT	FLIGHT OPERATIONS	725.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7266 DA. 890176	FLIGHT TRAINING & PLANNING FACILITIES-MISSION OPS DIRECTORATE INFORMATION SVS PURCHASE	FLIGHT OPERATIONS	1153.0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
 NASA ADP BUDGET SYSTEM
 SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS IN FY1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY(89) OBLIGATIONS (\$ IN THOUSANDS)
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7200-EA, 890014	ENGINEERING DIRECTORAT-ACTION W I VR COSTS < \$250K & CUM COSTS < \$1M	FLIGHT OPERATIONS	1124.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7201-EA, 890278	CENTRAL COMPUTING FACILITY- LEASE TO OWN UNISYS EQUIPMENT	FLIGHT OPERATIONS	2930.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7201-FA, 890280	CENTRAL COMPUTING FACILITY- CENTER INFORMATION SYSTEM	FLIGHT OPERATIONS	2106.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7257-EA, 890288	ENGINEERING SIMULATIONS LABORATORY-CYBER 840 5YR CEASE/PURCHASE	FLIGHT OPERATIONS	300.0
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7274-DA, 890292	FLIGHT DESIGN COMPUTATIONAL FACILITY-UNISYS 1100 LEASE	FLIGHT OPERATIONS	775.3
SPACE TRANSPORTATION OPERATIONS	KENNEUV SPACE CENTER LOCATION 7601-J3, 890022	KENNEDY INVENTORY MANAGEMENT SYS(KIMS)	LAUNCH AND LANDING OPERATIONS	550.0
SPACE TRANSPORTATION OPERATIONS	KENNEDY SPACE CENTER LOCATION 7601-P3, 890028	COMPUTER AIDED ENGINEERING SYSTEM COMPUTER AIDED ENGINEERING/COMPUTER AIDED DESIGN	LAUNCH AND LANDING OPERATIONS	1609.0
SPACE TRANSPORTATION OPERATIONS	KENNEDY SPACE CENTER LOCATION 7601-O1, 890032	UPDATE AUTOMATION SYSTEM	LAUNCH AND LANDING OPERATIONS	4149.0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY89 OBLIGATIONS (\$ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	U S RESEARCH FACILITY, DRYDEN FLIGHT RESEARCH FACILITY. 21-89-05	TELEMETRY/RADAR ACQUISITION AND PROCESSING SYSTEM	SUPPORTS FLIGHT MISSIONS AT THE WESTERN AERONAUTICAL TEST RANGE	1800.0	
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	AMES RESEARCH FACILITY, CROWS LANDING SITE, 51-89-01	MICROWAVE LANDING SYSTEM	SUPPORTS FLIGHT MISSIONS AT THE WESTERN AERONAUTICAL TEST RANGE	700.0	
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	AMES RESEARCH FACILITY, DRYDEN FLIGHT RESEARCH, FACILITY 51-89-02	MOBILE TELEMETRY/ TRACKING SYSTEM	SUPPORTS FLIGHT MISSIONS AT THE WESTERN AERONAUTICAL TEST RANGE	436.0	
SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER LOCATION 5103-BK, 890062	MISSION 6 DATA OPERATIONS TEST BED PROCF-MISSION 6 DATA OPERATIONS TEST BED PROC.	COMMUNICATIONS AND DATA SYSTEMS	467.0	
SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER LOCATION 5104-AA, 890082	NASA COMMUNICATIONS (NASCOM) SYSTEM-MANAGEMENT OPERATIONS SYSTEM NASCOW	COMMUNICATIONS AND DATA SYSTEMS	1335.0	
SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER LOCATION 5106-AE, 890092	MULTI-SATELLITE OPERATIONS CONTROL CENTER-CONTINUING MSOCC UPGRADE	COMMUNICATIONS AND DATA SYSTEMS	2446.0	
SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER LOCATION 5103 BK, 890158	MISSION 6 DATA OPERATIONS TEST BED PROCF-MISSION 6 DATA OPERATIONS TEST BED PROC.	COMMUNICATIONS AND DATA SYSTEMS	800.0	
SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS	GOOSARO SPACE FLIGHT CENTER LOCATION 5105-AB, 890166	DRSS TRACKING AND DATA RELAY SATELLITE-NETWORK CONTROL CENTER SVSTCM CONTRACT # 28620	SPACE NETWORK	1200.0	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY89 OBLIGATIONS (\$ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER LOCATION 5103-BJ, 88-005625	GENERIC TIME DIVISION MULTIPLEX (TDM) DATA CAPTURE SYSTEM	SUPPORTS COMMUNICATIONS AND DATA SYSTEMS	2100.0	
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER LOCATION 5104-AA, 88-005825	COMMUNICATIONS SWITCHING SYSTEM	SUPPORTS COMMUNICATIONS AND DATA SYSTEMS	1000.0	
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER MDG 14, 51-80-02	PROJECT OPERATIONS CONTROL CUTER	SUPPORT MISSION CONTROL WORKLOAD	800.0	
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER BLDG. 23, 51-82-01	UNIVAC 1100/82 COMPUTER AND PERIPHERALS	SPACELAB OUTPUT PROCESSOR	100.0	
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER BLDG. 14, 51-82-06	COMMAND MANAGEMENT SYSTEM	PROVIDES COMPUTING CAPABILITY FOR PROJECT OPERATIONS CONTROL CENTERS (POCC'S)	1600.0	
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER BLDG. 14, 51-82-07	ORBIT COMPUTATION SYSTEM	PROVIDES MISSION OPERATIONS OPERATIONS ORBIT COMPUTING SUPPORT	700.0	
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER BLDG 23, 51-83-03	GAMMA RAY OBSERVATORY (GRO) DATA CAPTURE SYSTEM	CAPTURES SCIENCE DATA FROM GRO SPACECRAFT	100.0	
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER, Wallops Flight Facility. 51-87-02	TRACKING SYSTEM REPLACEMENTS INCLUDING PRECISION MOBILE TELEMETRY TRACKING EQUIPMENT	FLIGHT MISSION SUPPORT	800.0	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
 NASA ADP BUDGET SYSTEM
 SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS IN FY1989 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY(89) OBLIGATIONS (\$ IN THOUSANDS)
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER, Wallops Flight Facility, 51-89-03	RF EQUIPMENT REPLACEMENT	FLIGHT MISSION SUPPORT	480.0
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER, Wallops Flight Facility, 51-89-04	MOBILE RADAR IMPROVEMENTS	FLIGHT MISSION SUPPORT	920.0
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER, BLDG. 314, 51-89-05	SERVICE PLANNING SEGMENT COMPUTER HARDWARE	NCC AUGMENTATION	1000.0
SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS	JET PROPULSION LABORATORY LOCATION 5502-NC, 890038	DEEP SPACE NETWORK CONTROL-INCREASE DSCC'S TLM, M&C, CMD CAPABILITIES	GROUND NETWORK	940.0
SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS	JET PROPULSION LABORATORY LOCATION 5502-NP, 890044	NETWORK PROJECT-HIGH RATE TELEMETRY	GROUND NETWORK	1038.0
SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS	JET PROPULSION LABORATORY LOCATION 5502-NP, 890046	NETWORK PROJECT-NETWORK OPS CONTROL CENTER (NOCC) UPGRADE	GROUND NETWORK	764.0
SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS	JET PROPULSION LABORATORY LOCATION 5502-NP, 890048	NETWORK PROJECT-GROUND COMMUNICATIONS SVSIEM UPGRADE	COMMUNICATIONS AND DATA SYSTEMS	1900.0

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1989 ESTIMATES

SUMMARY OF CONSULTING SERVICES ESTIMATES

	<u>1987</u> <u>Actual</u>	<u>1988</u>		<u>1989</u> <u>Budget</u> <u>Estimate</u>
		<u>Revised</u> <u>Estimate</u> (Thousands of Dollars)	<u>Current</u> <u>Estimate</u>	
<u>Research and Program Management</u>				
Consultants Employed by NASA.....	1,211	1,000	1,300	1,300
Contractual Services.....	<u>355</u>	<u>1,000</u>	<u>400</u>	<u>400</u>
Subtotal.....	1,566	2,000	1,700	1,700
<u>Research and Development</u>				
Contractual Services.....	2,419	2,900	2,500	2,500
Total, NASA.....	<u>3.985</u>	<u>4.900</u>	<u>4.200</u>	<u>4.200</u>

NASA uses paid consultants and consulting services contracts to provide advice and expert input in addition to or beyond that available from its in-house, civil service workforce. Management controls are established which assure that before entering into either a consultant services arrangement with an individual or consulting services contract, there is ample justification presented and the action is approved at top management levels. The use to which these services will be put is as follows:

	1987 <u>Actual</u>	1988		1989
		<u>Revised Estimate</u>	<u>Current Estimate</u>	<u>Budget Estimate</u>

(Thousands of Dollars)

Research and Program Management

Consultants Employed by NASA.....	1,211	1,000	1,300	1,300
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NASA hires experts and consultants to provide expert advice and input on the selection of experiments for future space missions. The use of contract employees, in addition to NASA civil service personnel, provides the agency with an independent view that assures the selection of experiments likely to have the greatest scientific merit. Other individuals are employed to provide independent looks at technical and functional problems in order to give top management the widest possible range of views before making major decisions. The increase from the 1988 revised estimate to the current estimate reflects 1988 experience and the agency's internal management studies.

Contractual Services.....	355	1,000	400	400
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NASA contracts with consulting services firms for studies of management policies and programs in such areas as ADP, EEO, and the NASA Management Study group (S.C. Phillips Study). The decrease from the 1988 revised estimate to the current estimate reflects the 1988 experience. In 1989, studies will continue to provide independent assessment and expertise

Research and Development

Contractual Services.....	2,419	2,900	2,500	2,500
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In consonance with its legislative charter, NASA seeks advice from many source in the private se tor on what would be the most productive future programs. The purpose for seeking such advice is to assure the widest review of programmatic thrust is available. Funds are required to provide external expertise and input into organizaitonal decisions, and evaluation of program effectiveness. In 1989, the funds will be used to support analyses conducted by the National Academy of Sciences in the Space Science and Applications, and Aeronautics and Space Technology program areas,

1989 CONGRESSIONAL BUDGET
 DETAIL OF PERMAMENT POSITIONS
 NASA TOTAL

	FY 1987 ACTUAL	FY 1988 ESTIMATE	FY 1989 ESTIMATE
Executive level II	1	1	1
Executive level III	1	1	1
Executive level V	1	1	1
Subtotal	3	3	3
=====			
ES-6	49	52	52
ES-5	108	111	112
ES-4	249	270	272
ES-3	44	50	52
ES-2	15	26	28
ES-1	12	6	6
	477	515	522
=====			
GS-18	1	1	1
GS-16	6	6	6
GS/GM-15	1,772	1,825	1,864
GS/GM-14	3,081	3,108	3,197
GS/GM-13	5,004	5,097	5,070
GS-12	2,949	2,791	3,033
GS-11	2,107	2,179	2,237
GS-10	305	316	334
GS-09	1,209	1,300	1,337
GS-08	302	317	348
GS-07	1,102	1,010	1,082
GS-06	632	640	704
GS-05	1,195	1,200	1,191
GS-04	381	390	362
GS-03	100	104	106
GS-02	29	37	24
	20,175	20,321	20,896
=====			
SPECIAL UNGRADED POSITIONS ESTABLISHED BY NASA ADMIN.	14	24	24
UNGRADED POSITIONS	1,154	1,137	1,080
TOTAL PERMAMENT POSITIONS	21,823	22,000	22,525
=====			
UNFILLED POSITIONS, END OF YEAR	24	0	0
TOTAL PERMAMENT EMPLOYMENT, EOY	21,799	22,000	22,525
=====			

1989 CONGRESSIONAL BUDGET

PERSONNEL SUMMARY

	FY 1987	FY 1988	FY 1989
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AVERAGE GS/GM GRADE	11.4	11.4	11.4
AVERAGE ES SALARY	\$73,628	\$73,811	\$73,787
AVERAGE GS SALARY	\$39,829	\$40,658	\$41,063
AVERAGE SALARY OF SPECIAL UNGRADED POSITIONS ESTAB- LISHED BY NASA ADMINISTRATOR	\$64,271	\$65,687	\$66,675
AVERAGE SALARY OF UNGRADED POSITIONS	\$29,795	\$30,628	\$31,000

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