NASA

National Aeronautics and
Space Administration

Budget Estimates

FISCAL YEAR **1988**

Volume III

Research and Program Management

Special Analyses

CONTENTS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1988 ESTIMATES

VOLUME III

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RESEARCH AND
PROGRAM
MANAGEMENT

SUMMARY
INFORMATION

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1988 ESTIMATES

GENERAL STATEMENT

The Research and Program Management appropriation provides funds for the performance and management of research, technology and test activities at NASA installations, and the planning, mnagement 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 mintenance of facilities and mage its use in support of research and development programs, and (3) provide effective and efficient technical and adninistrative support for the research and developnent programs. For 1988, an appropriation of $1,598,000,000 is requested.

The Research and Program Management appropriation provides funding for the 22,425 permanent and temporary civil service workyears (FTE) at eight mjor installations and Headquarters. This civil service workforce is NASA's most inportant resource and is vital to future space and aeronautics research activities. About seventy percent of the Research and Program Management appropriation provides for the salaries and related costs of this civil service workforce. Three percent of this appropriation is used 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 mjor portion of their technical program. 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 selected Space Station hardware and subsystems developnent and operations planning and definition.

Kennedy Space Center: Launch of Space Shuttle flights; mnagement 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; mnagement of NASA's activities on the Spacelab project; management of large autmted spacecraft projects such as the Hubble Space Telescope; conduct and development of experiments in mterials processing in space; and mnagement of selected Space Station hardware and subsystems.

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

Office of Space Science and Applications

Goddard Space Flight Center: Development and operation of Earth orbital flight experiments and autmted 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 developnent of the Space Station platforms and payload accommodations. The Wallops Flight Facility is an operational element and carponent 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 carponent 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; enviromntal quality monitoring by remote sensing; advanced space systems technology; and research in the areas of structures and mterials, 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 system research and technology; development of the space station power system; and mnagement of expendable launch vehicle program.

The 1988 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 ($1,111,631,000): Includes salaries and benefits, the government's contribution to personnel benefits for NASA permanent and temporary civil service employees (including the cost of the Federal Employees Retirement System (FERS) and thk Civil Service Retirement System (CSRS)), and for personnel of other Government agencies detailed to NASA. In FY 1988, the cost of an additional 625 FTE is included. 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 enployees.

2. Travel ($43,312,000): 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 magement; for flight mission support; for meetings and technical seminars and symposia; and for pemnent and tenporary relocations.

3. Operation of Installation ($443,057,000): Provides a broad range of services, supplies, and equipment in support of each center's institutional activities. These are divided into three mjor 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 program and technical shops supporting institutional activities; and Management and Operations, covering the cost of administrative communications, printing, transportation, medical, supply, and related services. The munts by mjor subcategory are as follows:

A. Facilities Services ($232,548,000): Includes rental of real property; the cost of maintenance, repair and related activities for facilities and equipment; custodial services; minor mdifications and alterations; and utilities services.

B. Technical Services **($89,980,000)**: Includes the cost of general purpose automatic data processing for management activities (including development of agencywide automated systems); education and informational programs; shops and other essential technical services.

C. Management and Operations **($120,529,000)**: Includes the cost of administrative camunications; printing and reproduction; administrative supplies; general purpose mterials and equipment; transportation of equipment and supplies (including payments to interagency mtor pools); medical services and other support.

SUMMARY OF THE BUDGET PLAN BY FUNCTION

	1986 Actual	1987 hnded Budget[1/]	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
I. Personnel and Related Costs.....	960,615	979,865	1,023,015	1,111,631
II. Travel.....	29,185	37,200	37,200	43,312
111. aeration of Installation.....	351,510	407,935	406,269	443,057
A. Facilities Services.....	(187,964)	(220,527)	(214,079)	(232,548)
B. Technical Services..	(64,577)	(83,347)	(83,355)	(89,980)
C. Management and aerations.. ..	(98,969)	(104,061)	(108,835)	(120,529)
Total.....	1,341,310	1,425,000	1,466,484	1,598,000

1/ Amendment Transmitted on Auguest 8, 1986

SUMMARY OF CHANGES FROM TIE. 1987 AMENDED BUDGET TO TIE. 1987 CURRENT ESTIMATE

On August 8, 1986, NASA submitted an amendment to the 1987 Budget that reduced the request from $1,441,000,000 to $1,425,000,000. The amendment identified savings resulting from the standdown of activities because of the Challenger Accident and to amend the estimate for travel because of the governmentwide increase in per diem rates. The amended request of $1,425,000,000 has been appropriated. The current estimate for 1987 is $1,466,484,000 with the $41,484,000 for the cost of the January general pay raise and the cost of inplementing the Federal Employees Retirement System (FERS) added. The President's Budget recommendation includes language to permit transfer of funds from the R&D and SFCDC appropriations.

BASIS OF THE 1988 ESTIMATE

The 1988 Budget estimte of $1,598,000,000, an increase of $131.5 million over the current 1987 estimate, provides for: a civil service ceiling of 22,425 workyears (an increase of 625 FTE from 1987), the full year cost of the January 1987 general pay raise, the estimated 1988 cost to continue implementation of FERS, a minimum level of travel to support Agency missions and programs; support service contractor effort at the anticipated wage-rates; utility usage consistent with progranmatic requirements at projected rates; and supplies, mterials, equipnent 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 1988, by functional category is summarized as follows:

1. Personnel and Related Costs ($1,111,631,000): The 1988 estimate for Personnel and Related Costs is $88.6 million higher than 1987. Of the increase, $44.9 million is for the increased 1988 cost of implementing FERS, $8.2 million for the full year cost of the January 1987 general pay increase, $28.9 million for the compensation, benefits and supporting costs for the 625 additional FTE, and the balance ($6.6 million) is for changes in reimbursements received, career developnent costs and other changes in salaries and benefits paid.

2. Travel ($43,312,000): Because the vast majority of NASA funds are spent for activity in the private sector (over 85%), travel for both progranmatic 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 pemnent personnel are degreed scientists and engineers) travel to scientific and technical meetings, seminars and symposia is inportant for the interchange of information and maintenance of their technical currency. In 1988, the growth in travel over 1987 is the increase associated with the added 625 FTE ($4.3 million) and the expected rise in the general cost of transportation, per diem and miscellaneous travel expenses.

3. Operation of Installation **($443,057,000)**: The **1988** plan provides for anticipated changes in the price levels of support service contractor wage rates and utility rates, the alteration in the funding plans fran reimbursable launch vehicles activities, the change in price levels for supplies, mterials, 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 **625** additional **FTE** planned for in **1988.**

A. Facilities Services **($232,548,000)**: The **1988** estimte, an increase of **$18,469,000** over the **1987** current estimte, covers the anticipated rate and price increases for utilities, support contractor wage rates, supplies, mterials, equipment and minor contractual effort, minor changes to support levels, principally needed as Space Shuttle flights resume and support to increased civil service staffing.

B. Technical Services **($89,980,000)**: The **$6,625,000** increase in **1988** covers anticipated support service contractor wage-rates, the anticipated cost of supplies, mterials, equipment and other contractual efforts, and support to increased civil service staffing.

C. Management and Operations **($120,529,000)**: The **$11,694,000** increase in this subcategory is the result of the support to increased civil service staffing, increased costs of supplies, mterials, 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 resurption of Space Shuttle flights.

In summary, the **1988** budget requirement of **$1,598,000,000** is to provide for **22,425** 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 pemnent 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. Program such as students participating in cooperative training, summer employment, youth opportunity, and tenporary clerical support are covered in this 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 Carpensation: 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 conpensation, NASA, as authorized and required by law, mkes the employer's contribution to personnel benefits. These benefits include contributions to the Civil Service Retirement Fund, the Federal Employees Retirement System, enployees' life and health insurance, payments to the Medicare fund for pemnent enployees, and social security contributions for non-permanent personnel. Payments to the civil service retirement fund for re-enployed annuitants and for severance pay to former enployees 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-mturity surveys.

3. Personnel Training: Training is provided within the framework of the Govermnt Employees Training Act of 1958. Part of the training costs consists of courses offered by other Govermnt agencies, and the remainder provides for training through nongovermnt sources.

II. TRAVEL

A. Program Travel:

The largest part of travel is for direction, coordination and magement 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 subsystem, the number of design reviews, and the number and carplexity 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 developnent to participate in both Govermnt 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 problem to their associates and provides for the dissemination of technical results to the United States community. Many of the Govermnt sponsored meetings are working panels convened to solve certain problems for the benefit of the Govermnt.

C. Management and Operations Travel:

Management and operations travel provides for the direction and coordination of general magement matters and travel by officials to review the status of program. It includes travel by functional mnagers in such areas as personnel, financial magement 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 mtor pools are included in the Operation of Installation function (Management and Operations subfunction).

III. 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 mjor 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 mnagement activities, and the cost of educational and infomtion programs and technical shops supporting institutional activities); and Management and werations (the cost of administrative communications, printing, transportation, medical, supply, and related services). A description of each mjor subfunction follows:

A. Facilities Services:

Rental of Real Property: Rental of real property includes the rental of building space directly by NASA or through the General Services Ministration 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 conplex 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.

Maintenance and Related Activities: Maintenance and related activities include the recurring day-to-day mintenance of facilities (grounds, buildings, structures, etc.) and equipment acconplished 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 mintenance and other services are reflected for office, shop, laboratory and other facilities equipment as well as administrative internal cmnications 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 mintenance of general purpose data processing equipnent which supports institutional operations at each installation. Excluded is equipment dedicated to specific research or operational systems which is funded from the Research and Developnent or the Space Flight, Control and Data Communications appropriations.

b. Operations: Operations services include programing, 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 Program:

a. Libraries: The technical libraries are established to provide installation staff with books, periodicals, technical reports and other scientific docmntation.

b. Education and Information Program: The educational and informational program provide for the docmntation and dissemination of information about the Agency's program to the general public, the educational community at the elementary and secondary levels, and the mass cmnications media. Assistance to the mass cmnications 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. Shop and Support Services: Shop and support services include general fabrication shops, reliability and quality assurance activities, safety, photographic services, graphics, and audio-visual mterial.

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 mintenance of all general purpose motor vehicles used by both civil service and support contractor personnel. 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

	1986 Actual	1987 Amended Budget	1987 Current Estimate	1988 Budget Estimate
	(IN TOTAL WORKYEARS)			
Johnson Space Center	3,337	3,312	3,244	3,472
Kennedy Space Center	2,097	2,112	2,110	2,137
Marshall Space Flight Center	3,303	3,324	3,324	3,484
National Space Technology Laboratories	133	134	134	149
Goddard Space Flight Center	3,648	3,675	3,675	3,675
Anies Research Center	2,112	2,144	2,144	2,144
Langley Research Center	2,865	2,911	2,911	2,911
Lewis Research Center	2,704	2,694	2,694	2,694
Headquarters	1,354	1,357	1,353	1,623
Inspector General	107	107	111	136
TOTAL, NASA	21,660	21,800	21,800	22,425

SUMMARY OF BUDGET PLAN BY INSTALLATION

(IN THOUSANDS OF COLLARS)

Johnson Space Center	206,010	213,770	225,965	249,046
Kennedy Space Center	192,229	198,251	189,777	220,643
Marshall Space Flight Center	194,217	202,172	208,049	232,512
National Space Technology Laboratories	11,212	11,313	12,014	13,916
Goddard Space Flight Center	199,485	214,338	218,433	231,025
Ames Research Center	123,325	133,913	135,129	145,247
Langley Research Center	145,644	155,033	158,173	168,208
Lewis Research Center	143,415	150,320	157,171	169,995
Headquarters	120,449	140,396	145,344	158,866
Inspector General	5,324	5,404	6,429	8,542
TOTAL, NASA	1,341,310	1,425,000	1,466,484	1,593,000

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

NASA TOTAL

	1986 ACTUAL	1987 AMENDED BUDGET ESTIMATE	1987 CURRENT ESTIMATE	1988 BUDGET ESTIMATE
Space Station	1,603	2,128	2,101	2,779
Space Flight Programs	5,144	4,473	5,026	4,883
Space Trans. Capab. Dev.	1,370	1,504	1,214	1,174
Space Shuttle	3,774	2,969	3,812	3,709
Space Science and Applications	4,197	4,188	3,816	3,754
Physics and Astronomy	2,283	2,252	1,965	1,943
Life Sciences	250	251	245	246
Planetary Exploration	182	180	179	180
Space Applications	1,482	1,505	1,427	1,385
Aeronautics & Space Tech	4,615	4,885	4,807	4,812
Aeronautical Res & Tech	3,350	3,418	3,216	3,192
Space Res & Tech	1,265	1,275	1,271	1,296
Transatmospheric RST	0	192	320	324
Commercial Programs	114	118	128	129
Safety, Reliability and Quality Assurance	27	0	33	60
Tracking and Data Programs	707	674	665	668
SUBTOTAL DIRECT	16,407	16,466	16,576	17,085
Center Management & Operations	4,605	4,581	4,501	4,593
SUBTOTAL (FTP'S)	21,012	21,047	21,077	21,678
Other Controlled FTE's (PMI's/Co-ops/OTFTP's)	648	753	723	747
GRAND TOTAL (FTE)	21,660	21,800	21,800	22,425

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
FISCAL YEAR 1988 ESTIMATES
RESEARCH AND PROGRAM MANAGEMENT
DISTRIBUTION OF BUDGET PLAN BY FUNCTION BY INSTALLATION

(THOUSANDS OF DOLLARS)

FUNCTION	TOTAL NASA	JOHNSON SPACE CENTER	KENNEDY SPACE CENTER	MARSHALL SPACE 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 COSTS											
1986 ACTUAL	960,615	155,899	92,835	148,087	5,318	156,929	93,571	116,350	112,766	74,033	4,827
1987 BUDGET	979,865	157,229	95,506	152,178	5,193	162,915	96,698	118,595	112,842	73,781	5,008
1987 CURRENT	1,023,815	165,001	98,895	155,886	5,838	169,165	100,451	123,246	119,265	79,820	5,448
1988 ESTIMATE	1,111,631	178,707	106,073	172,856	6,805	179,868	106,863	130,887	129,174	93,357	7,161
TRAVEL											
1986 ACTUAL	29,185	4,519	2,088	4,780	190	4,542	2,811	2,839	2,548	4,652	216
1987 BUDGET	37,200	5,920	3,180	6,245	220	5,409	3,293	3,554	3,198	5,911	270
1987 CURRENT	37,200	5,700	2,650	6,220	220	5,310	3,729	3,650	3,101	6,345	275
1988 ESTIMATE	43,312	6,835	3,464	7,326	355	5,575	3,915	3,833	3,256	8,385	368
OPERATION OF INSTALLATION											
1986 ACTUAL	351,510	45,592	97,306	41,350	5,704	38,014	26,943	26,455	28,101	41,764	281
1987 BUDGET	407,935	52,621	99,565	43,749	5,900	46,014	33,922	32,884	34,280	58,784	216
1987 CURRENT	406,269	55,264	98,232	45,943	5,956	43,958	30,949	31,277	34,805	59,575	310
1988 ESTIMATE	443,057	63,504	110,506	52,330	6,676	45,582	34,469	34,288	37,565	57,717	420
Facility Svcs											
1986 ACTUAL	187,964	25,125	58,484	20,657	3,366	20,036	15,132	13,872	20,327	10,965	0
1987 BUDGET	221,083	29,167	61,064	21,359	3,116	24,251	21,510	17,723	24,202	18,691	0
1987 CURRENT	214,079	29,362	59,820	23,031	3,137	22,308	17,859	16,182	22,935	19,454	0
1988 ESTIMATE	232,548	34,084	66,298	26,208	3,493	24,631	19,126	17,612	24,840	16,256	0
Technical Svcs											
1986 ACTUAL	64,577	8,695	13,206	7,808	612	5,687	4,007	4,594	2,356	17,376	236
1987 BUDGET	82,791	9,880	13,024	8,145	714	9,694	4,186	6,771	3,856	26,370	151
1987 CURRENT	83,355	12,083	12,925	8,568	709	9,332	4,486	6,150	3,718	25,141	243
1988 ESTIMATE	89,980	13,696	15,490	10,412	938	7,871	5,871	5,822	4,142	25,388	350
Management and Operations											
1986 ACTUAL	98,969	11,772	25,616	12,885	1,726	12,291	7,804	7,989	5,418	13,423	45
1987 BUDGET	104,061	13,574	25,477	14,245	2,070	12,069	8,226	8,390	6,222	13,723	65
1987 CURRENT	108,835	13,819	25,487	14,344	2,110	12,318	8,613	8,945	8,152	14,980	67
1988 ESTIMATE	120,529	15,724	28,718	15,710	2,245	13,080	9,472	10,854	8,583	16,073	70
TOTAL											
1986 ACTUAL	1,341,310	206,010	192,229	194,217	11,212	199,485	123,325	145,644	143,415	120,449	5,324
1987 BUDGET	1,425,000	215,770	198,251	202,172	11,313	214,338	133,913	155,033	150,320	138,396	5,494
1987 CURRENT	1,466,484	225,965	199,777	208,049	12,014	218,433	135,129	158,173	157,171	145,740	6,033
1988 ESTIMATE	1,598,000	249,046	220,643	232,512	13,916	231,025	145,247	168,208	169,995	159,459	7,949

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, 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; [$1,425,000,000] ***$1,598,000,000***: ***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. *(Additional* authorizing ***legislation to be proposed.)***

Note.—Public Laws 99-500 and 99-591, section 101(g), provide funds to the extent and in the manner provided for in the conference version of H.R. 5313, Department of Housing and Urban Development-Independent Agencies Appropriations Act, 1987.

OBJECT CLASSIFICATION
(Thousands of Dollars)

		1986 Actual	1987 Estimte	1988 Estimte
	Direct obligations:			
	Personnel conpensation:			
11.1	Full-time permnent	813.871	840.864	873.171
11.3	Other than full-time pemnent	13.509	15.660	16.203
11.5	Other personnel conpensation	15.236	16.691	18.402
11.8	Special personal services payments	5.086	6.454	7.226
11.9	Total personnel conpensation	847.702	879.669	915.002
12.1	Personnel benefits: Civilian	100.634	125.911	177.018
13.0	Benefits for former personnel	306	303	324
21.0	Travel and transportation of persons	29.185	37.200	43.312
21.0	Payments to interagency motor pools	1.465	1.377	1.485
22.0	Transportation of things	2.457	6.925	5.947
23.1	Rental payments to GSA	8.559	11.253	12.755
23.2	Rental payments to others	237	130	1.000
23.3	Communications, utilities and miscellaneous charges	97.172	106.817	120.282
24.0	Printing and reproduction	2.380	3.057	3.128
25.0	Other services	226.429	259.156	282.519
26.0	Supplies and mterials	16.652	16.994	19.298
31.0	Equipment	7.574	17.338	15.571
32.0	Lands and structures	22	32	36
41.0	Grants, subsidies, and contributions	536	322	323
99.0	Subtotal. direct obligations	1.341.310	1.466.484	1.598.000
99.0	Reimbursable obligations	40.309	40.000	40.000
99.9	Total obligations	1.381.619	1.506.484	1.638.000

INSTALLATION
JUSTIFICATION

JOHNSON
SPACE CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1988 ESTIMATES

LYNDON B. JOHNSON SPACE CENTER

DESCRIPTION

The Lyndon B. Johnson Space Center (JSC) is located approximtely 20 miles southeast 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, 1986 was $782,553,000.

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

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

Space Shuttle Production and werations Capability - mdification of the orbiter for safe return to flight, system modifications and improvements, production of the replacement orbiter, and support to NASA Headquarters for mnagement of the Shuttle system including: Shuttle configuration mnagement; Shuttle system engineering and integration; and detailed program planning, direction, and scheduling; and development, acquisition and/or mdifications 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 Systems - develop and demonstrate Environmental Control and Life Support Systems (ECLSS) and Extravehicular Activity (EVA) system suitable for STS and advanced needs.

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

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

Advanced Missions - mnage studies to define advanced transportation and orbital system.

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

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

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

Life Science

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

Food Systems Technology - develop nutritional requirements and food preparation and packaging

system 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.

Technology Experiments in Space - m a g e 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 developnt of techniques to process, understand, and apply the data obtained.

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

JOHNSON

	1986 ACTUAL	1987 AMENDED BUDGET ESTIMATE	1987 CURRENT ESTIMATE	1988 BUDGET ESTIMATE
Space Station	662	815	802	900
Space Flight Programs	1,948	1,782	1,846	1,869
Space Trans. Capab. Dev.	541	563	458	450
Space Shuttle	1,407	1,219	1,388	1,419
Space Science and Applications	142	142	130	124
Physics and Astronomy	24	25	23	16
Life Sciences	82	73	67	67
Planetary Exploration	31	33	29	29
Space Applications	5	11	11	12
Aeronautics & Space Tech	28	39	28	28
Aeronautical Res & Tech	0	1	0	0
Space Res & Tech	28	38	28	28
Commercial Programs	5	6	6	4
SUBTOTAL DIRECT	2,785	2,784	2,812	2,925
Center Management & Operations	458	469	435	441
SUBTOTAL (FTP'S)	3,243	3,253	3,247	3,366
Other Controlled FTE's (PMI's/Co-ops/OTFTP's)	94	89	97	106
GRAND TOTAL (FTE)	3,337	3,342	3,344	3,472

PROGRAM DESCRIPTION

Permanent Civil
Service Workyears

RESEARCH AND DEVELOPMENT

SPACE STATION..... 900

As one of NASA's four mjor 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 contract in FY 1987, the staffing for FY 1988 provides for the management of initial developnent activities through the Preliminary Design Review.

Specific JSC Space Station project responsibilities are software for the integrated truss assembly; mobile transporter; airlocks and 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 cmnications and tracking system (except internal audio and video); the guidance, navigation, and control system and EVA systems.

SPACE FLIGHT PROGRAMS

SPACE TRANSPORTATION ILITY VELOPMENT 450

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 perfomnce of its assigned responsibilities. JSC is responsible for crewmission training in conjunction with flight hardware and the developnent 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 equipnent provide 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 program 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 developmnt of upper stages and the integration of payloads have been and will continue to be mjor tasks of interest. 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.....	1,419

The 1988 staffing provides for continuation of the Shuttle production activities to support a schedule consistent with the major program milestones. It also provides developmnt, integration, and operations support for the Mission Control Center (MCC) and the Shuttle Mission Simlator (SMS).

Activities consistent with operation of the orbiter fleet and procurement of necessary flight and ground support equipnent will be continued. Also included are those activities necessary to m a g e the build of the replacement orbiter. The National Space Transportation System 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 mnagement. Overall mnagement 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 subsystems. JSC is responsible for a large quantity of supporting equipmnt. Examples of such equipnent are: extra-vehicular mobility unit, closed circuit television, survival radio sets, dosimetry, crew equipnent, photographic camera systems, and bioinstrunentation.

To integrate all vehicle systems into an efficient operating system, m y 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 system. General capability and performance criteria are established for special areas of consideration such as

electromagnetic conpatibility and lightning protection. System operations require the preparation of system perfomce 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 system; performing engineering analysis and perfomce evaluation for communication and tracking systems ground testing; providing expertise in guidance, navigation, control, instrunentation and electrical power distribution; mnagement and operation of orbital maneuvering system conponents, reaction control engine perfomce, and reaction control system engine valve detection techniques; analysis of vehicle attachment and separation systems; analysis of total Shuttle system, Shuttle/payload interface, crew station evaluation, and engineering analysis to determine overall vehicle perfomce characteristics in the area of aerodynamic performance, flight characteristics, perfomnce, and dynamics including aeroelasticity.

The successful flight and operations performce of the Space Shuttle is dependent on the proper functioning of integrated electronic equipnent. Collectively, these are termed the Integrated Avionics System. Avionics provides the Shuttle pilots and crew with the total assessment and command capability necessary to mnage, 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, instrunentation, 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 equipnent, 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 system operational procedures and checklists. Tasks include preparation of developnent system and software handbooks, flight rules, detailed crew activity plans and procedures, developnent of MCC and network system 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

system; and the developnent 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 developnent and analysis, acconplished immediately prior to the flight. The software activities for operational flights also include the continued developnent, 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 enconpasses the flight design, flight analysis, and software preparation activities. The flight design tasks include supporting the crew training sirmlations and developnent 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, forrmlation, and verification support for the guidance, targeting and navigation system software requirements in the orbiter and MCC. In addition, the flight dependent data co-located in the erasable memory (mission-tomission 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 1inks.

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 system) 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 volune 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-tomission 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.

Permanent Civil
Service Workyears

SPACE SCIENCE AND APPLICATIONS

PHYSICS AND ASTRONOMY..... 16

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. JSC integrates the experiments into other Spacelab pallets, such as the OAST Multi Purpose Experiment Structure (MPES) Pallet and the large format camera. In some cases, JSC also designs and develops the individual experiments to be used on the missions.

LIFE SCIENCES..... 67

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 performce, 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 developnent has been initiated. JSC has mission mnagement responsibility for the life sciences payloads, which includes systems management and engineering of the payload equipnent and operation of the payload during f1ights.

PLANETARY EXPLORATION..... 29

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 infomtion 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 mterials and of remote sensing data, a theoretical studies program and a programwhich is involved in the developnent of remote sensing instrunentation. The definition of geoscience requirements for future planetary flight missions involves extensive interaction with the planetary science community.

	Permanent Civil Service Workyears
SPACE APPLICATICNS	12

Space applications flight project responsibilities at JSC center around Shuttle payload instrunent developnent. 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 mnagement responsibilities for the Earthward-looking remote sensing missions OSTA-5 and OSTA-7. This includes the mission planning, real-time mission control, mission requirements definition, and experiment integration.

AERONAUTICS AND SPACE TECHNOLOGY

SPACE RESEARCH AND TECHNOLOGY	28

JSC is undertaking the study of a family of technologies for the Space Station era and for improved STS operations. The technologies include: improvement of man-machine interactions in space, advanced thermal concepts, evaluation of ADA language in NASA flight systems, enviromntally controlled life support systems efficiencies, developnent of docking/berthing system required for large space systems, data system architectural designs, and methodologies to improve cost effectiveness of guidance, navigation and control system.

COMMERCIAL PROGRAMS AND TECHNOLOGY UTILIZATION	4

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 govermnt 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 developnent 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.

	Permanent Civil Service Workyears
CENTER MANAGEMENT AND OPERATIONS SUPPORT.....	441

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.

Management 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 magement, and magement system and analysis.

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

SUMMARY OF RESOURCES REQUIREMENTS

Funding Plan by ɜti

		1986 Actual	1987 hnded Budget Estimte	1987 Current Estimte	1988 Budget Estimte
			(Thousands of Dollars)		
I.	Personnel and Related Costs.....	155,899	157,229	165,001	178,707
11.	Trael.....	4,519	5,920	5,700	6,835
111.	Operation of Installation.....	45,592	52,621	55,264	63,504
	A. Facilities Services	(25,125)	(29,167)	(29,362)	(34,084)
	B. Technical Services	(8,695)	(9,880)	(12,083)	(13,696)
	C. Management and Operations	(11,772)	(13,574)	(13,819)	(15,724)
	Total, fund requirements	206,010	215,770	225,965	249,046

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
I. **PERSONNEL AND RELATED COSTS**	155.899	157.229	165.001	178.707
Summary of Fund Requirements				
A. Compensation and Benefits				
1. Compensation				
a. Full-time pemnent	130.937	129.006	134.126	137.953
b. Other than full-time permnent	1.662	1.748	2.031	2.268
c. Reimbursable detailees	3.953	5.957	5.031	5.660
d. Overtime and other compensation	2.192	2.682	2.330	2.399
Subtotal. Carpensation	138.744	139.393	143.518	148.280
2. Benefits	15.688	15.913	19.325	27.556
Subtotal. Carpensation and Benefits	154.432	155.306	162.843	175.836
B. Supporting Costs				
1. Transfer of personnel	469	623	702	1.333
2. Personnel training	998	1.300	1.456	1.538
Subtotal. Supporting Costs	1.467	1.923	2.158	2.871
Total. Personnel and Related Costs	155.899	157.229	165.001	178.707

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
A. Carpensation and Benefits....	154,432	155,306	162,843	175,836
1. Compensation...	138,744	139,393	143,518	148,280
a. Full-time pemnent	130,937	129,006	134,126	137,953

The Current Estimte for 1987 reflects a change from the 1987 Amended Budget Estimte due to a pay raise for special salary-rate employees, a general pay raise, and the estimte for the Federal Employees Retirement System (FERS). The 1988 Budget Estimte includes funding for an addition to the civil service workforce, and full year cost of the 1987 pay raise.

Basis of Cost for Full-time Workyears

In 1988, the cost of full-time workyears will be $137,953,000.

Cost of full-time pemnent workyears in 1987		134,126
Cost increases in 1988		7,855
Within grade and career advances:		
Full year cost of 1987 increases	1,140	
Partial year cost of 1988 actions	1,277	
Extra day	499	
Full year cost of the 1987 pay raise	1,039	
Additional FTE in 1988	3,900	
Cost decreases in 1988		-4,028
Full year effect of 1987 turnover savings	-1,214	
Partial year effect of 1988 turnover savings	-2,814	
Cost of full-time pemnent workyears in 1988		137,953

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
b. Other than full-time permnent				
1. Cost	1,662	1,748	2,031	2,268
2. Workyears	132	135	143	152

The distribution of 1988 workyears is as follows:

Distribution of Other than Full-Time Workyears

Program	Workyears
Development programs	83
Summer programs	12
Other tenporary programs	11
Youth Opportunity Programs	46
Total	152

The increase from the 1987 Amended Budget Estimte to the 1987 Current Estimte and to the 1988 Budget Estimte are the result of the mix between tenporary and permanent workyears. These increases are primarily due to the increases in the developmental programs (Co-ops and PMI's), and an increase in the summer programs.

c. Reimbursable detailees	3,953	5,957	5,031	5,660

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 1987 Amended Budget Estimte to the 1987 Current Estimte is due to a reduction in the number of detailees. FY

1988 is higher due to an increase of detailees to support the resumption of shuttle flights.

	1986 Actual	1987 hnded Budget Estimate	1987 Current Estimte	1988 Budget Estimte
d. Overtime and other compensation	2,192	2,682	2,330	2,399

Overtime in 1987 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 decrease from the 1987 estimte to the 1987 Current Estimte is due to greater than anticipated Shuttle standdown savings. The 1988 Budget Estimte accounts for partial year funding of Shuttle flight overtime activity.

2. Benefits	15,688	15,913	19,325	27,556

The following are the munts of contribution by category:

Civil Service Retirement Fund	9,180	9,168	12,194	20,110
Employee Life Insurance	283	314	280	295
Employee Health Insurance	3,287	3,528	3,443	3,572
Workmen's Compensation	694	675	698	705
FICA	729	738	1.128	1,168
Medicare	1,479	1,452	1,534	1,658
Other benefits	36	38	48	48
Total	15,688	15,913	19,325	27,556

The increases from the 1987 Amended Budget Estimte to the 1987 Current Estimates are due primarily to the January 1, 1987 pay raise, and the new Federal Employees Retirement System. The increase in 1988 is due to the pay raise, and the full year effect of the FERS and an addition to the civil service workforce.

	1986 Actual	1987 hnded Budget Estimte	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
B. Supporting Costs.....	1,467	1,923	2,158	2,871
1. Transfer of Personnel.....	469	623	702	1,333

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 increase in 1987 reflects expected increases in the number of accessions. Accessions will increase significantly in 1988 because of authorization of additional civil service workforce.

2. Personnel Training.....	998	1,300	1,456	1,538

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 1987 hnded Budget Estimate to the 1987 Current Estimate reflects an increase in the level of training, as well as an increase in projected tuition and other costs. The increase in the 1988 Budget Estimate over the 1987 Current Estimte is due to inflation and anticipated tuition increases and training for additional new hires.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		'(Thousands of Dollars)		
I. TRAVEL	4,519	5,920	5,700	6,835

Summary of Fund Requirements

A. Program Travel.....	3,497	4,840	4,495	5,471
B. Scientific and Technical Development Travel.....	359	430	419	539
C. Management and merations Travel.....	663	650	786	825
Total, Travel.....	4,519	5,920	5,700	6,835

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimte
	(Thousands of Dollars)			

Explanation of Fund Requirements

A. Program Travel	3,497	4,840	4,495	5,471

Program Travel is specifically required for the accomplishment of the Center's mission and accounts for approximtely 80 percent of the travel budget for 1988. The 1987 travel supports the planned increase of support to production of a replacement orbiter and a modest increase in Space Station support. In addition to supporting Shuttle production the 1988 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. Scientific and Technical Development Travel	359	430	419	539

Scientific and technical developnt travel permits errployees to participate in meetings and technical seminars with other representatives of the aerospace community. A relatively stable level of support is anticipated with changes for 1987 and 1988 occurring only to reflect changes in travel costs for per diem and transportation.

C. Management and Operations Travel	663	650	786	825

Management and operations travel is used for the direction and coordination of general mnagement matters. It includes travel in such areas as personnel, financial magement, and procurement activities; travel of the Center's top mnagement to NASA Headquarters and other NASA Centers; and local transportation. The increase for the 1987 Current Estimte is due to the nature of the redefinition and planning work scheduled for fiscal year 1987. This work will carry over somewhat into 1988.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
III. OPERATION OF INSTALLATION	**45,592**	**52,621**	**55,264**	**63,504**
Summary of Fund Requirements				
A. Facilities Services	25,125	29,167	29,362	34,084
B. Technical Services	8,695	9,880	12,083	13,696
C. Management and Operations	11,772	13,574	13,819	15,724
Total, Operation of Installation	45,592	52,621	55,264	63,504

Explanation of Fund Requirements

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

The increase from the 1987 Amended Budget Estimte to the 1987 Current Estimte and the increase in 1988 is due to the personnel payroll system, the accounting system upgrade, other administrative ADP system requirements, maintenance and related services backlog of repairs, an anticipated rate increase in utilities and funding to support the additional civil service workforce.

	1986 Actual	1987 Amended Budget Estikte	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
A. FACILITIES SERVICES.....	25,125	29,167	29,362	34,084

This physical plant supports an average daily on-site population of approximtely 7,200 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 Requirements

1. Maintenance and Related Services.....	8,551	10,987	11,163	13,715
2. Custodial Services.....	5,286	6,070	5,918	6,363
3. Utility Services.....	11,288	12,110	12,281	14,006
Total, Facilities Service.....	25,125	29,167	29,362	34,084

Explanation of Fund Requirements

1. Maintenance and Related Services.....	8,551	10,987	11,163	13,715

This activity involves routine mintenance 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; actninistrative office alterations and painting; ground mintenance; and other facility and system design and modification tasks.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		

The increase fran the 1987 Amended Budget Estimte to the 1987 Current Estimte is due to refinement of mintenance requirements that had been delayed due to budget reductions. The increase in 1988 is due to replacement of equipnent and an effort to reduce the current facility repair and mintenance backlog.

2. Custodial Services.....	5,286	6,070	5,918	6,363

This activity involves support contractor effort at JSC to provide security guard services such as protection of govermnt facilities, equipnent, 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 mintenance of alarms and fixed fire fighting equipnent, and industrial safety and inspection. The decrease from the 1987 Amended Budget Estimte to the 1987 Current Estimte is due to a reduction in the requirements for higly specialized services. The increase in 1988 is due to contractor escalation increases.

3. Utility Services.....	11,288	12,110	12,281	14,006

This category includes purchased utilities and support contractor effort for the operation and mintenance of the utility distribution system. The increase from the 1987 Amended Budget Estimte to the 1987 Current Estimte is due to higher utility consumption because of the completion of modular office buildings, and to the increasing number of personal computers, remote computer terminals, and printers. The increase in 1988 is due to increased consumption to support additional office space and increased Shuttle training and flight requirements.

	1986 Actual	1987 hnded Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
B. TECHNICAL SERVICES	8,695	9,880	12,083	13,696
Summary of Fund Requirements				
1. Automatic Data Processing	5,822	6,432	8,474	9,425
2. Scientific and Technical Information	1,861	2,488	2,492	3,090
3. Shop and Support Services	1,012	960	1,117	1,181
Total, Technical Services	8,695	9,880	12,083	13,696
Explanation of Fund Requirements				
1. Automatic Data Processing	5,822	6,432	8,474	9,425

This activity provides support to all JSC administrative ADP functions; included within this area are institutional portions of lease and mintenance costs of hardware systems within the Central Computer Facility, as well as contractor effort for computer programing, operations, keypunch, and other support personnel. The ADP systems supported include institutional mnagmnt, finance and accounting, procurement, contract status and tracking, personnel magement, payroll, and utility tracking. The increase from the FY 1987 hnded Budget Estimte to the FY 1987 Current Estimte is due to developnt of a prototype personnel payroll system (NPPS) to be implemented NASA-wide as well as several other accounting and ahinistrative systemupgrades to replace outdated systems. The NPPS as well as the other accounting and ahinistrative system upgrades are due to be completed by the end of 1988. The 1988 estimte also includes funding to support the additional civil service workforce.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
2. Scientific and Technical Informtion...	1,861	2,488	2,492	3,090

This activity provides for a public affairs educational and infomtional program and support to the Center in provision of various scientific and technical infomtion services. Included in the public affairs program are: motion picture production from script to screen; film clip preparation; exhibit mnagemnt and refurbishment; visitor orientation tours; lecturing; mail answering services; and other public affairs activities. The increase in 1988 reflects a return to Shuttle launch-related activities.

3. Shop and Support Services.....	1,012	960	1,117	1,181

These funds provide for a support contractor who provides JSC graphics and photographic services. Graphic mterials are prepared for use in presentations and senior management reviews. Various kinds of film are processed and reproductions and reprints made. The increase from the 1987 Amended Budget Estimte to the 1987 Current Estimte and to the 1988 Budget Estimate is based on contractor cost escalation.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
C. MANAGEMENT AND OPERATIONS	11,772	13,574	13,819	15,724
1. Administrative Communications	2,274	3,026	2,543	2,897
2. Printing and Reproduction	219	230	182	189
3. Transportation	1,484	2,153	2,149	2,826
4. Installation Common Services	7,795	8,165	8,945	9,812
Total, Management and Operations	11,772	13,574	13,819	15,724
Explanation of Fund Requirements				
1. Administrative Communications	2,274	3,026	2,543	2,897

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 1987 Amended Budget Estimate to the 1987 Current Estimate is due to reductions in FTS charges since the installation of the Program Support Communications Network (PSCN) operated by NASA. The 1988 increase is due to an expected general rate increase and to the addition to the civil service workforce.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
2. Printing and Reproduction.....	219	230	182	189

Printing services are provided by on-site and off-site facilities. The on-site printing plant, operated by JSC personnel, produces approximtely 60 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 52,000,000 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 fran 1987 budget to the 1987 Current Estimte and the 1988 budget is based on a reduction of off-site printing in 1987. The increase in 1988 is due to an increase in off-site printing because of a return to Shuttle launch-related activities.

3. Transportation.....	1,484	2,153	2,149	2,826

Transportation includes adninistrative aircraft maintenance and fuel costs, lease of passenger vehicles and trucks, including GSA drivers and dispatchers and mintenance of vehicles. The increase fran the 1987 Current Estimte to the 1988 Budget Estimte is due to realignment of truck lease rental costs to transportation.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimate	1988 Wldget Estimte
		(Thousands of Dollars)		
4. Installation Common Services..	7,795	8,165	8,945	9,812

These services support center magement 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 enviromntal 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 equipnent at the Center and at WSTF; JSC share of operating costs at Ellington Field and miscellaneous actninistrative support. The increase from the 1987 Amended Wldget Estimate to the 1987 Current Estimate is due to contractor rate increases, as well as health and actninistrative equipment replacement. The increase in 1988 is to support required administrative functions such as the EPA mandate to review hazardous waste management, administrative equipnent replacement, and support for the additional civil service workforce.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE FLIGHT CENTER

STAFFING SUMMARY

	FY87	FY88
SES	65	65
GS/GM-15	304	304
GS/GM-14	518	590
ALL OTHER GS/GM	2401	2480
WAGE GRADE	6	5
TOTAL	3284	3434

DIRECTOR, DEPUTY DIRECTOR, ASSOCIATE DIRECTOR

	FY87	FY88
SES	8	8
GS/GM-15	6	6
GS/GM-14	2	2
ALL OTHER GS/GM	16	16
WAGE GRADE	0	0
TOTAL	32	32

OFFICE OF INSPECTOR GENERAL, JSC

PERSONNEL OFFICE

	FY87	FY88
SES	0	0
GS/GM-15	1	1
GS/GM-14	4	4
ALL OTHER GS/GM	51	51
WAGE GRADE	0	0
TOTAL	56	56

EQUAL OPPORTUNITY PROGRAMS OFFICE

	FY87	FY88
SES	0	0
GS/GM-15	0	0
GS/GM-14	1	1
ALL OTHER GS/GM	5	5
WAGE GRADE	0	0
TOTAL	6	6

LEGAL OFFICE

	FY87	FY88
SES	1	1
GS/GM-15	1	1
GS/GM-14	6	6
ALL OTHER GS/GM	7	7
WAGE GRADE	0	0
TOTAL	15	15

PUBLIC AFFAIRS OFFICE

	FY87	FY88
SES	1	1
GS/GM-15	0	0
GS/GM-14	2	2
ALL OTHER GS/GM	25	25
WAGE GRADE	0	0
TOTAL	28	28

WHITE SANDS TEST FACILITY

	FY87	FY88
SES	1	1
GS/GM-15	1	1
GS/GM-14	7	7
ALL OTHER GS/GM	35	35
WAGE GRADE	0	0
TOTAL	44	44

SPACE STATION PROGRAM OFFICE

	FY87	FY88
SES	4	4
GS/GM-15	22	22
GS/GM-14	41	51
ALL OTHER GS/GM	104	114
WAGE GRADE	0	0
TOTAL	171	191

SPACE STATION PROJECTS OFFICE

	FY87	FY88
SES	3	3
GS/GM-15	12	12
GS/GM-14	24	31
ALL OTHER GS/GM	34	42
WAGE GRADE	0	0
TOTAL	73	88

ORBITER AND GFE PROJECTS OFFICE

	FY87	FY88
SES	3	3
GS/GM-15	18	18
GS/GM-14	36	53
ALL OTHER GS/GM	46	64
WAGE GRADE	0	0
TOTAL	103	138

NATIONAL SPACE TRANSPORTATION SYSTEMS OFFICE

	FY87	FY88
SES	6	6
GS/GM-15	31	31
GS/GM-14	56	92
ALL OTHER GS/GM	86	122
WAGE GRADE	0	0
TOTAL	178	250

DIRECTOR, SAFETY, RELIABILITY, AND QUALITY ASSURANCE

	FY87	FY88
SES	3	3
GS/GM-15	16	16
GS/GM-14	13	13
ALL OTHER GS/GM	113	113
WAGE GRADE	0	0
TOTAL	144	114

DIRECTOR, FLIGHT CREW OPERATIONS

	FY87	FY88
SES	3	3
GS/GM-15	28	28
GS/GM-14	18	18
ALL OTHER GS/GM	101	101
WAGE GRADE	0	0
TOTAL	160	160

DIRECTOR, MISSION OPERATIONS

	FY87	FY88
SES	6	6
GS/GM-15	33	33
GS/GM-14	58	58
ALL OTHER GS/GM	366	366
WAGE GRADE	0	0
TOTAL	463	463

DIRECTOR, MISSION SUPPORT

	FY87	FY88
SES	3	3
GS/GM-15	28	28
GS/GM-14	47	47
ALL OTHER GS/GM	205	205
WAGE GRADE	0	0
TOTAL	283	283

DIRECTOR, ENGINEERING

	FY87	FY88
SES	6	6
GS/GM-15	54	54
GS/GM-14	114	114
ALL OTHER GS/GM	440	440
WAGE GRADE	0	0
TOTAL	614	614

DIRECTOR, SPACE AND LIFE SCIENCES

	FY87	FY88
SES	3	3
GS/GM-15	30	30
GS/GM-14	41	42
ALL OTHER GS/GM	162	162
WAGE GRADE	0	0
TOTAL	236	237

DIRECTOR, ADMINISTRATION AND PROGRAM SUPPORT

	FY87	FY88
SES	3	3
GS/GM-15	16	16
GS/GM-14	33	33
ALL OTHER GS/GM	304	304
WAGE GRADE	0	0
TOTAL	356	356

DIRECTOR, CENTER OPERATIONS

	FY87	FY88
SES	2	2
GS/GM-15	8	8
GS/GM-14	15	15
ALL OTHER GS/GM	301	308
WAGE GRADE	6	5
TOTAL	332	338

KENNEDY
SPACE CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1988 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, 1986, was $1,894,134,000.

CENTER ROLES AND MISSIONS

The Launch merations 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 mjor 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 equipnent. The technical facilities developed at KSC represent a recognized national resource. The principal roles of the Center are:

Space Transportation System (STS) Ground merations - includes Space Shuttle launch preparation, launch, landing and refurbishnent; Spacelab and Spacelab payloads ground processing; payload/experiment integration and processing; upper stages ground processing; orbiter logistics; and operation and mintenance **of** ground support equipment.

Space Station - Space Station effort at KSC will consist of activities in three mjor areas: utilization, system engineering and integration, and operational readiness.

Expendable Launch Vehicle merations - includes launch preparation, checkout and launch for the current inventory of launch vehicles on a reimbursable basis.

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

KENNEDY

	1986 ACTUAL	1987 AMENDED BUDGET ESTIMATE	1987 CURRENT ESTIMATE	1988 BUDGET ESTIMATE
Space Station	88	244	108	288
Space Flight Programs	1,339	1,172	1,321	1,176
Space Trans. Capab. Dev.	160	310	154	150
Space Shuttle	1,179	862	1,167	1,026
Space Science and Applications	108	121	102	92
Physics and Astronomy	93	108	85	75
Life Sciences	15	13	17	17
Commercial Programs	10	5	12	14
SUBTOTAL DIRECT	1,545	1,542	1,543	1,570
Center Management & Operations	487	488	487	487
SUBTOTAL (FTP'S)	2,032	2,030	2,030	2,057
Other Controlled FTE's (PMI's/Co-ops/OTFTP's)	65	82	80	80
GRAND TOTAL (FTE)	2,097	2,112	2,110	2,137

PROGRAM DESCRIPTION

	Permanent Civil Service Workyears
RESEARCH AND DEVELOPMENT	
SPACE STATICIN.....	288

Space Station effort will consist of definition and integration studies, activities in the areas of utilization and operational readiness studies.

SPACE FLIGHT PROGRAMS	
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT.....	150

The upper stages currently consist of the Inertial Upper Stage (IUS), Transfer Orbit Stage (TOS), and the Payload Assist Module (PAM). These upper stages are expendable, propulsive stages intended for use in the deploymnt 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 comnercial 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 of 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 conpatible with the Spacelab, with each other, and with safety requirements. The first Spacelab flight unit flew aboard STS-9 in November 1983.

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 conpatibility with KSC facilities; and provide support coordination during the payload checkout and launch at KSC.

	Permanent Civil Service Workyears
SPACE SHUTTLE.....	1,026

The design, mdification or acquisition, installation and checkout of equipnent and facilities to be used in support of launch requirements will continue. This includes equipment provided by KSC contractors, as well as equipnent to be supplied by developnent 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 equipnent and associated subsystems which have been in place since the mid-1970's must be upgraded/replaced due to obsolescense 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. This includes the Atlas Centaur and Delta vehicles. Launches at both the Eastern Space and Missle Center (ESMC) and Vandenberg Air Force Base (VAFB) are the responsibility of KSC.

	Pemnent Civil Service Workyears
SPACE SCIENCE AND APPLICATIONS	
PHYSICS AND ASTRONOMY.....	75

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.....	17

KSC will continue its support role in the definition, developnent 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 AND TECHNOLOGY UTILIZATION.....	14

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 govermnt capabilities, to encourage private sector investment that is independent of NASA funding and to develop a comnercial space policy and insure consistent NASA-wide implementation. This effort established an organizational focal point to foster comnercial 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.

	Permanent Civi1 Service Workyears
CENTER MANAGEMENT AND OPERATIONS SUPPORT.....	487

Center Management and merations 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 infomtion and control services supporting all levels of center management, both program and functional. Specific functions include resources and financial mnagement, program control, contracting and procurement, property managment, personnel magement, and mnagement systems and analysis.

merations Support - Personnel providing for the operational and mintenance of institutional facilities, buildings, systems and equipment, including those who mnage 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

		1986 Actual	1987 hnded Budget Estimte	1987 Current Estimte	1988 Budget Estimte
I.	Personnel and Related Costs.....	92,835	95,506	98,895	106,673
11.	Trael.....	2,088	3,180	2,650	3,464
111.	Operation of Installation.....	97,306	99,565	98,232	110,506
	A. Facilities Services...	(58,484)	(61,064)	(59,820)	(66,298)
	B. Technical Services..	(13,206)	(13,024)	(12,925)	(15,490)
	C. Management and Operations..	(25,616)	(25,477)	(25,487)	(28,718)
	Total, Fund Requirements.....	192,229	198,251	199,777	220,643

RESOURCES REQUIREMENTS BY FUNCTION

	1986 Actual	1987 Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
I. PERSONNEL AND RELATED COSTS	**92.835**	**95.506**	**98.895**	**106.673**
Summary of Fund Requirements				
A. Carpensation and Benefits	90.929	93.017	95.597	104.199
1. Carpensation				
a. Full-time permanent	77.476	78.691	78.979	82.207
b. Other than full-time pemnent	1.385	1.503	1.513	1.524
c. Reimbursable detailees	54	85	179	186
d. Overtime and other carpensation	2.575	2.968	2.962	3.830
Subtotal. Carpensation	81.490	83.247	83.633	87.747
2. Benefits	9.439	9.770	11.964	16.452
Subtotal. Carpensation and Benefits	90.929	93.017	95.597	104.199
B. Supporting Costs				
1. Transfer of personnel	1.030	1.141	1.881	1.014
2. Personnel training	876	1.348	1.417	1.460
Subtotal. Supporting Costs	1.906	2.489	3.298	2.474
Total. Personnel and Related Costs	92.835	95.506	98.895	106.673

Explanation of Fund Requirements

	1986 Actual	1987 Amended Budget Estimte-	1987 Current Estimte	1988 Budget Estimate
		'(Thousands of Dollars)		
A. Compensation and Benefits.....	90,929	93,017	95,597	104,199
1. Compensation.....	81,490	83,247	83,633	87,747
a. Full-time Permanent.....	77,476	78,691	78,979	82,207

The Current Estimte for 1987 reflects a change from the 1987 Amended Budget Estimte due to the estimted costs of the Federal Pay Raise and the Federal Employees Retirement System (FERS), offset by more freshout lower salaried hiring. The increase in 1988 reflects the full year costs of the pay raise and additional civil service workforce.

Basis of Cost for Civil Service Workyears

In 1988, the cost of pement workyears will be $82,207,000, an increase of $3,228.000 over 1987. The increase is calculated as follows:

Cost of full-time pement workyears in 1987		78,979
Cost increases in 1988		5,644
Within grade and career advances:		
Full year cost of 1987 increases	596	
Partial year cost of 1988 actions	1,027	
Extra day	345	
Full year cost of the 1987 pay raise	612	
Change in reimbursements received	2,314	
Additional FTE in 1988	750	
Cost decreases in 1988		-2,416
Full year effect of 1987 turnover savings	-1,247	
Partial year effect of 1988 turnover savings	-1,169	
Cost of full-time pemnent workyears in 1988		82,207

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimte
		(Thousands of Dollars)		
b. Other than full-time pemnent				
(1) Cost	1,385	1,503	1,513	1,524
(2) Workyears	97	113	111	111

The distribution of 1988 workyears is as follows:

Distribution of Other than Full-Tim Pemnent Workyears

Program	Workyears
Other temporary programs	73
Youth Opportunity Programs	31
Summer Program	7
Total	111

This program remains level in 1987 and 1988.

c. Reimbursable detailees	54	85	179	186

The military personnel detailed to Kennedy Space Center on a reimbursable basis is in the Security Office and KSC's new Center Director. The increase in the 1987 Current Estimate over the 1987 Amended Budget Estimte is due to one additional detailee, the KSC Center Director, and the added costs of the January 1, 1987 pay raise. The 1988 estimate reflects full year costs of the pay raise.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
d. Overtime and other compensation.....	2,575	2,968	2,962	3,830

This item includes overtime, holiday pay, night differential, Sunday premium and incentive awards. The increase in 1988 is due to the return to flight effort.

2. Benefits.....	9,439	9,770	11,964	16,452
The following are the amounts of contribution by category:				
Civil Service Retirement Fund.....	5,645	5,712	7,846	12,238
Employee Life Insurance.....	186	215	200	203
Employee Health Insurance.....	2,021	2,349	2,122	2,133
Workmen's Carpensation.....	256	340	282	308
FICA.....	269	152	372	390
Medicare.....	991	930	1,070	1,092
Other Benefits OPM Annuity & Unemp Comp..	71	72	72	88
Total.....	9,439	9,770	11,964	16,452

The increase from the 1987 Amended Budget Estimte to the 1987 Current Estimte is due to the added costs of the Federal Pay Raise and the new Federal Employees Retirement System (FEES). The increase in 1988 is due to the full year cost of the pay raise and the FERS and to the addition to the civil service workforce.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
B. Supporting Costs.....	1,906	2,489	3,298	2,474
1. Transfer of personnel.....	1,030	1,141	1,881	1,014

Transfer of personnel includes actual expenses involved in the movement and storage of employee's household goods. The increase in 1987 Current Estimate reflects greater relocation activity than previously anticipated. 1988 reflects a decrease in the number of relocations.

2. Personnel training.....	876	1,348	1,417	1,460

The increase in FY 1987 Current Estimte from the FY 1987 hnded Budget Estimate is due to a re-evaluation of KSC's training needs related to new employees, and the need to upgrade the skills of existing civil service personnel. FY 1988 reflects 1987 levels with slight increases in costs and additional training for new hires.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
11. TRAVEL	**2,088**	**3,180**	**2,650**	**3,464**
Summary of Fund Requirements				
A. Program Travel	1,139	2,457	1,971	2,732
B. Scientific and Technical Development Travel	72	83	39	61
C. Management and Operations Travel	877	640	640	671
Total, Travel	2,088	3,180	2,650	3,464
Explanation of Fund Requirements				
A. Program Travel	1,139	2,457	1,971	2,732

Program travel is directly related to the accomplishment of KSC's mission and accounts for approximtely 78 percent of the Center's travel budget. Program travel reflects: the continued involvement in launch site operations; the design, mnufacturing, and testing of ground system equipment, and construction of facilities; and the activation of systems mnufactured at off-site locations.

The decrease from the 1987 Amended Budget Estimte to the 1987 Current Estimte is due to reduced activity resulting fran the standdown of Shuttle Operations. The increase in FY 1988 reflects increased activity to support resumption of Shuttle launches and travel funds for additional civil service workforce.

	1988 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estikte
		'(Thousandsof Dollars)		
B. Scientific and Technical Development Travel.....	72	83	39	61

Scientific and Technical Development Travel permits enployees 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 problem to associates. Many of the meetings are working panels convened to solve certain problem for the benefit of the govermnt. The decrease from the 1987 hnded Wldget Estimte to the 1987 Current Estimte reflects a reduction of travel due to concentration of efforts on the investigation of the Challenger accident. The increase in 1988 reflects same level of effort as 1987 at anticipated price levels as well as additional funding for the increased civil service workforce and increased transportation costs.

C. Management and Operations Travel.....	877	640	640	671

Management and Operations Travel is used for the direction and coordination of general mnagement mtters. It includes travel concerning such areas as personnel, financial magement, and procurement activities; travel of the Center's top mnagement 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 enployees, such as unpaid advisory committee members and preemployment interviews for NASA SES positions. The increase in 1988 reflects the same level of travel as in 1987 at anticipated cost levels.

	1986 Actual	1987 Amended Budget Estimate-	1987 Current Estimte	1988 Budget Estimate
		(Thousands of 'Dollars)		
III. OPERATION OF INSTALLATION	**97,306**	**99,565**	**98,232**	**110,506**
Summary of Fund Requirements				
A. Facilities Services	58,484	61,064	59,820	66,298
B. Technical Services	13,206	13,024	12,925	15,490
C. Management and Operations	25,616	25,477	25,487	28,718
Total, Operation of Installation	97,306	99,565	98,232	110,506

Explanation of Fund Requiranent

Operation of Installation provides a broad range of services, supplies, and equipnent in support of the Center's institutional activities. These are divided into three mjor functional areas: Facilities Services, the cost of renting real property, mintaining 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 infomtional program and technical shops supporting institutional activities; and Management and Operations, the cost of actninistrative cmnications, printing, transportation, medical, supply, and related services.

The decrease in the Operation of Installation from the 1987 Amended Budget Estimate to the 1987 Current Estimte is the result of reduced energy prices. The increase from the 1987 Current Estimte to the 1988 Budget Estimte results from the changing price levels for support service contracts, utilities and goods and services, a return to flight capability, additional support for new facilities and costs associated with the additional civil service workforce.

	1986 Actual	1987 hnded Budget Estimate-	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
A. FACILITIES SERVICES.....	58,484	61,064	59,820	66,298
Summary of Fund Requirements				
1. Maintenance and Related Services.....	9,564	7,851	9,316	10,407
2. Custodial Services.....	23,994	24,845	25,095	27,474
3. Utility Services.....	24,926	28,368	25,409	28,417
Total, Facilities Services.....	58,484	61,064	59,820	66,298
Explanation of Fund Requirements				
1. Maintenance and Related Services.....	9,564	7,851	9,316	10,407

This activity involves the necessary management, supervisory, engineering, operation and maintenance required to plan, initiate, and perform services on institutional facilities, system, and equipment. It includes ground maintenance; the development and implementation of a maintenance program for all institutional govermnt furnished and contractor acquired systems, facilities, and equipment; the operations and maintenance at the Kennedy Resident Office at Vandenberg Air Force Base, CA; and the general management and supervision of the operations and maintenance of the power, lighting, HVAC, water and sewersystem. Also, the contractor will implement and mnage energy conservation projects, programs, audits, and inspections on institutional facilities to insure conformnce of energy conservation policy and to identify new energy initiatives in such areas as modifications, operational changes, energy studies and awareness. These funds also provide mterials and equipnent needed to support these functional needs.

The increase in 1987 from the hnded Budget Estimate results from unanticipated costs associated with providing operation and maintenance support for the additional facilities coming on-line. The increase in 1988 is due to expected contractor wage rates and manpower buildup for operation and the maintenance of new facilities, return to flight capability and projects to support the additional civil service workforce.

	1986 Actual	1987 hnded Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
2. Custod al Services.....	23,994	24,845	25,095	27,474

This category includes janitorial services, fire protection, and security. Funding provides janitorial services to highly specialized clean room areas and orbiter support equipnent; conducting fire drills and fire inspections of facilities and equipnent 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 infomtion; and mintaining area surveillance and traffic control. Other activities in this category consist of pest control services, laundry services, and supplies and equipnent used by the support contractor performing the function. The slight increase from the 1987 Amended Budget Estimte to the 1987 Current Estimte reflects current price levels. The increase in 1988 results from expected price and wage levels, manpower buildup for operation and mintenance of new facilities and return to flight capability.

3. Utility Services...	24,926	28,368	25,409	28,417

The mjor utility is electrical energy purchased from Florida Power and Light Company through an Air Force contract. Fuel oil is purchased from a local supplier. Steam service is provided by the Air Force. Water services are purchased from the City of Cocoa and sewage treatment is accomplished on-site. Utility plant operations and mintenance and utility distribution systems maintenance are provided by a support contractor and by the Air Force. At the Kennedy Resident Office at Vandenberg Air Force Base, CA., utilities are purchased through the United States Air Force.

The decrease from the 1987 hnded Budget Estimtes to the 1987 Current Estimte reflects lower utility rates and a decrease in consumption.

The increase from the 1987 Current Estimte to the 1988 Wldget Estimte is for anticipated support contractor wage rates, projected purchased utility rates and projected utility, mnpower consumption for O&M of new facilities and return to flight capability.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estikte
		(Thousands of Dollars)		
B. TECHNICAL SERVI	13,206	13,024	12,925	15,490
Summary of Fund Requirements				
1. Automatic Data Processing	10,184	10,022	9,909	12,140
a. Equipment	426	550	531	1,825
b. merations	9,758	9,472	9,378	10,315
2. Scientific and Technical Informtion	1,233	1,220	1,252	1,384
a. Library	847	852	850	925
b. Education and infomtion	386	368	402	459
3. Shop and Support Services	1,789	1,782	1,764	1,966
Total, Technical Services	13,206	13,024	12,925	15,490

Explanation of Fund Requirements

1. Automatic Data Processing	10,184	10,022	9,909	12,140

The Base Operations contractor provides programing services for payroll, general accounting, supply, procurement, preventive maintenance, contract surveillance, personnel, security, resources and financial mnagement reports and related mnagement infomtion. The contractor also provides for the developnt and maintenance of general management *ADP* program which include the lease, purchase, and maintenance of ADP equipment, and programing and operations services. The slight decrease fran the 1987 Amended Budget Estimte to the 1987 Current Estimte is due to current price levels. The increase in 1988 reflects anticipated price levels for goods and services, the purchase of computer equipment and associated software to upgrade the overburdened adninistrative computer (IBM 4381) system and funding to support costs of the additional civil service workforce.

	1986 Actual	1987 Anended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
2. Scientific and Technical Infomtion.....	1,233	1,220	1,252	1,384

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 informtion program.

The base operations contractor operates the library facilities, which provide technical and mnagement books and periodicals, and military, federal, and professional society specifications and standards. The contractor also operates an STS and Spacelab documents repository which catalogs, classifies, and indexes docunents; and provides docunent reference and distribution services. Public Affairs support provides for the gathering and dissemination of infomtion about the agency's program to the mass communications media, the general public, and the educational community at the elementary and secondary levels. The slight increase from the 1987 Amended Budget Estimte to the 1987 Current Estimte is due to current price levels of anticipated costs for needed goods and services. The increase in 1988 reflects continuing the 1987 level of services at anticipated price levels.

3. Shop and Support Services.....	1,789	1,782	1,764	1,966

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 mgement of a comprehensive safety program. This includes the establishment and developnent of both short and long-range work plans, emergency plans and schedules in support of KSC base operations. The decrease from the 1987 Anended Budget Estimte to the 1987 Current Estimte is due to current price levels. The increase fran the 1987 Current Estimte to the 1988 Budget Estimte is for anticipated increases in the number of support service contractors with the return to STS flights at anticipated price levels.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
C. MANAGEMENT AND OPERATIONS	25,616	25,477	25,487	28,718
Summary of Fund Requirements				
1. Administrative Camrunications	2,655	2,503	2,403	2,742
2. Printing and Reproduction	618	600	619	710
3. Transportation	4,260	4,211	4,254	4,807
4. Installation Common Services	18,083	18,163	18,211	20,459
Total, Management and Operations	25,616	25,477	25,487	28,718
Explanation of Fund Requirements				
1. Adninistrative Camrunications	2,655	2,503	2,403	2,742

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 institutional 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 performs 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 adninistrative communications systems and equipment and for operation of communications centers at KSC and ESMC. The decrease from the 1987 hnded Budget Estimte to the 1987 Current Estimate is due to current price levels. The increase from the 1987 Current Estimte to the 1988 Budget Estimate reflects anticipated rate changes, return to flight status and funding for support of additional pemnent enployees.

	1986 Actual	1987 Anended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
2. Printing and Reproduction.....	618	600	619	710

This category includes printing services which are performed by the Government Printing Office (GPO) and minor commercial firms contracted by GPO. These items include KSC reproduction, the house organ, the telephone directory, and Public Affairs brochures and miscellaneous launch support material. Also included are printing and copier services at VAFB. The slight increase from the 1987 Anended Budget Estimte to the 1987 Current Estimte is due to current price levels. The increase in 1988 is due to anticipated rate changes and increased printing requirements resulting from return to flight capability.

3. Transportation.....	4,260	4,211	4,254	4,807

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

The slight increase from the 1987 Amended Wldget Estimte to the 1987 Current Estimte reflects current price levels. The increase from the 1987 Current Estimte to the 1988 Budget Estimte is for anticipated support contractor and vehicle mintenance rate and consumption increases due to return to flight capability.

	1986 Actual	1987 hnded Budget Estimte	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
4. Installation Common Services...	18,083	18,163	18,211	20,459

These funds provide for management and logistics services, mil and distribution services, medical services, and a wide variety of minor contracts for special and one-time services. The Base merations contractor provides magement for the following areas: procurement, resources, mintenance, logistics, energy, data and infomtion, staffing and training, planning and scheduling, and safety. This includes the estimating, planning, budgeting, authorizing, controlling, accumulating, and reporting of all costs and manpower associated with contract activities; and the necessary magement, supervisory, and administrative personnel required to plan, initiate, and perform the services and operations.

The base operations contractor also provides a broad range of logistics services including receipt, storage, and issue of supplies and equipment as well as mintaining various supply mnagement system. Mail and distribution services, provided by the support contractor include distribution of interoffice mil, classified docunent control, operation of the KSC branch post office, and postal service charges.

Two mjor 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 mintenance, applied research, and job certification for civil service and contractor personnel. The contractor has been charged with ensuring compliance with Occupational Safety and Health ministration 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 mintenance of a centerwide toxic substances inventory; surveillance of the potable water supply and distribution; sewage mnagement, sewage treatment and disposal; treatment and disposal of industrial wastes, solid wastes mnagement and disposal; selection and use of pesticides; and the surveillance of sanitation practices in all food services areas.

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

The slight increase from the 1987 Amended Budget Estimate to the 1987 Current Estimte is due to current price levels. The increase in 1988 is attributed to a contractor buildup for return to flight capability, anticipated contractor wage rates and support for additional civil service workforce.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHN F. KENNEDY SPACE CENTER

GM/GS-GM/GS	1.621	1.614
TOTAL	2.069	2.077

CENTER DIRECTOR

	FY87	FY88
SES	5	5
GM/GS-15	1	1
GM/GS-14	1	1
OTHER GM/GS	5	5
WG	-	-
TOTAL	8	8

PUBLIC AFFAIRS OFFICE

	FY87	FY88
SES	1	1
GM/GS-15	-	-
GM/GS-14	3	3
OTHER GM/GS	26	26
WG	-	-
TOTAL	30	30

CHIEF COUNSEL

	FY87	FY88
SES	1	1
GM/GS-15	1	1
GM/GS-14	2	2
OTHER GM/GS	3	3
WG	-	-
TOTAL	7	7

EXECUTIVE MANAGEMENT OFFICE

	FY87	FY88
SES	1	1
GM/GS-15	3	3
GM/GS-14	10	10
OTHER GM/GS	33	33
WG	5	5
TOTAL	52	52

EQUAL OPPORTUNITY PROGRAM OFFICE

	FY87	FY88
SES	-	-
GM/GS-15	-	-
GM/GS-14	1	1
OTHER GM/GS	4	4
WG	-	-
TOTAL	5	5

PERSONNEL OFFICE

	FY87	FY88
SES	-	-
GM/GS-15	1	1
GM/GS-14	5	5
OTHER GM/GS	31	31
WG	-	-
TOTAL	37	37

SAFETY, R&QA & PROTECTIVE SERVICES

	FY87	FY88
SES	1	1
GM/GS-15	6	6
GM/GS-14	6	6
OTHER GM/GS	66	66
WG	-	-
TOTAL	79	79

COMPTROLLER

	FY87	FY88
SES	1	1
GM/GS-15	5	5
GM/GS-14	15	15
OTHER GM/GS	97	97
WG	-	-
TOTAL	118	118

BIOMEDICAL OPERATIONS & RESEARCH OFFICE

	FY87	FY88
SES	1	1
GM/GS-15	2	2
GM/GS-14	5	5
OTHER GM/GS	20	20
WG	-	-
TOTAL	28	28

ADVANCED PROJECTS, TECHNOLOGY & COMMERCIALIZATION OFFICE

	FY87	FY88
SES	1	1
GM/GS-15	5	5
GM/GS-14	8	8
OTHER GM/GS	11	11
WG	-	-
TOTAL	25	25

SPACE STATION PROJECT OFFICE

	FY87	FY88
SES	2	2
GM/GS-15	7	7
GM/GS-14	16	16
OTHER GM/GS	9	9
WG	-	-
TOTAL	34	34

DIRECTOR OF SHUTTLE OPERATIONS

	FY87	FY88
SES	2	2
GM/GS-15	7	7
GM/GS-14	5	5
OTHER GM/GS	95	95
WG	-	-
TOTAL	109	109

DIRECTOR OF SHUTTLE ENGINEERING

	FY87	FY88
SES	3	3
GM/GS-15	14	14
GM/GS-14	47	44
OTHER GM/GS	228	223
WG	-	-
TOTAL	282	284

DIRECTOR OF CENTER SUPPORT OPERATIONS

	FY87	FY88
SES	2	2
GM/GS-15	11	11
GM/GS-14	22	22
OTHER GM/GS	232	232
WG	-	-
TOTAL	267	267

DIRECTOR OF ENGINEERING DEVELOPMENT

	FY87	FY88
SES	2	2
GM/GS-15	2	2
GM/GS-14	5	5
OTHER GM/GS	26	26
WG	-	-
TOTAL	35	35

DIRECTOR OF PAYLOAD MANAGEMENT & OPERATIONS

	FY87	FY88
SES	2	2
GM/GS-15	5	5
GM/GS-14	10	10
OTHER GM/GS	68	68
WG	-	-
TOTAL	85	85

DIRECTOR, SHUTTLE LOGISTICS PROJECT MANAGEMENT

	FY87	FY88
SES	1	1
GM/GS-15	5	5
GM/GS-14	5	5
OTHER GM/GS	48	49
WG	-	-
TOTAL	59	60

DIRECTOR, PROJECT MANAGEMENT

	FY87	FY88
SES	1	1
GM/GS-15	5	5
GM/GS-14	19	19
OTHER GM/GS	65	65
WG	-	-
TOTAL	90	90

DIRECTOR, PAYLOAD PROJECTS MANAGEMENT

	FY87	FY88
SES	1	1
GM/GS-15	3	3
GM/GS-14	10	10
OTHER GM/GS	11	11
WG	-	-
TOTAL	25	25

DIRECTOR, LAUNCH & LANDING OPERATIONS

	FY87	FY88
SES	1	1
GM/GS-15	11	11
GM/GS-14	22	30
OTHER GM/GS	95	92
WG	-	-
TOTAL	129	134

DIRECTOR, INFORMATION SYSTEMS

	FY87	FY88
SES	1	1
GM/GS-15	6	6
GM/GS-14	17	17
OTHER GM/GS	96	96
WG	-	-
TOTAL	120	120

DIRECTOR, MECHANICAL & FACILITIES ENGINEERING

	FY87	FY88
SES	1	1
GM/GS-15	6	6
GM/GS-14	15	15
OTHER GM/GS	81	81
WG	-	-
TOTAL	103	103

DIRECTOR, ELECTRONIC ENGINEERING

	FY87	FY88
SES	1	1
GM/GS-15	6	6
GM/GS-14	18	18
OTHER GM/GS	75	75
WG	-	-
TOTAL	100	100

DIRECTOR, STS PAYLOAD OPERATIONS

	FY87	FY88
SES	1	1
GM/GS-15	3	3
GM/GS-14	21	21
OTHER GM/GS	140	140
WG	-	-
TOTAL	165	165

DIRECTOR, EXPENDABLE VEHICLES OPERATIONS

	FY87	FY88
SES	1	1
GM/GS-15	5	5
GM/GS-14	13	13
OTHER GM/GS	58	58
WG	-	-
TOTAL	77	77

MARSHALL
SPACE FLIGHT CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1988 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 conponent Michoud Assembly Facility via the Tennessee, Ohio, and Mississippi Rivers.

The Michoud Assembly Facility, located **15** miles east of New Orleans, Louisiana, is where the external tanks for the Space Shuttle are being produced 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 conputer services for MSFC, Michoud, other NASA Centers, and associated contractors, as well as other govermnt agencies.

A number of individual facilities at MSFC and its conponent installations are unique within NASA, and the Nation. 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, conplex 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 **$911,973,000** as of September **30, 1986.**

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 mnagemnt and payload definition and development; for design and development of large, complex, and specialized automated spacecraft; for mnagement of mterials processing in space activities; for solar and magnetospheric physics; and for astrophysics. MSFC has a primry role within NASA for the developnt 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, conplex space structures, space propulsion system, mterials and engineering, mterials 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 mjor industrial sites in various locations throughout the nation, and in Europe. The principal and supporting roles are:

PRINCIPAL

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 mnitoring 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. The Center 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. This includes propulsion/transportation systems for a next generation Space Shuttle, unmanned launch vehicles, heavy-lift launch vehicles, 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 programmagement, system engineering, developnent of related payload carriers, procurement, flight and ground operations sustaining engineering, and implementation of a payload operations control center on-site.

- 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 mintenance of the original design requirements throughout the life of the STS program, decrease the unit cost of mufacturing through design improvements, and upgrade operational perfomnce 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, developnent, and procurement of large, conplex and/or specialized automated spacecraft as assigned. The current focus is on maintaining the health and safety of the Hubble Space Telescope during the stretchout resulting fran the Shuttle program standdown and the comprehensive review of failure mdes and effects analysis and design certification reviews to ensure that scientific objectives can be met, and requirements for launch and deployment are acceptable.

Space Station - completion of space station preliminary design and definition studies and initiation of the developnent of the pressurized structures (modules and nodes), habitability and laboratory modules, logistics mdule, enviromntal control and life support system (ECLSS) subsystem, internal thermal control, and internal audio and video.

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 developnent and mnagement of space processing experiments and facilities.

Science - engage in space research as necessary to maintain a peer group to act as a focal point for interaction with the scientific community in program of interest, such as the Spacelab Program, the Advanced X-Ray Astrophysics Facility, and the Space Station.

SUPPORTING ROLES

Space Structures and Materials - contributing to the developnent of large, conplex space structures and materials technology base; developing and testing technology for advanced optical system.

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

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

MARSHALL

	1986 ACTUAL	1987 AMENDED BUDGET ESTIMATE	1987 CURRENT ESTIMATE	1988 BUDGET ESTIMATE
Space Station	312	455	475	655
Space Flight Programs	1,300	1,040	1,464	1,479
Space Trans. Capab. Dev.	449	445	519	509
Space Shuttle	851	595	945	970
Space Science and Applications	977	1,045	653	618
Physics and Astronomy	806	858	508	491
Space Applications	171	187	145	127
Aeronautics & Space Tech	104	158	125	125
Space Res & Tech	104	158	125	125
Commercial Programs	28	35	35	35
Tracking and Data Programs	12	12	12	12
SUBTOTAL DIRECT	2,733	2,745	2,764	2,924
Center Management & Operations	493	489	470	470
SUBTOTAL (FTP'S)	3,226	3,234	3,234	3,394
Other Controlled FTE's (PMI's/Co-ops/OTFTP's)	77	90	90	90
GRAND TOTAL (FTE)	3,303	3,324	3,324	3,484

PROGRAM DESCRIPTION

Pemnent Civi1
Service Workyears

RESEARCH AND DEVELOPMENT

SPACE STATION..... 655

The technical and programmatic management of Work Package #1 for the Space Station is the responsibility of MSFC. This package contains the habitation, logistics, and laboratory modules and the internal thermal control, internal audio and video, and the enviromntal 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 mnufacturing and technology laboratory outfitted to accommodate mterials processing and other related disciplines.

In FY 1988, the design, development, test, evaluation and production of conponents, 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 enphasis 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.

SPACE PLIGHT PROGRAMS

SPACE TRANSPORTATION CAPABILITY DEVELOPMENT..... 509

Spacelab

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

Inertial Upper Stages (IUS)

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

Transfer Orbit Stave (TOS)

Activities include technical direction and magement of the production and integration of a TO6 vehicle for the Mars Observer mission.

Payload Assist Module (PAM)

Activities include two SRM Star-48 Nozzle validation firings; sustaining engineering and inventory mnagement of govermnt owned PAM-A hardware; feasibility studies relative to the utilization of various PAM configurations for future NASA missions; and continuation of the SRM Integrity Program.

Tethered Satellite System (TSS)

Activities include continued technical and programmatic magement involving the U. s. developed deployer and instrument developnt, and overall system engineering activities for the cooperative effort between the U. S. and Italy, specifically, delivery of the deployer into storage and the delivery of one U.S. experiment.

Orbital Maneuver ing Vehicle (OMV)

Activities include completion of spacecraft preliminary design (PIX) including the completion of the program major milestone, PIX, continuation of the system engineering and integration activities, receipt of initial long lead procurement item; developnt of subsystem components and beginning of subsystem hardware fabrication and qualification; continued developnt of flight and ground software leading to completion of the system requirements review, 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) advanced transportation including reusable evolutionary upper stages and launch vehicle systems; (2) platform and facilities in low-earth and geosynchronous orbit such as tethered satellite system application and geostationary platform; (3) orbital services such as satellite servicing applications and in-orbit assembly, mintenance and repair; and (4) flight demonstration studies. The Phase C/D start of the Aeroassist Flight Experiment (AFE) is planned for early FY 1988.

	Pemnent Civil Service Workyears
SPACE SHUTTLE.....	970

This provides for the activities necessary to return to safe flight including proper enphasis on SR&QA following the Challenger accident. This includes the redesign, testing, and certification of the SRM joint/seals, as well as re-examination of all failure mode effects analysis/critical item list for all projects (SRB, SSME and ET) and recertification/redesign as required, and performing hazard analysis. This effort also provides main engines for a four Space Shuttle orbiter fleet and continues a logistics support capability to provision spares and repair/overhaul flight hardware. Activity will continue in the development of an alternate turbopump for the Shuttle main engine. Recertification testing of the engine design changes which will be incorporated in the SSME flight engine for the return to flight status.

Included in this activity is the standard operational support services for the Space Shuttle in the operations phase. Major activity in FY 1988 will be associated with the resumption 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 (ET), solid rocket motors (SRM), booster hardware, and propellants; and replenishment spare components for the main engine. Typical functions will be production engineering, mnufacturing, sustaining engineering, anomaly resolution, logistics configuration magement, system level analysis, test and integration tasks, ground operations, and contract mnagement.

Permanent Civil
Service Workyears

SPACE SCIENCE AND APPLICATIONS

PHYSICS AND ASTRONOMY .. 491

I Space Te escope

Tr objectiv of the Hubble Space p (HST) proj is to place in orbit a high quality optical 2 tele y t 1 pa 3 1 f r use by the tronomical community i juncti with NASA. MSFC is the lead center f the ; of the Hubble Space Telescope projec d a overall ementation r under the Off of Space Science and A lications for meeting cost, schedule, and techni performance of the ect This includes p emphasis on 3 QA e h assessment an evaluation of) ac d activities for system ng g, and lopment, assembly and ve ificati 1 in and r e . ft the HST launch an orbital cation, the operations phase will be 1 by GSFC. The total HST p including ement and mintenance and bishmen ll be phased over to GSFC 1989.

Gamma Ray Observatory

The objective of the Gamma Ray Observatory (GRO) mission is to measure gamma radiation from the universe, and to explore the fundamental physical processes powering it. MSFC has responsibility for the design and developnent of the Burst and Transient Source Experiment (BATSE) which is one of the four experiments being developed to attain the GRO objectives. BATSE hardware will be delivered for GRO integration and test activities at the GRO integration contractor facility.

Spacelab Payload Mission Management

In 1988, MSFC will be responsible for managing and planning activities of the Astro missions, Materials Science Laboratory missions, Atlas missions, Spacelab J mission, International Microgravity Laboratory missions, Space Plasma Laboratory missions, Space Technology Experiments Platform mission, and other dedicated and partial payload missions as assigned including proper emphasis on SR&QA. The Marshall Space Flight Center is also responsible for definition and developnent of selected payloads,

facilities, experiments, 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 1988, MSFC will continue to manage the assigned mission planning and definition activities, as well as developnt of the required instruments and supporting hardware and software.

Interface will continue to be maintained during 1988 with the appropriate NASA program offices, the 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 system 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. In 1988, definition efforts on the Advanced X-Ray Astrophysics Facility and technology support leading to development activities in subsequent years will continue. The principal application area is in atmospheric research and materials science research, which support definition efforts of future STS payloads.

	Pement Civil Service Workyears
SPACE APPLICATIONS	127

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 1988, 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 ground based research, engineering and scientific analyses, advanced studies, definition, design developnent, and operations of materials processing payloads.

Combined Release and Radiation Effects Satellite (CRRES)

The CRRES satellite consists of active experiments in low earth orbit (Phase one of a two-phase mission) to further understand the Earth's upper atmosphere and ionosphere. The CRRES satellite will be in storage during FY 1988 with health checks and maintenance of docunentation as appropriate.

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 system, 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
AERONAUTICS AND SPACE TECHNOLOGY	
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. The primry effort in 1988 will be on developing technology for future high-performance system and large space systems.

COMMERCIAL PROGRAMS AND TECHNOLOGY UTILIZATION.....	35

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 govermnt capabilities to encourage private sector investment that is independent of NASA funding and to develop a comnercial

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 developnent 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 met technical needs in the industrial and public sectors, the program increasingly focuses participation by all NASA and contractor scientific and engineering personnel.

	Pement Civil Service Workyears
TRACKING AND DATA PROGRAMS	
SPACE AND GROUND NETWORK COMMUNICATIONS AND DATA SYSTEMS	12

These activities involve the management and mnitoring of the Program Support Communications Network which is the cmnications 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	470

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 - Personnel providing management and support services to all levels of Center management, both program and functional. Specific functions include resources and financial management, personnel management, and mnagement system and analysis.

Operations Support - Personnel managing or providing for the operation and mintenance of institutional facilities, buildings, system and equipnent, 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

		1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
			(Thousands of Dollars)		
I.	Personnel and Related Costs...	148,087	152,178	155,886	172,856
11.	Travel.....	4,780	6,245	6,220	7,326
111.	Operation of Installation.....	41,350	43,749	45,943	52,330
	A. Facilities Services.....	(20,657)	(21,359)	(23,031)	(26,208)
	B. Technical Services.....	(7,808)	(8,145)	(8,568)	(10,412)
	C. Management and Operations.....	(12,885)	(14,245)	(14,344)	(15,710)
	Total, fund requirements.....	194,217	202,172	208,049	232,512

RESOURCES REQUIREMENTS BY FUNCTION

	1986 Actual	1987 hnded Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		'(Thousands of	Dollars)	
I. **PERSONNEL AND RELATED COSTS**	148,087	152,178	155,886	172,856
Basis of Fund Requirements				
A. Carpensation and Benefits				
1. Carpensat ion				
a. Full-time permanent	127,280	129,071	130,533	137,473
b. Other than full-time permanent.....	1,370	1,573	1,723	1,743
c. Overtime and other compensation	1,981	2,066	2,041	2,273
Subtotal, mensation	130,631	132,710	134,297	141,489
2. Benefits.....	16,145	16,821	19,116	27,837
Subtotal, Compensation and Benefits....	146,776	149,531	153,413	169,326
B. Supporting Costs				
1. Transfer of personnel	404	1,405	1,162	2,022
2. Personnel training	907	1,242	1,311	1,508
Subtotal, Supporting Costs.....	1,311	2,647	2,473	3,530
Total, Personnel and Related Costs.....	148,087	152,178	155,886	172,856

Explanation of Fund Requirements

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
A. Compensation and Benefits..	146,776	149,531	153,413	169,326
1. mensation	130,631	132,710	134,297	141,489
a. Permanent positions	127,280	129,071	130,533	137,473

The increases in the 1987 Current Estimate and the 1988 Budget Estimte are due to the pay raise and the estimated cost of the Federal Employee Retirement System (FERS).

Basis of Cost for Pement Positions

In 1988 the cost of permanent positions will be $137,473,000, an increase of $6,940,000 fran 1987. This increase is calculated as follows:

Cost of full-time permnent workyears in 1987		130,533
Cost increases in 1988		9,846
Within grade and career advances:		
Full year cost of 1987 increases	1,291	
Partial year cost of 1988 actions	1,647	
Extra day	496	
Full year cost of the 1987 pay raise	1,012	
Additional FTE in 1988	5,400	
Cost decreases in 1988		-2,906
Full year effect of 1987 turnover savings	-1,506	
Partial year effect of 1988 turnover savings	-1,400	
Cost of full-time permnent workyears in 1988		137,473

	1986 Actual	1987 hnded Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of	Dollars)	
b. Other than full-time permanent				
(1) Cost	1,370	1,573	1,723	1,743
(2) Manyears	109	129	136	136

The increase from the 1987 Amended Budget Estimte to the 1987 Current Estimate reflects an additional 10 positions in youth opportunity programs and the January 1, 1987 pay raise. The 1988 level remains the *same* as 1987.

Distribution of Other Than Full Time Pemnent Workyears

Program	Workyears
Cooperative education programs.....	74
Other temporary programs.....	16
Youth opportunity programs.....	46
Total.....	136

c. Overtime and Other Compensation	1,981	2,066	2,041	2,273

The 1987 Current Estimate is essentially the *same* as the 1987 Amended Budget Estimate. The increase for 1988 is due to the effect of the pay raise and Federal Employees Retirement System.

2. Benefits.	16,145	16,821	19,116	27,837

The distribution of these costs by major categories is as follows:

Category of Cost	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
Civil Service Retirement Fund	a,924	a,515	11,741	19,862
Employee life insurance	295	440	294	314
Employee health insurance	3,337	3,864	3,229	3,399
FICA	498	683	657	850
Unemployed Compensation	9	5	10	15
Workmen's mensation	1,568	1,624	1,519	1,528
Medicare	1,514	1,690	1,666	1,869
Total	16,145	16,821	19,116	27,a37

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		

The increases in the **1987** Current Estimate and the **1988** Budget Estimte are due to the full year cost of the pay raise and the FERS.

B. Supporting Costs.....	**1,311**	**2,647**	**2,473**	**3,530**
1. Transfer of personnel.....	**404**	**1,405**	**1,162**	**2,022**

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 **FY 1987** Amended Budget Estimte to the **1987** Current Estimate is due to an adjustment in the estimated cost of moving household goods. The increase in the **1988** Budget Estimte includes anticipated relocations associated with the additional civil service workforce.

2. Personnel training.....	**907**	**1,242**	**1,311**	**1,508**

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 program conducted at MSFC include: enhancement of scientific and engineering leadership in the scientific community; mintenance **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 **1987** Current Estimate and the **1988** 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, propulsion technology and funding for training the additional civil service workforce.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimte
		'(Thousandsof Dollars)		
11. TRAVEL	**4,780**	**6,245**	**6,220**	**7,326**
Summary of Fund Requirements				
A. Program Travel	4,218	5,604	5,584	6,511
B. Scientific and Technical Development Travel	106	145	120	265
C. Management and Operations Travel	456	496	516	550
TOTAL TRAVEL	4,780	6,245	6,220	7,326
Explanation of Fund Requirements				
A. Program Travel	4,218	5,604	5,584	6,511

Program travel is directly related to the accomplishment of the Center's mission, and accounts for almost ninety percent of total travel. Travel requirements include those for ongoing programs such as the Shuttle, Spacelab, Space Station, CMV, Upper Stages, Hubble 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 1987 Budget Estimte and the 1987 Current Estimte for travel are essentially the same and will focus on the redesign, testing, and qualification required to return the Shuttle system to flight status, the increased activity required to support the Space Station and increased per diem rates. The increase in the 1988 travel cost is due to continuation of support to Space Station and travel for the additional civil service workforce.

	1986 Actual	1987 hnded Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
B. Scientific and Technical Development Travel	106	145	120	265

Scientific and technical related travel permits enployees to participate in meetings and technical seminars with representatives of the aerospace community. This participation allows enployees 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 slight decrease from the 1987 hnded Budget Estimate to the 1987 Current Estimate is the result of concentrating on the Solid Rocket Motor redesign. These meetings were held on site. The increase in travel cost in 1987 and 1988 is primarily due to increased per diem rates, travel for addition to the civil service and expected transportation increases.

C. Management and Operations Travel.....	456	496	516	550

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 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 commerical 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 in travel costs in the 1987 Current Estimate and the 1988 Budget Estimate over the 1987 hnded Budget Estimate is primarily due to increased per diem rates and expected increase in transportation costs.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
111. OPERATION OF INSTALLATION	**41,350**	**43,749**	**45,943**	**52,330**
Summary of Fund Requirements				
A. Facilities Services	20,657	21,359	23,031	26,208
B. Technical Services	7,808	8,145	8,568	10,412
C. Management and Operations	12,885	14,245	14,344	15,710
Total, Uperation of Installation	41,350	43,749	45,943	52,330

Explanation of Fund Requirements

Uperation of Installation provides a broad range of services, supplies, and equipment in support of the Center's institutional activities. These are divided into three mjor functional areas: Facilities Services, the cost of mintaining and repairing institutional facilities and equipnent, 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 ackninistrative cmnications, printing, transportation, medical, supply, and related services.

The increase reflected in the 1987 Current Estimate from the Amended Budget Estimate is based primarily on increased cost of utility rates. The 1988 Budget Estimate provides for anticipated utility rate increases at the planned level of usage, upgrade of computers including peripherals and hardware and update of software and system, the anticipated price levels for other required goods and services and support to the additional civil service workforce.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		'(Thousands of Dollars)-		
A. FACILITIES SERVICES	**20,657**	**21,359**	**23,031**	**26,208**

The Marshall Space Flight Center occupies **1,841** acres under a Department of the *Army* non-revocable lease in a conplex of science and engineering laboratories and special developnent and test facilities. The complex encompasses approximately **3.8** million gross square feet of building space on Redstone Arsenal. This physical plant houses an average daily on-Center population of approximately **5,150** personnel.

Summary of Fund Requirements

1. Maintenance and Related Services	**5,140**	**6,015**	**5,871**	**6,768**
a. Facilities	**4,446**	**5,228**	**5,190**	**5,619**
b. Equipment	**694**	**787**	**681**	**1,149**
2. Custodial Services	**4,481**	**4,325**	**4,498**	**4,883**
3. Utility Services	**11,036**	**11,019**	**12,662**	**14,557**
Total, Facilities Services	**20,657**	**21,359**	**23,031**	**26,208**

Explanation of Fund Requirements

1. Maintenance and Related Services	**5,140**	**6,015**	**5,871**	**6,768**

This activity involves maintenance and operation of a total of **211** facilities (buildings, structures, and trailers). The **1987** Current Estimate reflects a decrease in and a deferral of repair and alteration projects and maintenance and repair of equipment because of budget constraints. The increase **fran 1987** to **1988** reflects the restoration of a portion of repair and alteration projects and replacement equipnent deferred from prior years and projects to support additional permanent employees.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
2. Custodial Services.....	4,481	4,325	4,498	4,883

Custodial services include janitorial services, security services, fire protection, trash removal, sanitary landfill operations, and related supplies and materials. Janitorial services is provided to about 3 million square feet of facility space and trash removal for approximtely 130 separate locations. Security and fire protection services include 24-hour coverage of MSFC property, law enforcement, and motor vehicle registration and control. The 1987 Amended Budget Estimte anticipated decreased rates for fire protection and sanitary landfill which did not materialize. The increases in 1987 and 1988 reflect negotiated labor rates and anticipated price levels for other goods and services.

3. Utility Services.....	11,036	11,019	12,662	14,557

This function provides for the cost of electricity, steam, natural gas, water, and sewage disposal service provided by RASA on a reimbursable basis. It also provides for the propane and burner fuel to generate steam for heating and cooling. The increase fran the 1987 Amended Budget Estimte to the 1987 Current Estimte and to the 1988 Budget Estimte reflects the 1987 projected NASA rates with an increase in consumption due to additional in-house activities as the STS returns to flight.

	1986 Actual	1987 Amended Wldget Estimte	1987 Current Estimate	1988 Wldget Estimate
		(Thousands of Dollars)		
B. TECHNICAL SERVICES	7,808	8,145	8,568	10,412
Summary of Fund Requirements				
1. Automatic Data Processing	4,955	5,278	5,415	7,318
a. Equipment	317	325	367	1,795
b. Operations	4,638	4,953	5,048	5,523
2. Scientific and Technical Infomtion	920	1,098	1,198	1,026
a. Library	795	996	1,070	894
b. Education and information	125	102	128	132
3. Shop Support Services	1,933	1,769	1,955	2,068
Total, Technical Services	7,808	8,145	8,568	10,412

Explanation of Fund Requirements

1. Automatic Data Processing	4,955	5,278	5,415	7,318

Funds provide centralized system analysis, programing, operations, and related conputational services to meet the mnagement and administrative computing requirements. This category also includes mintenance of ADP equipnent such as central site conputers and associated equipnent. Activities supported include IBM 3083, systems software, and data base management system.

This function also provides for the developnent and utilization of conputer techniques and system programing of digital computers and associated equipnent. This activity includes the operations of magnetic tape libraries; receipt, control, and distribution of data processing products; and testing and cleaning of magnetic tapes.

The increase in the **1987** arrent Estimte reflects the current administrative conputer support required. The increase from the **1987** Current Estimte to the **1988** Budget Estimte is due to the purchase of updated administrative computer hardware to achieve increased productivity and maximum cost efficiency. In addition, this provides funding to support the additional civi1 service workforce in **1988.**

	1986 Actual	**1987** Amended Budget Estikte	**1987** arrent Estimte	**1988** Budget Estikte
		(Thousands of Dollars)		
2. Scientific and Technical Information.....	**920**	**1,098**	**1,198**	**1,026**

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 the preparation of reproducible pages for publication of NASA technical manuscripts and related docunents and MSFC's share of the operation of the MSFC Visitor Information Center located at the Alabama Space and Rocket Center. The increase in the **1987** arrent Estimte from the **1987** Amended Budget is due to a revised estimate based on FY **1986** actual cost, and includes the purchase of equipnent and supplies and mterials at required levels. The decrease from **1987** Current Estimte to **1988** Budget Estimte reflects the purchase of equipnent in **1987.**

	1986 Actual	1987 hnded Budget Estimate	1987 Current Estimte	1988 Budget Estikte
		(Thousands of Dollars)		
3. Shop and Support Service	1,933	1,769	1,955	2,068

These funds provide the Center with support in the areas of graphics, photographic services, and related supplies, mterials, and equipnent. The 1987 Current Estimte is higher than the 1987 Amended Wldget because it is based on the 1986 actual level of services at expected cost. The increase in 1988 is based on anticipated price levels.

C. MANAGEMENT AND OPERATIONS	12,885	14,245	14,344	15,710
Summary of Fund Requirements				
1. Administrative Communications	3,327	3,534	3,792	4,318
2. Printing and Reproduction	378	802	868	824
3. Transportation	3,165	3,772	3,555	4,017
4. Installation Common Services	6,015	6,137	6,129	6,551
Total, Management and Operations	12,885	14,245	14,344	15,710

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estikte
		(Thousands of Dollars)		

Explanation of Fund Requirements

1. Administrative Communications.....	3,327	3,534	3,792	4,318

Communications support for MSFC consists of local telephone service and various kinds of non-telephone communications. Funds providing for non-telephone communications include use of Weeden Mountain radio transmission facilities, support of the emergency warning system, and operations of MSFC's fire surveillance system. The MSFC central exchange provides local telephone service as provided by Boeing Network Services and South Central Bell. Federal Telephone Service (FTS) is provided by the GSA, long distance commercial tolls by South Central Bell and AT&T, and the AUTODIN is provided by the Air Force. The AUTODIN network is a secure digital message system that provides institutional support in sending classified and non-classified messages. The AUTODIN network is also used to interface with world wide DoD elements such as ordering supplies and mterials from the Defense Logistics Agency. The increase between the 1987 Amended Budget Estimte and the 1987 Current Estimte is due to an increase in long distance tolls (FTS) based on 1986 actual rate experience, and escalation for supplies, mterials and equipnent. The increase in 1988 reflects anticipated price levels for long distance tolls (FTS), and other required services, including support for additional civil service workforce.

2. Printing and Reproduction.....	378	802	868	824

A portion of MSFC's printing and reproduction requirements is met by a contractor operated on-site reproduction plant. MSFC purchases reproduction services from the Government Printing Office, the Army, and private firms. Off-site printing is an overflow requirement that cannot be handled within the on-site workload or capability. The increase from the 1987 Budget to the 1987 Current Estimte reflects the additional printing requirements in support of Shuttle anomaly resolution activites. The decrease from the 1987 Current Estimte to the 1988 Budget Estimte reflects the projected level of services required.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
3. Transportation	3,165	3,772	3,555	4,017

Transportation includes operation and maintenance of vehicles and aircraft, transportation of related supplies and mterials, and purchases of transportation equipment. Included is the mintenance of general purpose vehicles, material handling equipment, special purpose trailers and vehicles, equipnent such as cranes, tractors, generators and welders; and intermediate and mjor inspections. Freight charges for shipment of mterials and equipnent by both surface and air transportation are also included. The decrease from the 1987 Amended Budget Estinmte to the 1987 Current Estimte reflects lower rate increases than expected. The increase in the 1988 Budget Estimte reflects support service contractor rate increases and some replacement vehicles.

4. Installation Common Services	6,015	6,137	6,129	6,551

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

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

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

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, toxic disposal, postage, and acquisition of supplies and materials. The 1987 Budget Estimate and the 1987 Current Estimte are essentially the same. The increase in the 1988 Budget Estimte is due to additional civil service workforce.

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

OFFICE OF DIRECTOR

	FY 87	FY 88
SES	4	4
GS-16		
GS-15		
GS-14		
ALL OTHER GS	4	4
WAGE BOARD		
TOTAL PERMANENT	8	8

MSFC SUMMARY

	FY 87	FY 88
SES	86	86
GS-16	1	1
GS-15	176	179
GS-14	544	548
ALL OTHER GS	2413	2615
WAGE BOARD	30	30
TOTAL PERMANENT	3228	3435

ASSOCIATE DIRECTOR FOR SCIENCE

	FY 87	FY 88
SES	1	1
GS-16		
GS-15		
GS-14		
ALL OTHER GS	1	1
WAGE BOARD		
TOTAL PERMANENT	2	2

EXECUTIVE STAFF

	FY 87	FY 88
SES		
GS-16		
GS-15	1	1
GS-14	1	1
ALL OTHER GS	11	11
WAGE BOARD		
TOTAL PERMANENT	13	13

SAFETY, REL & QUAL ASSUR. OFFICE

	FY 87	FY 88
SES	3	3
GS-16		
GS-15	9	12
GS-14	31	35
ALL OTHER GS	137	145
WAGE BOARD		
TOTAL PERMANENT	180	195

PUBLIC AFFAIRS OFFICE

	FY 87	FY 88
SES		
GS-16		
GS-15		
GS-14	2	2
ALL OTHER GS	20	20
WAGE BOARD		
TOTAL PERMANENT	22	22

CHIEF COUNSEL

	FY 87	FY 88
SES	1	1
GS-16		
GS-15	2	2
GS-14	3	3
ALL OTHER GS	8	8
WAGE BOARD		
TOTAL PERMANENT	14	14

CENTER COMPTROLLER

	FY 87	FY 88
SES	1	1
GS-16		
GS-15	3	3
GS-14	11	11
ALL OTHER GS	103	103
WAGE BOARD		
TOTAL PERMANENT	118	118

ADMINISTRATIVE OPERATIONS OFFICE

	FY 87	FY 88
SES	1	1
GS-16		
GS-15	3	3
GS-14	13	13
ALL OTHER GS	155	155
WAGE BOARD		
TOTAL PERMANENT	172	172

EQUAL OPPORTUNITY OFFICE

	FY 87	FY 88
SES		
GS-16		
GS-15	1	1
GS-14		
ALL OTHER GS	6	6
WAGE BOARD		
TOTAL PERMANENT	7	7

SHUTTLE PROJECTS OFFICE

	FY 87	FY 88
SES	6	6
GS-16		
GS-15	25	25
GS-14	46	46
ALL OTHER GS	124	124
WAGE BOARD		
TOTAL PERMANENT	200	200

SPECIAL PROJECTS OFFICE

	FY 87	FY 88
SES	1	1
GS-16		
GS-15	12	12
01-14	30	30
ALL OTHER GS	51	51
WAGE BOARD		
TOTAL PERMANENT	94	94

SPACE TELESCOPE PROJECT OFFICE

	FY 87	FY 88
SES	3	3
GS-16		
GS-15	5	5
GS-14	12	12
ALL OTHER GS	12	12
WAGE BOARD		
TOTAL PERMANENT	32	32

SPACELAB PAYLOAD

	FY 87	FY 88
SES	2	2
GS-16		
01-11	10	10
GS-14	36	36
ALL OTHER GS	55	55
WAGE BOARD		
TOTAL PERMANENT	103	103

SPACE STATION PROJECTS OFFICE

	FY 87	FY 88
SES	2	2
GS-16		
GS-15	8	8
GS-14	30	30
ALL OTHER GS	76	76
WAGE BOARD		
TOTAL PERMANENT	116	116

PROGRAM DEVELOPMENT

	FY 87	FY 88
SES	3	3
GS-16	8	8
GS-15	16	16
GS-14	46	46
ALL OTHER GS	107	107
WAGE BOARD	0	0
TOTAL PERMANENT	180	180

NOTE: ALL MANPOWER SHOWN IN SOY

SCIENCE AND ENGINEERING

	FY 87	FY 88
SES	23	23
GS-16	1	1
01-11	61	67
GS-14	254	254
ALL OTHER GS	1249	1434
WAGE BOARD	36	36
TOTAL PERMANENT	1620	1815

INSTITUTIONAL & PROGRAM SUPPORT

	FY 87	FY 88
SES	4	4
GS-16	0	0
GS-15	14	14
GS-14	37	37
ALL OTHER GS	294	304
WAGE BOARD	0	0
TOTAL PERMANENT	349	359

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1-6-87 Revised 2/2/87

NATIONAL SPACE
TECHNOLOGY
LABORATORIES

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1988 ESTIMATES

NATIONAL SPACE TECHNOLOGY LABORATORIES

DESCRIPTION

The National Space Technology Laboratories is located in southwest Mississippi, approxirmtely 50 miles northeast of New Orleans, Louisiana. Total land area is 138,807 acres of which 13,480 acres rmke 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 Intercostal Waterway. Capital investment for the National Space Technology Laboratories, as of September 30, 1986, was $337,744,880.

CENTER ROLES AND MISSIONS

The n Space [n logy Laboratories (NSTL), former y the i Test Facility (MTF) is NASA's pr at test ty for large iquid pr cket engines and propulsion systems. The redesignat by NASA of M to the NSTL in i 1974 recognized h emerging role of the installation in space a i technology laboratories

NSTL is presently engaged in development and acceptance testing of the Space Shuttle rmin engines and rmin propulsion system developnent testing. NSTL also conducts applied research and development in the fields of remote sensing, enviromntal sciences, and other selected applications programs. NSTL manages the installation and, through interagency agreements, provides support and mintains full utilization of all facilities by NASA and co-located elements of other executive agencies. These agencies are engaged in carpatible research, developnent, 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. NSTL's principal roles are:

Space Shuttle: - NSTL provides, mintains 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 m i n 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

NSTL

	1986 ACTUAL	1987 AMENDED BUDGET ESTIMATE	1987 CURRENT ESTIMATE	1988 BUDGET ESTIMATE
Space Station	4	0	4	5
Space Flight Programs	19	5	22	32
Space Trans. Capab. Dev.	0	5	0	0
Space Shuttle	19	0	22	32
Space Science and Applications	31	44	30	30
Space Applications	31	44	30	30
Commercial Programs	5	1	5	5
SUBTOTAL DIRECT	59	50	61	72
Center Management & Operations	63	69	62	66
SUBTOTAL (FTP'S)	122	119	123	138
Other Controlled FTE's (PMI's/Co-ops/OTFTP's)	11	15	11	11
GRAND TOTAL (FTE)	133	134	134	149

PROGRAM DESCRIPTION

	Permanent Civil Service Workyears
RESEARCH AND DEVELOPMENT	
SPACE STATI~.....	5

During FY 1986, NSTL/ERL supported GSFC and JSC Space Station Data Management System (DMS) test bed efforts by developing a payload simlator software package which during FY 1988, will evolve in complexity and in phases as Space Station subsystems and their requirements for payload interactions become better defined. The payload sirmlator provides a significant and varying data load to the DMS network. It will also serve as a training tool for potential payload users.

SPACE FLIGHT PROGRAMS	
SPACE S~.....	32

In 1988, the National Space Technology Laboratories will continue to provide, maintain, and manage the facilities and the related capabilities required for developnent and acceptance testing of the Space Shuttle main engines. During FY 1987, NSTL's B-1 test stand is undergoing intensive modification to accomplish the conversion of the facility to that of an active single engine test position. Fran FY 1988 on, the dual capability will exist to retain the B-2 test stand capability for Main Propulsion Test Article testing while utilizing the B-1 test stand as a single engine test position.

SPACE SCIENCE AND APPLICATIONS	
SPACE APPLICATIOPJS.....	30

In 1988, 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 program 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.

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

	Permanent Civil Service Workyears
COMMERCIAL PROGRAMS AND TECHNOLOGY UTILIZATION.....	5

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 goverrrnent capabilities, to encourage private sector investment that is space technology and the use of such technology to facilitate private sector space activities through access to governmnt 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 form 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 met technical needs in the industrial and public sectors, the program increasingly focuses conscientious participation by all NASA and contractor scientific and engineering personnel.

CENTER MANAGEMENT AND OPERATIONS SUPPORT.....	66

Center Management and Operations Support provides support or services to all NSTL organizations. 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 - Personnel providing information and magement 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 magement, and management system and analysis.

Operations Support - Personnel managing or providing for the operation and maintenance of institutional facilities, buildings, system 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

		1986 Actual	1987 hnded Budget Estimte	1987 Current Estimte	1988 Budget Estimte
			(Thousands of Dollars)		
I.	Personnel and Related Costs.....	5,318	5,193	5,838	6,885
II.	Travel.....	190	220	220	355
III.	Operation of Installation.....	5,704	5,900	5,956	6,676
	A. Facilities Services.....	(3,366)	(3,116)	(3,137)	(3,493)
	B. Technical Services.....	(612)	(714)	(709)	(938)
	C. Management and Operations.....	(1,726)	(2,070)	(2,110)	(2,245)
	Total, fund requirements.....	11,212	11,313	12,014	13,916

RESOURCE REQUIREMENTS BY FUNCTION

	1986 Actual	1987 Amended Budget Estimate	1987 arrent Estimate	1988 Budget Estimate
		(Thousands of 'Dollars)		
I. **PERSONNEL AND RELATED COSTS**	5,318	5,193	5,838	6,885
Summary of Fund Requirements				
A. Compensation and Benefits				
1. Compensation				
a. Full-time permnent	4,530	4,328	4,759	5,283
b. Other than full-time pemnent positions	157	245	180	186
c. Overtime and other conpensation	13	14	14	24
Subtotal, Carpensation	4,700	4,587	4,953	5,493
2. Benefits	541	521	742	1,051
Subtotal, Carpensation and Benefits	5,241	5,108	5,695	6,544
B. Supporting Costs				
1. Transfer of Personnel	53	50	102	283
2. Personnel Training	24	35	41	58
Subtotal - Supporting Costs	77	85	143	341
Total - Personnel and Related Costs	5,318	5,193	5,838	6,885

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
A. Carpensation and Benefits.....	5,241	5,108	5,695	6,544
1. Carpensation.....	4,700	4,587	4,953	5,493
a. Full-time Pemnent.....	4,530	4,328	4,759	5,283

The increases in the 1987 Current Estimte from the 1987 Amended Budget Estimte is due to the January 1, 1987 pay raise and the new Federal Employees Retirement System (FERS). The increase in the 1988 Budget Estimte reflects the estimted impact of the pay raise and the new FERS and additional civil service workforce.

Basis of Cost for Civil Service Workyears

In 1988, the cost of perment workyears will be $5,283,000, an increase of $524,000 over 1987. The increase results from the following:

Cost of full-time perment workyears in 1987		4,759
Cost increases in 1988		552
Within grade and career advances:		
Full year cost of 1987 increases	21	
Partial year cost of 1988 actions	27	
Extra day	17	
Full year cost of the 1987 pay raise	37	
Additional FTE in 1988	450	
Cost decreases in 1988		-28
Full year effect of 1987 turnover savings	-14	
Partial year effect of 1988 turnover savings	-14	
Cost of full-time permnent workyears in 1988		5,283

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
b. Other than full-time pemnent				
1. Cost	157	245	180	186
2. Workyears	11	15	11	11

The distribution of 1988 workyears is as follows:

Distribution of Other than Full-Tim Pemnent Workyears

Program	Workyears
Developmental progr~	4
Other temporary progr~	7
Total	11

The decrease fran the 1987 hnded Budget Estimte to the 1987 Current Estimte is *a* reduction in the number of Other Than Full Time Pemnent (OTFTP) enployees. The 1988 increase is the full year effect of the 1987 OTFTP personnel.

c. Overtime and other canpensation	13	14	14	24

The increase from the 1987 estimates to the 1988 Budget Estimte is for support to the increased Space Shuttle main engine test requirement.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
2. Benefits	541	521	742	1,051
Following are the amounts of contribution by category:				
Civil Service Retirement Fund	319	305	515	790
Employee Life Insurance	10	11	11	12
Employee Health Insurance	113	116	112	129
FICA	45	39	49	51
Medicare	52	50	55	69
Annuitant & Other Benefits	2	0	0	0
Total	541	521	742	1,051

The increase from the 1987 Amended Budget Estimate to the 1987 Current Estimate is the result of an increase in the number of permnent workyears, and the estimted impact of the pay raise and the Federal Employees Retirement System (FERS). The 1988 estimate reflects the full year effect of the 1987 pay raise, the FERS and the additional civil service workforce.

B. Supporting Costs	77	85	143	341
1. Transfer of personnel	53	50	102	283
The current estimates for 1987 and 1988 are based on projected hiring plans.				
2. Personnel training	24	35	41	58

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. Increases in the 1987 Current Estimate from the 1987 Amended Ehdget Estimate will be used to provide additional funding for NASA employee training to help

maintain the current skill level. The 1988 Budget Estimte includes funding to train the additional civil service workforce.

	1986 Actual	1987 hnded Budget Estimate	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
11. TRAVEL	**190**	**220**	**220**	**355**
Summary of Fund Requirements				
A. Program Travel	88	114	104	219
B. Scientific and Technical Development Travel	4	4	4	16
C. Management and Operations Travel	98	102	112	120
Total Travel	190	220	220	355

Explanation of Fund Requirements

A. Program Travel	88	114	104	219

Program travel requirements are directly related to the accomplishnents of the NSTL mission, and will primarily be in support of Space Science and Applications Programs. Program travel accounted for about 62 percent of total travel in 1986. The increase from 1987 to 1988 includes expected increases in transportation and per diem costs, and travel for additions to the civil service workforce.

B. Scientific and Technical Development Travel	4	4	4	16

Scientific and technical development travel will permit enployees to participate in meetings and technical seminars with other representatives of the aerospace community. This participation allows enployees to retain technical competency and gain awareness of technological advances outside NSTL 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 1988 Budget Estimte is anticipated travel for the additional civil service workforce and expected transportation costs.

	1986 Actual	1987 Anended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
C. Management and Operations Travel.....	98	102	112	120

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 NSTL's top management to NASA Headquarters and other NASA Centers. The increase from the 1987 Anended Budget Estimte to the 1987 Current Estimte and from 1987 to 1988 reflects expected transportation and per diem increases.

	1986 Actual	1987 hnded Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
111. OPERATION OF INSTALLATION	5,704	5,900	5,956	6,676
Summary of Fund Requirements				
A. Facilities Services	3,366	3,116	3,137	3,493
B. Technical Services	612	714	709	938
C. Management and Operations	1,726	2,070	2,110	2,245
Total, Operation of Installation	5,704	5,900	5,956	6,676

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 equipmnt, and the cost of custodial services and utilities; Technical Services, the cost of automatic data processing for magement 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, and related services.

Funding changes from the 1987 hnded Wldget Estimte to the 1987 Current Estimte are minor. The 1988 increases are due to expected utility rate increases and requirements for updated technical equipmnt due to expanded work in the areas of space station, single Space Shuttle main engine testing and support and funding to support additional civil service workforce.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
A. FACILITIES SERVICES	**3,366**	**3,116**	**3,137**	**3,493**

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 Requirements

1. Rental of Real Property	18	20	20	21
2. Maintenance and Related Services	1,176	584	627	751
a. Facility	1,154	554	579	671
b. Equipment	22	30	48	80
3. Custodial Services	330	343	358	372
4. Utility Services	1,842	2,169	2,132	2,349
Total, Facilities Services	3,366	3,116	3,137	3,493

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
1. Rental of Real Property	18	20	20	21

Provides for lease of hanger space for earth resources aircraft.

2. Maintenance and Related Services	1,176	584	627	751

This activity provides for the mdification and alteration of facilities in support of B-1 test stand operations and maintenance. Also provided is the mdification, alteration and maintenance of installation facilities and movements of personnel and equipnent of the Earth Resources Laboratory (ERL) and equipnent purchases for the ERL contracts. The increase in the 1987 Current Estimte is the continuation of of services adjusted for revised 1987 facility requirements. The 1988 increase is the continuation of 1987 activities at 1988 anticipated price levels.

3. Custodial Services	330	343	358	372

Provides for NASA's share of janitorial services and fire protection, provided by the NSTL institutional support services contractor. The increase from the 1987 Amended Budget Estimte to the FY 1987 Current Estimte reflects higher support service contract wage rates than previously estimted. The 1988 increase is the continuation of 1987 activities at 1988 anticipated price levels.

4. Utility Services	1,842	2,169	2,132	2,349

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 1987 Amended Budget Estimte to the 1987 Current Estimte is the result of lower than anticipated utility rates. The increase in the 1988 Budget Estimte reflects expected rates for utilities and anticipated support service contract wage rates.

	1986 Actual	1987 hnded Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
B. TECHNICAL SERVICES	612	714	709	938
Summary of Fund Requirements				
1. Automatic Data Processing	5	6	6	7
2. Scientific and Technical Information	118	152	157	164
a. Library	15	24	24	25
b. Education and information	103	128	133	139
3. Shop Support and Services	489	556	546	767
Total - Technical Services	612	714	709	938

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
	(Thousands of Dollars)			

Explanation of Fund Requirements

1. Automatic Data Processing.....	5	6	6	7

Provides supplies and mterials in support of the Centers ADP requirements.

2. Scientific and Technical Information.....	118	152	157	164

Provides for books, periodicals, and other technical reports by the Center, and NASA's share of upgrading and operating the NSTL Visitor Information Center (VIC). The increase from the 1987 Amended Budget Estimte to the 1987 Current Estimte reflects a greater than expected demand for public information. The 1988 estimte includes current requirements at expected cost levels.

3. Shop Support and Services.....	489	556	546	767

Provides for NASA's share of such technical services as safety, photography and graphics. Provides for the purchase of operation and mintenance support services and updated equipnent to support the technical services at NSTL. The increase in 1988 reflects a small increase for the purchase of required equipnent.

	1986 Actual	1987 Amended Budget Estimate	1987 arrent Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
C. MANAGEMENT AND OPERATIONS	1,726	2,070	2,110	2,245
Summary of Fund Requirements				
1. Administrative Camunications	897	1,033	1,037	1,132
2. Printing and Reproduction	25	44	46	48
3. Transportation	689	873	902	935
4. Installation Common Services	115	120	125	130
Total - Management and Operations	1,726	2,070	2,110	2,245
Explanation of Fund Requirements				
1. Administrative Camunications	897	1,033	1,037	1,132

Provides for NASA's share of the local telephone service, Federal Telecommunications System (FTS), long distance, and operation and mintenance of the on-site communications equipnent and switchboard. The increase from the 1987 arrent Estimate to the 1988 Budget Estimte reflects expected cost escalation and support for additional civil service workforce.

	1986 Actual	1987 hnded Budget Estimate	1987 Current Estimate	1988 Budget Estimte
		'(Thousandsof	Dollars)	
2. Printing and Reproduction.....	25	44	46	48

Provides for printing and reproduction services in support of the Earth Resources Laboratory and the local house organ. The increases from the **1987** h n d e d Budget Estimate to the **1987** Current Estimate and the **1987** Current Estimte to the **1988** Budget Estimte reflect expected cost escalation.

3. Transportation.....	689	873	902	935

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 increases from the **1987** Anended Budget Estimate to the **1987** Current Estimte and the **1987** Current Estimate to the **1988** Budget Estimate reflect anticipated cost increases in motor pool operations.

4. Installation Common Services.....	115	120	125	130

Provides supplies, materials and equipnent for the Center. The increase from the **1987** Current Estimate to the **1988** Budget Estimte reflects the same level of service at anticipated price levels.

ORGANIZATION CHART

FY1988 CONGRESSIONAL BUDGET
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
NATIONAL SPACE TECHNOLOGY LABORATORIES

NSTL SUMMARY STAFFING

	FY87	FY88
SES	3	3
GM-15	9	9
GM-14	11	11
All other GS/GM	111	117
TOTAL PERMANENT	134	140

OFFICE OF THE DIRECTOR

	FY87	FY88
SES	2	2
All other GS/GM	4	4
TOTAL PERMANENT	6	6

CHIEF COUNSEL

	FY87	FY88
GM-15	1	1
GM-14	0	0
All other GS/GM	2	2
TOTAL PERMANENT	3	3

PUBLIC AFFAIRS OFFICE

	FY87	FY88
GM-14	1	1
All other GSIGM	2	2
TOTAL PERMANENT	3	3

PERSONNEL OFFICE

	FY87	FY88
GM-13	1	1
All other GSIGM	3	3
TOTAL PERMANENT	4	4

SAFETY/QUALITY AND HEALTH

	FY87	FY88
GM-14	1	1
All other GSIGM	2	3
TOTAL PERMANENT	3	4

COMPTROLLER

	FY87	FY88
GM-15	1	1
All other GS/GM	20	21
TOTAL PERMANENT	21	22

PROCUREMENT & CONTRACTS OFFICE

	FY87	FY88
GM-15	1	1
GM-14	2	2
All other GSIGM	11	11
TOTAL PERMANENT	14	14

ENGINEERING & PROPULSION TEST SUPPORT

	FY87	FY88
GM-15	1	1
GM-14	1	1
All other GS/GM	15	17
TOTAL PERMANENT	17	19

EARTH RESOURCES LABORATORY

	FY87	FY88
SES	1	1
GM-15	4	4
GM-14	3	3
All other GS/GM	32	33
TOTAL PERMANENT	40	41

INSTALLATIONS OPERATIONS OFFICE

	FY87	FY88
GM-15	1	1
GM-14	2	3
All other GS/GM	20	20
TOTAL PERMANENT	23	24

GODDARD
SPACE FLIGHT CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1988 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, 1986, was approximately $845,425,000.

The majority of the Goddard Space Flight 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 Goddard Space Flight Center, established in 1959 as the first major United States installation devoted to the investigation and exploration of space, conducts a wide-ranging program in space science and applications. 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 both the ground network of tracking and data acquisition facilities and the Tracking and Data Relay Satellite System; 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:

Attached Shuttle Payloads - manages and develops low cost reusable carrier systems which accommodate a variety of payloads to be flown on Shuttle missions.

ING

Planetary Science - develops and applies techniques for the 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.

PRINCIPAL

Earth Orbital Spacecraft Development 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 Tracking and Data Systems - 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. This also includes the implementation of the 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 those of the Department of Defense, other government agencies, 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 - Goddard is the management center for the Delta launch vehicle.

Space Science and Applications - develops the science and technology discipline bases, 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.

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 of balloon activities conducted for NASA and other agencies.

Spacelab Payload Development - develops, analytically integrates and processes data for Spacelab payloads in astrophysics, solar terrestrial physics, astronomy, and applications.

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

GODDARD

	1986 ACTUAL	1987 AMENDED BUDGET ESTIMATE	1987 CURRENT ESTIMATE	1988 BUDGET ESTIMATE
Space Station	172	200	245	249
Space Flight Programs	87	75	68	60
Space Trans. Capab. Dev.	18	14	24	24
Space Shuttle	69	61	44	36
Space Science and Applications	1,993	2,000	1,982	1,977
Physics and Astronomy	1,181	1,105	1,171	1,178
Life Sciences	1	1	1	1
Planetary Exploration	76	75	75	75
Space Applications	735	819	735	723
Aeronautics & Space Tech	79	78	70	77
Aeronautical Res & Tech	10	9	13	10
Space Res & Tech	69	69	57	67
Commercial Programs	11	9	9	9
Tracking and Data Programs	612	579	578	569
SUBTOTAL DIRECT	2,954	2,941	2,952	2,941
Center Management & Operations	617	635	635	635
SUBTOTAL (FTP'S)	3,571	3,576	3,587	3,576
Other Controlled FTE's (PMI's/Co-ops/OTFTP's)	77	99	88	99
GRAND TOTAL (FTE)	3,648	3,675	3,675	3,675

SUMMARY OF RESOURCES REQUIREMENTS

FUNDING PLAN BY FUNCTION

		1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
			(Thousands of Dollars)		
I.	Personnel and Related Costs.....	156,929	162,915	169,165	179,868
11.	Travel.....	4,542	5,409	5,310	5,575
III.	Operation of Installation.....	38,014	46,014	43,958	45,582
	A. Facilities Services.....	(20,036)	(24,251)	(22,308)	(24,631)
	B. Technical Services.....	(5,687)	(9,694)	(9,332)	(7,871)
	C. Management Operations.....	(12,291)	(12,069)	(12,318)	(13,080)
	Total, fund requirements..	199,485	214,338	218,433	231,025

PROGRAM DESCRIPTION

	Permanent Civil Service Workyears
SPACE STATION.....	249

Space Station activities involve the evaluation of proposals and initial studies for definition of the Flight Telerobotic Servicing System, user science requirements, automated free-flying platforms, attachment of payloads on Space Station that are not in pressurized modules, and provisions to service, maintain and repair space platforms and free-flying spacecraft. In addition, systems engineering and integration efforts will be performed in direct support of the Space Station Program Office. Discipline studies in robotic, thermal and data systems requirements will be conducted. Working groups of scientists will be activated to involve potential users in Space Station requirements definition.

SPACE TRANSPORTATION CAPABILITY DEVELOPMENT.....	24

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

SPACE SHUTTLE (Space Transportation Operations).	36

Space Shuttle activities at GSFC include planning and implementing the equipment systems, communications data, voice circuits, and operational procedures required for support of the Shuttle program.

Goddard manages and coordinates the Agency's Get-Amy-Special (GAS) Program. Center personnel coordinate with an international array of experimenters (including private citizens, and those from 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 magement 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. A Scout launch capability is maintained by the Wallops Flight Facility.

	Permanent Civil Service Workyears
PHYSICS AND ASTRONOMY	1,178

Astrophysics activities have the objective of: accomplishing 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 providing advanced technical development of experiments and spacecraft components for future astrophysics missions. Organized activities accomplish 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 1988, 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 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 1987 and 1988, 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. The Roentgen Satellite, a 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.

The GSFC will provide the management and support of NASA domestic and International Sounding Rocket programs. The project involvement extends from the conception through launch and data analysis in support of research within galactic astronomy, high energy astrophysics, solar physics, plasma

physics, upper atmospheric and interdisciplinary research, and the space applications materials processing science. During 1988, we plan to continue using sounding rocket technology for the Space Shuttle via sounding rocket class payloads. This is a cost-effective approach which allows the experimenter to obtain scientific data from an instrument designed to fly on a sounding rocket or the Shuttle.

GSFC astrophysics efforts in 1988 include continuation of the Spartan Program involving development and flight of low cost, autonomous sub-satellites for sounding rocket experiments. Design of Spartan payloads is based on sounding rocket technology. Deployment and retrieval of each Spartan is accomplished on a single shuttle flight.

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

	Permanent FTE's (Civil Service)
LIFE SCIENCES	1

At GSFC, Life Sciences is utilizing data from remote sensing satellites as part of its efforts to further understand global biological characteristics and processes.

PLANETARY EXPLORATION	75

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

SPACE APPLICATIONS	723

The 1987 and 1988 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 in general is directed toward solving major problems in the above mentioned disciplines. It stresses continuity of research and development from the assessment of

these problems to conceptual instrument design and testing, mission payload studies, concepts of flight missions, and final analyses and evaluation after launch. Examples of instrumentation activities include: instrumentation for measuring temperature and pressure profiles in the atmosphere which are essential input parameters for our weather and climate models; user active and passive microwave systems for measuring sea surface temperatures and winds, as well as soil moisture essential for water resources modeling and agricultural yield predictions; new instruments for ocean color measurements important for ocean studies; and high precision laser electronic ranging systems to support the Earth and ocean dynamics activities.

Applications flight project responsibilities for 1987–1988 include:

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

2. Continued operations of 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 radiation budget;

5. Conducting correlation measurements from balloons, sounding rockets, aircraft, and ground installations; and

6. Development activities will be continued on the Upper Atmospheric Research Satellite (UARS) instrument and the spacecraft, leading to launch in 1991.

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 Nimbus-7 spacecraft for the solution of problems concerning pollution, ocean resources and dynamics, and weather and climate. Similar activities will be conducted using the data from the new generation of Landsat-4 spacecraft. 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 involve analysis of data collected from operating satellites including the Dynamics Explorer, the Interplanetary Monitoring Probe and the International Sun-Earth Explorers. Additionally, the International Sun-Earth Explorer series is providing opportunities to study the dynamic interactions of the solar wind and the Earth's magnetosphere from various points in space.

	Permanent FTE's (Civil Service)
AERONAUTICAL RESEARCH AND TECHNOLOGY	10

In 1987 and 1988, the Wallops airport will be used to conduct research tests of various aircraft in the 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 automatic landing of aircraft.

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

SPACE RESEARCH AND TECHNOLOGY	67

The Space Research and Technology Program activities provide results directly applicable to space missions. Past efforts have produced many worthwhile advances in space system capability, reliability, and effectiveness. During 1988, program areas of continuing emphasis will include thermal systems and spacecraft systems. New initiatives or expanded effort are also planned in 1988 in the following areas: optical communications, advanced science instruments, robotic servicing, advanced data systems, and computer science. A major role is also envisioned for Goddard in support of the space flight experiments program.

COMMERCIAL PROGRAMS	9

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 and development.

Technology Utilization activities are directed toward the application of space technology to public and private sector needs. Foremost among the technology applications projects in 1987 and 1988 are the cerebrospinal fluid control system and the closed loop control system for hypertension. Other activities include: (1) new technology identification, evaluation, and pulication; (2) dissemination methods and techniques; (3) public sector technology applications projects; (4) outreach activities to encourage industrial participation in the program.

During 1988, the GSFC Tracking Network will provide tracking support for the Space Transportation System launched payloads.

During 1987 and 1988, ground station support will also continue for a number of operating satellites such as the International Sun Earth Explorers, International Ultraviolet Explorer, Solar Maximum Mission, and Nimbus. Some examples of this support include: mission control, orbit/attitude computing, and sensor data processing.

During 1987 and 1988, operation of the Image and Telemetry Data Processing Facilities will continue. During the latter part of 1988, the Spacelab Data Processing Facility will be returned to operational status to support the resumption of Spacelab missions.

During 1987 and 1988, the Hubble Space Telescope (HST) Data Capture Facility will support HST testing in preparation for the launch of the HST in 1988.

Design and development of a generic data capature facility began in 1985. This system, when implemented, will minimize the repetitive development cost currently encountered in the support of different scientific missions. These activities will continue in 1987 and 1988.

Releases of consolidated orbit computation software were completed in 1985 and 1986 with a subsequent release scheduled for completion in 1987. The software will provide the capability to perform realtime and non-realtime orbit determination as well as orbit computation product generation and tracking data evaluation with a single software system on a single processor.

In the area of mission control, work will continue on the Multisatellite Operations Control Center to allow for the automation of systems in order to minimize manpower requirements for mission support. Likewise, work will proceed in the Hubble Space Telescope Operations Control Center to ready that facility for observer activities beginning after the launch in 1988.

	Permanent FTE's (Civil Service)
CENTER MANAGEMENT AND OPERATIONS SUPPORT	635

Center Management and Operations Support is support or services being provided to all Goddard Space Flight Center 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, 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.

RESOURCES REQUIREMENTS BY FUNCTION

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of	Dollars)	
I. PERSONNEL AND RELATED COSTS.....	156,929	162,915	169,165	179,868
Summary of Fund Requirements				
A. Compensation and Benefits				
1. Compensation				
a. Full-time Permanent.....	136,370	140,552	143,230	144,856
b. Other than full-time permanent.....	1,552	2,000	1,851	2,001
c. Overtime and other compensation.....	1,861	2,332	2,179	2,456
Subtotal, Compensation.....	139,783	144,884	147,260	149,313
2. Benefits.....	14,772	15,552	19,132	27,536
Subtotal, Compensation & Benefits.....	154,555	160,436	166,392	176,849
B. Supporting Costs				
1. Transfer of personnel.....	748	694	1,050	1,196
2. Personnel training.....	1,626	1,785	1,723	1,823
Subtotal, Supporting Costs....	2,374	2,479	2,773	3,019
Total, Personnel and Related Costs.....	156,929	162,915	169,165	179,868

	1986 Actual	1987 Amended Budget Estimte	1987 arrent Estimate	1988 Budget Estimte
		'(Thousands of Dollars)		
A. Compensation and Benefits.....	154,555	160,436	166,392	176,849
1. Compensation.....	139,783	144,884	147,260	149,313
a. Permanent workyears.....	136,370	140,552	143,230	144,856

The change in conpensation from the 1987 Amended Budget Estimte to the 1987 arrent Estimte is due to the pay raise effective January 1, 1987. The change in carpensation fran 1987 to the 1988 Budget Estimate is due to the adjustments in permnent workyear costs (described below), and increases in carpensation for other than full-time workyears, overtime and awards.

Basis of Cost for Permanent Workyears

In 1988, the cost of full-time workyears will be 144,856. The increase from 1987 is calculated as follows:

Cost of full-time permnent workyears in 1987.....		143,230
Cost increases in 1988.....		5,183
Within grade and career advances:		
Full year cost of 1987 increases.....	1,202	
Partial year cost of 1988 actions.....	1,222	
Extra day.....	548	
Change in reimbursements received.....	923	
Full year cost of the 1987 pay raise.....	1,288	
Cost decreases in 1988.....		-3,557
Full year effect of 1987 turnover savings.....	-1,578	
Partial year effect of 1988 turnover savings.....	-1,979	
Cost of full-time permanent workyears in 1988.....		144,856

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
b. Other than full-time permanent workyears				
1. cost.....	1,552	2,000	1,851	2,001
2. Workyears.....	96	130	125	136

The distribution of 1988 workyears is as follows:

Distribution of Other than Full-Time Permanent Workyears

Program	Workyears
Developmental programs.....	59
Other temporary.....	40
Youth opportunity programs.....	37
Total.....	136

The application of 1986 actions resulted in significant reductions in other than full-time programs. The 1987 Current Estimate and the 1988 Budget Estimate restore these programs to planned strength.

c. Overtime and other compensation.....	1,861	2,332	2,179	2,456

The change from the 1987 Amended Budget Estimate to 1987 Current Estimate reflects a decrease in overtime due to the slippage in shuttle launch dates. The increase from the 1987 Current Estimate to the 1988 Budget Estimate is primarily due to overtime expected for resumption of launch activities and minor increases in performance awards.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
2. Benefits.....	14,772	15,552	19,139	27,536
The following are the amounts of contribution by category:				
Civil Service Retirement Fund.....	8,913	9,225	12,936	21,050
Employee Life Insurance.....	279	314	310	320
Employee Health Insurance.....	2,936	3,679	3,225	3,323
Workmen's Compensation.....	398	325	262	410
FICA.....	648	409	718	736
Medicare.....	1,594	1,600	1,677	1,693
Other.....	4	--	4	4
Total.....	14,779	15,552	19,139	27,536

Increases in Civil Service Retirement and FICA from the 1987 Amended Budget Estimate to the 1987 Current Estimate and from 1987 to the 1988 Budget Estimate primarily reflect changes in the Civil Service retirement law as applied to newly hired employees. Other benefits increases are due primarily to the pay raise.

B. Support Costs.....	2,374	2,479	2,773	3,019
1. Transfer of personnel.....	748	694	1,050	1,196

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 1987 Amended Budget Estimate to the 1987 Current Estimate and a further increase to the 1988 Budget Estimate reflect the costs associated with the contract for services to assist employees in permanent change of station moves, increased rate allowances for movement of household goods, and an increase in the number of personnel entitled to benefits.

2. Personnel Training.....	1,626	1,785	1,723	1,823

The personnel training costs are based on current training programs and the need to reorient skill of employees into areas compatible with the direction of the current space program and GSFC's role in the program. The 1987 Current Estimate is based on the projected cost for the current level of requirements.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
II. TRAVEL	**4,542**	**5,409**	**5,310**	**5,575**
Summary of Fund Requirements				
A. Program Travel	3,739	4,619	4,508	4,735
B. Scientific and Technical Development Travel	452	382	401	420
C. Management and Operations Travel	351	408	401	420
Total, Travel	4,542	5,409	5,310	5,575
Explanation of Fund Requirements				
A. Program Travel	3,739	4,619	4,508	4,735

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 decrease from the 1987 Amended Budget Estimate to the Current Estimate is due to the lapse in STS launch activity. The increase in the 1988 Estimate reflects resumption of STS Operations and increased programmatic activity necessary for meeting launch readiness dates.

B. Scientific and Technical Development Travel	452	382	401	420

Scientific and technical development travel permits employees to participate in meetings and technical seminars with other representatives of the aerospace community. This participation provides benefit from exposure to technological advances outside GSFC, 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 decrease in the 1987 Current Estimate from the 1986 level is due to attendance at meetings of overall shorter duration and less remote locations than those attended in 1986. The 1988 Budget Estimate reflects the same level of scientific meeting travel as in 1987.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
C. Management and Operations Travel..	351	408	401	420

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 other NASA Centers and local travel in and around the Washington metropolitan area, and to and from Wallops Flight Facility. The increase from the 1987 Current Estimate to the 1988 Budget Estimate reflects increased level of travel to develop productivity initiatives and conduct employment recruitment.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
III. OPERATION OF INSTALLATION.....	**38,014**	**46,014**	**43,958**	**45,582**
Summary of Fund Requirements				
A. Facilities Services.....	20,036	24,251	22,308	24,631
B. Technical Services.....	5,687	9,694	9,332	7,871
C. Management and Operations....	12,291	12,069	12,318	13,080
Total, Operation of Installation.....	38,014	46,014	43,958	45,582

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 educational and informtional program; and *(3)* Management and Operations - the cost of administrative communications, transportation, medical, supply and related services.

The *1987* Current Estimate provides for the purchase of an administrative computer and associated software additions. Other services, supplies, materials, and equipment purchases remain at essentially level of effort. The *1988* Budget Estimate provides for projected inflationary increases for all areas. Utility costs are projected with minimal rate increases.

A. FACILITIES SERVICES.....	20,036	24,251	22,308	24,631

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 6,000. 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.

	1986 Actual	1987 Amended Budget Budget	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
Summary of Fund Requirements				
1. Rental of Real Property.....	616	694	714	817
2. Maintenance and Related Services.....	4,328	6,541	6,089	7,024
3. Custodial Services.....	4,785	4,763	4,743	5,395
4. Utility Services.....	10,307	12,253	10,762	11,395
Total, Facilities Services	20,036	24,251	22,308	24,631

Explanation of Fund Requirements

1. Rental of Real Property.....	616	694	714	817

Provides space for personnel at tracking stations and the Goddard Institute for Space Studies (GISS) in New York. The increase from the 1987 Amended Budget Estimate to the 1987 Current Estimate reflects the delay of the planned closing of the Chile Tracking Station. The increase in the 1988 Budget Estimate reflects GSA projected rates.

2. Maintenance and Related Services	4,328	6,541	6,089	7,024

This activity includes general building maintenance such as painting, inspection, and mechanical and electrical maintenance. The activity also provides for ground maintenance and includes supplies and facilities equipment such as building materials, electrical and electronics materials, and general maintenance, and operating materials. The decrease from the 1987 Amended Budget to the 1987 Current Estimate is due to reductions in contract rates based on 1986 experience The increase from 1987 to 1988 is due to: anticipated support service contractor wage rates; expected 1988 price levels for supplies, materials, equipment, and other contractual effort; and structural repairs of several facilities

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
3. Custodial Service.....	4,785	4,763	4,743	5,395

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. The decrease from the 1987 Amended Budget Estimate to the 1987 Current Estimate reflects 1986 experience. The increase in the 1988 Budget Estimate is due to anticipated rate changes in support service contracts, required enhancement of security and fire protection and realignment of work in facilities inspection services.

4. Utility Services.....	10,307	12,253	10,762	11,395

The estimate provides for the purchase of utility services, for maintenance of the utility plant and distribution systems and supplies, materials, and equipment. 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. The decrease in the 1987 Current Estimate from the 1987 Amended Budget Estimate is due to reevaluation of utility rates and consumption. The 1988 estimate provide for utility service charges based on historical rate changes and consumption increases.

	1986 Actual	1987 Amended Budget Budget	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
B. TECHNICAL SERVICES.....	5,687	9,694	9,332	7,871
Summary of Fund Requirements				
1. Automatic Data Processing.....	4,783	8,788	8,383	6,852
a. Equipment.....	911	4,373	4,013	1,837
b. Operations.....	3,872	4,415	4,370	5,015
2. Scientific and Technical Information.....	642	646	627	691
a. Library.....	35	47	49	52
b. Education and Information..	607	599	578	639
3. Shop Support Services.....	262	260	322	328
Total, Technical Services....	5,687	9,694	9,332	7,871
Explanation of Fund Requirements				
1. Automatic Data Processing.....	4,783	8,788	8,383	6,852

This funding provides for the hardware, system software, maintenance, and programming and operations support necessary to supply management with accurate and timely information. The systems supported include institutional management, finance and accounting, and procurement and personnel management. The 1987 budget includes the purchase of a new Amdahl administrative computer which will be capable of handling current and future damands €or online systems and real-time information. The decrease in the 1987 Current Estimate from the 1987 Amended Budget Estimate is due to revised estimates for the purchase of the mainframe computer. The 1987 Current Estimate and the 1988 Budget Estimate include additional equipment purchases and software development. In 1988, the reduction from

the 1987 Current Estimate because of the purchase of a mainframe computer in 1987 is partially offset by the purchase of data storage devices to augment the capabilities of the new computer and increased contract support for systems design/development and operations support.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
2. Scientific and Technical Information.....	642	646	627	691

These funds provide for a public affairs educational and information program, and support to the Center in the provision of various scientific and technical information services. This estimate also provides for 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. Initial funding in 1986 for start of Greenbelt Vistor's Center renovations and exhibit upgrade represented approximately half of the project, with completion phased over the next two years. This will provide a comprehensive and participative view of the space program at GSFC. Continued maintenance of the existing exhibits, as well as an increase in distribution of literature and films, is provided for in 1987 and 1988.

3. Shop Support Services.....	262	260	322	328

Support is given in the areas of safety, fire protection system maintenance, and related supplies and equipment. Engineering and fabrication support for facility planning and alteration and safety, reliability, and quality assurance requirements, and other technical services are included in this category. The increase from the 1987 Amended Budget Estimate to the 1987 Current Estimate reflects the purchase of audio visual and fire warning system equipment deferred from 1986. The 1988 Budget Estimate represents a level of effort consistent with 1987.

	1986 Actual	1987 Amended Budget Budget	1987 Current Estimate	1988 Budget Estimate
		(Thousands of	Dollars)	
C. MANAGEMENT **AND** OPERATIONS.....	12,291	12,069	12,318	13,080
Summary of Fund Requirements				
1. Administrative Communications..	5,745	4,627	5,029	5,256
2. Printing and Reproduction..	64	69	74	78
3. Transportation.....	1,571	1,633	1,700	1,920
4. Installation Common Services...	4,911	5,740	5,515	5,826
Total, Management and Operations.....	12,291	12,069	12,318	13,080
Explanation of Fund Requirements				
1. Administrative Communications..	5,745	4,627	5,029	5,256

These funds support local telephone service, long distance service, and other administrative communications. In 1986 the Center installed its own interconnect phone system which should result in annual cost savings in 1987 due to reduced charges for leased lines, installation, and moves. Estimates for 1987 and 1988 provide for maintenance of the new system, as well as increases for FTS charges based on historical changes.

2. Printing and Reproduction..	64	69	74	78

This category covers the costs associated with the maintenance of administrative copiers across the Center. Estimates for 1987 and 1988 provide for service to additional equipment purchased in prior years.

3. Transportation.....	1,571	1,633	1,700	1,920

This funding supports: the operation and maintenance of the GSFC Administrative Aircraft; the maintenance and repair of the installation's vehicle fleet; fuel and supplies associated with the operation of the aircraft and vehicles; and special vehicle rental. The increases in cost both from the 1987 Amended Budget to the 1987 Current Estimate and from 1987 to 1988 represent the addition of contractor workyears for vehicle maintenance activities.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
4. Installation Common Services...	4,911	5,740	5,515	5,826

This activity supports Center management and staff activities, provides medical services, and covers various installation support services. Funding includes patent searches and applications; materials and equipment maintenance, (microfilm, special typewriters, etc.) for staff offices; 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: packing and crating; rigging equipment for shipment; storage and warehousing; and moving and hauling.

The decrease from the 1987 Amended Budget to the 1987 Current Estimate is the effect if revised estimtes for support service contracts based on 1986 experience. The increase from the 1987 Current Estimate to the 1988 Budget Estimate reflects anticipated price levels in 1988.

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

DIRECTOR
DEPUTY DIRECTOR

	87	88
SES	3	3
EXCEPTED	0	0
GS/GM 10	0	0
GS/GM 15	2	2
GSIGM 14	0	D
OTHER GS/GM	[illegible]	[illegible]
WAGEGRAOE	0	0
TOTAL	10	I0

NASA OFFICE OF INSPECTOR GENERAL GSFC FIELD OFFICE

TOTAL

	87	88
SES	40	40
EXCEPTED	2	2
GS/GM 16	1	1
GS/GM I5	320	320
GS/GM 14	540	540
OTHER GS/GM	2571	2571
WAGE GRADE	131	131
TOTAL	3627	3627

COMPTROLLER

	87	88
	1	1
EXCEPTED	0	0
GS/GM 18	0	0
GS/GM 15	3	
GS/GM 14	8	
OTHER GS/GM	94	
WAGEGRAOE	0	
TOTAL	104	10[illegible]

DIRECTOR OF FLIGHT ASSURANCE

	87	88
SES	1	1
EXCEPTED	0	0
GS/GM 16	0	0
GS/GM I5	10	10
GS/GM 14	22	11
OTHER GS/GM	86	86
WAGEGRAOE	0	0
TOTAL	125	125

CHIEF COUNSEL
CHIEF COUNSEL

	87	88
SES	I	1
EXCEPTED	0	0
GS/GM 18	0	0
GS/GM 16	2	2
GS/GM 14	2	2
OTHER GS/GM	4	4
WAGE GRADE	0	0
TOTAL	9	9

EQUAL OP PROGRAPORTUNITY MS OFFICE

	87	88
SES	0	0
EXCEPTED	0	0
GS/GM 16	0	8
GS/GM 16	0	0
GS/GM 14	1	1
OTHER GS/GM	4	4
WAGE GRADE	0	0
TOTAL	5	5

OFFICE OF PUOLIC AFFAIRS

	87	88
SES	0	0
EXCEIIEO	0	0
GS/GM 18	0	0
GS/GM 15	1	1
GS/GM 14	3	3
OTHER GS/GM	14	I4
WAGEGRAOE	0	0
TOTAL	18	18

DIRECTOR OF MANAGEMENT
OPERATIONS

	87	88
SES	3	3
EXCEPTED	0	0
GS/GM 16	0	0
GS/GM 15	16	16
GS/GM 14	I?	I?
OTHER GS/CM	492	492
WAGEGRAOE	131	131
TOTAL	678	678

DIRECTOR OF
FLIGHT PROJECTS

	87	88
SES	10	10
EXCEPTED	1	1
GS/GM 18	0	0
GS/GM 15	11	11
GS/GM 14	83	83
OTHER GS/GM	130	130
WAGEGRAOE	0	0
TOTAL	312	312

DIRECTOR OF
MISSIONS OPERATIONS
DATA SYSTEMS

	87	88
SES	4	4
EXCEPTED	0	0
GSIGM I0	0	0
GS/GM 16	45	45
GS/GM I4	44	44
OTHER GS/GM	4m	480
WAGE GRADE	0	0
TOTAL	595	595

DIRECTOR OF SPACE AND EARTH'
SCIENCES

	87	88
SES	13	13
EXCEPTED	1	1
GS/GM 18	1	1
GS/GM 15	102	102
GS/GM I4	144	144
OTHER GS/GM	495	496
WAGEORAOE	0	0
TOTAL	754	756

DIRECTOR OF
ENGINEERING

	87	88
SES	0	0
EXCEPTED		1
GS/GM 16		1
GS/GM 15		
GS/GM 14	130	13
OTHER GS/GM	574	574
WAGE GRADE		
TOTAL		710

DIRECTOR OF SUBORBITAL PROJECTS AND OPERATIONS
DIRECTOR OF
SUBORBITAL PROJECTS
AND OPERATIONS

	87	88
SES	4	4
EXCEPTED	0	0
GS/GM I D	0	0
GS/GM 15	11	11
GS/GM I4	32	32
OTHER GS/GM	204	204
WAGE GRADE	0	0
TOTAL	251	251

APPROVED: _____ DATE: _____

AMES
RESEARCH CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1988 ESTIMATES

AMES RESEARCH CENTER

DESCRIPTION

Established in 1940, Ames Research Center (ARC) 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, 1986, was $796,618,000.

The Ames Dryden Flight Research Facility (DFRF) 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, 1986, was $130,626,000.

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 use 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 sirmlation, 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 inproving efficiency, safety, performance and enviromntal acceptability.

Low-Speed Vehicle Systems - conduct research in/on the short and vertical takeoff and landing 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 inprove 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, sirmlation 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 ma 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 Sirmlation - inprove the state of the art to permit more effective use of simulators in aircraft design and validation-of-flight sirmlation; 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 control to support productive, efficient and safe missions including the space station and beyond.

Life Sciences:

Life Sciences Spaceflight Experiments - develop, manage and operate spaceflight experiments in the life sciences, particularly those involving non-hmn species, and provide informtion 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 man during and following 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 primary and contingency landing support to the Space Transportation System.

Advanced Turboprop - Conduct research and technology efforts including wind tunnel and flight tests to support NASA's efforts in advanced turboprop technology.

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

AMES

	1986 ACTUAL	1987 AMENDED BUDGET ESTIMATE	1987 CURRENT ESTIMATE	1988 BUDGET ESTIMATE
Space Station	15	11	15	15
Space Flight Programs	36	36	36	36
Space Shuttle	36	36	36	36
Space Science and Applications	344	336	346	346
Physics and Astronomy	120	105	120	120
Life Sciences	121	133	124	124
Planetary Exploration	50	47	50	50
Space Applications	53	51	52	52
Aeronautics & Space Tech	1,091	1,107	1,128	1,128
Aeronautical Res 6 Tech	944	919	955	955
Space Res & Tech	147	138	143	143
Transatmospheric R&T	0	50	30	30
Commercial Programs	5	4	5	5
Tracking and Data Programs	35	35	27	27
SUBTOTAL DIRECT	1,526	1,529	1,557	1,557
Center Management & Operations	502	500	502	502
SUBTOTAL (FTP'S)	2,028	2,029	2,059	2,059
Other Controlled FTE's (PMI's/Co-ops/OTFTP's)	84	115	85	85
GRAND TOTAL (FTE)	2,112	2,144	2,144	2,144

PROGRAM DESCRIPTION

RESEARCH AND DEVELOPMENT	Permanent Civil Service Workyears
SPACE STATION	15

In 1988, Space Station activities will focus upon developing payload specifications and outfitting for incorporation into the International Operating Configuration (IOC) and growth station. These Phase A and early Phase B activities will support life sciences and various space science activities. Efforts in human factors, i.e., design criteria for internal architecture and proximity operations for the station will continue. The AX-5 hard suit will be WETF tested and gradual transfer of technology to Johnson Space Center (JSC) for flight testing will begin. Information sciences will demonstrate Artificial Intelligence technology in a test bed at JSC. Further research on expert systems will continue to focus upon autmtion of both on board and ground control functions of the station.

SPACE FLIGHT PROGRAMS

SPACE SHUTTLE	36

Dryden Flight Research Facility is the secondary recovery site for the Space Shuttle missions and the primary recovery site for selected missions. Dryden also must be in a recovery mode for every launch in case the Space Shuttle must abort on the first orbit. 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 Space Shuttle servicing facilities located at Ames Dryden.

SPACE SCIENCE & APPLICATIONS PROGRAMS

PHYSICS AND AS~	120

In 1988, the civil service personnel will provide support for the airborne astronany program, which includes a C-141 aircraft, the Kuiper Airborne Observatory, 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 astronany 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, an ER-2, a E-8, and a C-130, some of which serve as unique national and international facilities for research in astronany, 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.

Infrared astronomy observation from space platforms avoids obscuration caused by the Earth's atmosphere. Ames has the responsibility for definition and development of instruments to accomplish these observations, which included such developments as the telescope portion of the Infrared Astronomical Satellite, launched in early 1983; definition of the Space Infrared Telescope Facility and definition studies of instruments to be used on potential free flyers in space.

Ames has an active program of laboratory, theoretical and computational studies to develop the basic astrophysical mdeling 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. The objectives of this program are 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 system.

	Pemnent Civil Service Workyears
LIFE	124

In 1988, the civil service personnel will continue to be involved in research, hardware development, and program management related to meeting programmilestones 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 and life-related chemicals on Earth and elsewhere in the universe.

Biomedical research will be conducted to investigate the effects of space flight on humans. Specifically, causes and potential countermeasures for neurophysiological, nusculo-skeletal, and cardiovascular changes observed during and immediately following space flight will continue to be studied. Ground-based space flight sinulations 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.

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 launch now until late in 1989. During this hiatus between missions the emphasis in 1988 will be placed 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, at a reduced level, to prepare SLS-1, International

Microgravity-1 (IML-1), Spacelab-J, and Atlas for flight readiness in **1989** and beyond. Emphasis will also be placed on the definition and design of hardware and experiments for Space Station and on new flight projects in exobiology.

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 analyses of chemical abundances in precambrian deposits by the use of an ultrasensitive stable isotope measuring system. 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 cometary material.

The Ecosystems Science and Technology Program will continue to enhance the understanding of the biological aspects of global conditions and biogeochemical processes on Earth. Progress will be achieved through investigations in remote sensing science and advanced sensor technology; and disciplinary research in areas of plant stress, hydrologic cycles, and forest biomass determinations. Interdisciplinary research will also include biogeochemical cycles and ecosystem disturbances. These research areas involve not only remote sensing, but theoretical and experimental work within the disciplines of **(1)** biology, **(2)** biochemistry, **(3)** atmospheric science, (4) geochemistry, and (5) spectroscopy.

	Permanent Civil Service Workyears
PLANETARY EXPLORATION	**50**

A continuing series of project mnagement activities, backed by the scientific expertise of principal investigators from Ames, other NASA Centers and the university community, will be continued in **1988** 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 **1988,** the 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,** two spacecraft that m d e 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 and which has examined Halley's Comet in the UV during perihelion passage, and which will attempt a study of the **1987** Encke passage; and the Galileo Probe which will enter and investigate the atmosphere of Jupiter and its environment.

Ames maintains an active program of laboratory, computational, and theoretical studies to develop basic atmospheric mdeling 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.

	Permanent Civil Service Workyears
SPACE APPLICATIONS	52

A highly diversified group of scientists, engineers, and technicians are required in **1988** to support programs in Earth and enviromntal observations including space, atmospheric, and stratospheric programs; to provide skilled personnel in support of the Agency's applications satellite programs; to interpret and process both spaceborne and airborne remotely sensed data; and to interact with and disseminate data and associated processing techniques to the user cmnity.

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 mdeling 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 storm and volcanic eruptions. These modeling efforts make effective use of the unique carputational resources at the Center. A similar programwhich focuses on the climtic 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.

Ames space applications responsibility is also fulfilled by conducting a continuing program of applied research and development to enhance the use of remote and in-site sensing technology for Earth resources applications and defining, developing, and evaluating potential future satellite sensors, data acquisition and processing techniques, and associated cmnications technology.

AERONAUTICS AND SPACE TECHNOLOGY PROGRAMS

AERONAUTICAL RESEARCH AND TECHNOLOGY	955

In **1988,** the program in aeronautics will be characterized in term of three elements: generic research and technology, vehicle specific technology (e.g., rotorcraft and 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 rotorcraft, powered-lift and high-performance aircraft by improving operational performance and terminal-area safety and efficiency and by reducing aircraft noise and vibrations.

Generic Research and Technolopy:

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 conpute 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 conputational capability supporting aeronautical research. Numerical Aerodynamic Sirmlation 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 srmll-scale research facilities and flight research vehicles to develop design methodologies for advanced aircraft. Flight research will continue for the development 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 non-linear 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 autmtion; and conducting flight research on digital fly-by-wire concepts to continue to support the development of advanced flight systems technology. In **1988,** the human factors program will continue basic and applied research in human performance , computational models for human machine visual perception, developnent 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.

Vehicle Specific Technology:

The vehicle specific technology is focused on rotorcraft, powered-lift and high-performance aircraft. The vehicle technology emphasis at Ames relates to, and depends on, the basic capabilities and the aeronautical research disciplines described previously. The **1988** research program will include srmll-scale and large-scale wind tunnel testing and ground-based sirmlation, and flight research. Powered-lift aircraft performance is highly dependent on high-lift technology (both propulsive and aerodynamic lift) and advanced guidance and control system, 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 inprove 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 autmtion will be conducted through the use of artificial intelligence. In 1988, technology for next-generation rotorcraft will pursue further understanding and evaluation of high speed rotorcraft concepts and will continue flight research on the X-wing.

Other Aeronautical Support:

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 developnent, as well as support for large NASA projects, such as the Space Shuttle. The Research and Technology Directorate of the U. S. Army Aviation Research and Development Activity, and the Aeroflightdynamics Directorate, both under Aviation Systems Command are 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, JVX support, Oblique Wing Research Aircraft flight research program, 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 F-111 program for research and developnent of a mission adaptive wing that will obtain moth in-flight contour changes to the wing aerodynamic shape to achieve improved aerodynamic efficiency; 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 the DARPA, a large scale flight investigation of the X-wing rotor system will be conducted, utilizing the Rotor Systems Research Aircraft. The focus will be in exploring the start-stop phase of flight for the high-speed X-wing concept.

Permanent Civil
Service Workyears

SPACE RESEARCH AND TECHNOLOGY..... 143

In 1988, civil service personnel will provide support to/for a space research and technology program which encunpasses both basic research and project support. The basic research focuses on entry technology and mterials research, with a germinal effort in artificial intelligence emphasizing advanced, knowledge-based systems methodologies for expert systems applications. The project work supports Space Shuttle, the Orbiter Experiments (OEX) Program, the Infrared Astronomy Program, the Galileo Probe, and advanced work related to technology definition of a space station with a future potential to be permanently manned.

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 that 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 mterials for heat shields to protect Earth and planetary entry vehicles (probes) and AOTV's; and develop cunputational chemistry codes to calculate basic properties of matter, and expand the understanding of surface envirorment interactions (corrosion). Research is also being conducted in the advanced electronics and mterials areas to determine atomic structure and properties of absorbed surface layers and to advance the state of the art of cunputing 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, mchine learning and validation methodologies. The AI research will be directed towards the demonstration of a major System Autonomy Demonstration Project (SADP) in 1988, the Thermal Control system for the Space Station, a joint NASA ARC/JSC collaborative effort.

In 1988, the Space Shuttle program will be supported with ground-based facilities to study a variety of aerodynamic and thermdynamic problems. The Galileo project will be supported with heat shield design and performnce data, heat shield shape change effects on aerodynamics, and subsonic probe stability. Groundbased facilities will also simulate AOTV heating environments and debris-inpact 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 mterials 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 tenperature 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; 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 system, 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 (IR) 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 system.

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 (EVA) systems and research on space habitat and operational systems designs.

	Permanent Civil Service Workyears
TRANSATMOSPHERIC RESEARCH AND TECHNOLOGY	**30**

The activities at Ames are in several major areas. The first emphasizes the special capabilities and expertise in hypersonic and conputational facilities at Ames Moffett for the conduct of extremely high Mach number tests and analysis of both wind tunnel and flight data. The second emphasizes computational methods using the Class VI and numerical aerodynamic simlation conputers, combined with

the advanced materials activities, to provide unique designs and tailoring of lightweight, high-temperature structural concepts. In addition, Ames Dryden is evolving the testing, instrumentation, data acquisition system, and range capabilities necessary for future flight testing of a hypersonic/transatmospheric research vehicle over the required range of speed, altitude and envelope conditions. These capabilities are being applied to the maturation of specific technologies required for the National Aero-Space Plane Program.

	Permanent Civil Service Workyears
COMMERCIAL PROGRAMS & TECHNOLOGY UTILIZATION	5

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 and development. This effort will establish an organizational focal point to initiate a program specifically intended to foster commercial use of and access to space.

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

TRACKING AND DATA ACQUISITION

SPACE AND GROUND NETWORK COMMUNICATIONS AND DATA SYSTEMS	27

In 1988, DFRF will maintain and operate the NASA Western Aeronautical Test Range, which provides direct operational support for a wide variety of aeronautical and aerospace programs. 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 is also supplied as support to program short of the analysis or second generation data processing function.

CENTER MANAGEMENT AND OPERATIONS	502

Center Management and Operations provides support or services to all Ames organizations. 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, Resources Management, and under the auspices of the Chief Engineer, Health, Safety, Security and Energy Management.

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

Operations Support - Provides for the operation and mintenance of institutional facilities, buildings, system, and equipnent, and which provides technical services such as administrative automatic data processing, library and infomtion services.

SUMMARY OF RESOURCES [redacted]

Funding Plan by Function

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
	(Thousands of Dollars)			
I. Personnel and Related Costs.. ..	93,571	96,698	100,451	106,863
11. Travel...	2,811	3,293	3,729	3,915
III. Operation of Installation.....	26,943	33,922	30,949	34,469
A. Facilities Services.....	(15,132)	(21,510)	(17,850)	(19,126)
B. Technical Services.....	(4,007)	(4,186)	(4,486)	(5,871)
C. Management and Operations.	(7,804)	(8,226)	(8,613)	(9,472)
Total, fund requirements....	123,335	133,913	135,129	145,247

[redacted]

REQUIREMENTS BY FUNCTION

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
I. PERSONNEL AND RELATED COSTS	**93,571**	**96,698**	**100,451**	**106,863**
Summary of Fund Requirements				
A. Compensation and Benefits				
1. Compensation				
a. Full-time permnent	78,346	78,950	82,290	83,786
b. Other than full-time permnent	2,084	2,693	2,226	2,247
e. Reimbursable detailees.. .	326	899	465	599
d. Overtime and other compensation	1,642	1,637	1,682	1,705
Subtotal, Compensation ...	82,398	84,179	86,663	88,337
2. Benefits.....	9,790	10,399	11,859	16,538
Subtotal, Compensation and Benefits.....	92,188	94,578	98,522	104,875
B. Supporting Costs				
1. Transfer of personnel	328	477	359	357
2. Personnel training.....	1,055	1,643	1,570	1,631
Subtotal, Supporting Costs	1,383	2,120	1,929	1,988
Total, Personnel and Related Costs.....	93,571	96,698	100,451	106,863

Explanation of Fund Requirements

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
A. Compensation and Benefits.....	92,188	94,578	98,522	104,875
1. Compensation.....	82,398	84,179	86,663	88,337
a. Full-time permnent workyears.....	78,346	78,950	82,290	83,786

The increase from the 1987 amended budget estimte to the 1987 current estimte is due to an adjustment between permanent and other-than-full-time permanent personnel, the January 1987 pay raise, and the effect of the clerical and engineering special rate increases.

Basis of Cost for Permanent Workyears

In 1988, the cost of permnent workyears will be $83,786,000. The increase from 1988 is calculated as follows:

Cost of full-time permnent workyears in 1987		82,290
Cost increases in 1988		2,990
Within grade and career advances:		
Full year cost of 1987 increases	1,000	
Partial year cost of 1988 actions	988	
Extra day	304	
Full year cost of the 1987 pay raise	698	
Cost decreases in 1988		-1,494
Full year effect of 1987 turnover savings	-463	
Partial year effect of 1988 turnover savings	-1,031	
Cost of full-time permnent workyears in 1988		83,786

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
b. Other than full-time permnent				
1. Cost	2,084	2,693	2,226	2,247
2. Workyears.....	120	163	128	128

The distribution of 1988 workyears is as follows:

Distribution of Other Than Full-time Pemnent Workyears

Program	Workyears
Development progr~.....	55
Summer employment program.....	1
Youth opportunity programs.....	43
Other tenporary programs.....	29
Total.....	128

The net reduction from the 1987 amended budget estimte to the 1987 current estimte is due to an adjustment between permnent and other FTE's offset by an increase for the January 1987 pay raise. The 1988 estimte reflects the same level of effort as 1987 with the full year effect of the pay raise.

c. Reimbursable detailees...	326	899	465	599

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 1987 reflects the actual number of technical military detailees expected. The increase in 1988 reflects a small increase in military detailees planned.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
d. Overtime and other cqensation.....	1,642	1,637	1,682	1,705

Overtime and other compensation includes overtime, holiday pay, incentive awards, Sunday premium pay, and night work differential. The use of overtime and other cqensation is primarily for off-peak operation of major facilities such as the Unitary Plan Wind Tunnel System, 40-by-80-by-120 foot Wind Tunnel, and the 6-by-6 foot Supersonic Wind Tunnel, and preparation for test flights. The increases in 1987 to 1988 reflect an overtime plan consistent with the facilities use schedule.

2. Benefits	9,790	10,399	11,859	16,538

The following are the amounts of contributions by category:

Civil Service Retirement Fund	5,542	5,068	7,265	11,421
Employee life insurance.....	165	200	175	182
Employee health insurance....	1,911	2,327	2,025	2,117
Workmen's compensation.....	649	765	624	624
FICA.....	602	1,109	830	1,220
Medicare.....	921	930	940	974
Total.....	9,790	10,399	11,859	16,538

The net increase from the 1987 amended budget to the 1987 current estimate reflects the alteration in the civil service retirement system, offset by decreases in FICA and employee health insurance. The 1988 increases reflect the first full year of the alteration in the civil service retirement system and the continuing application of FICA for new employees.

B. Supporting Costs.....	1,383	2,120	1,929	1,988
1. Transfer of personnel.....	328	477	359	357

The decrease from 1987 amended budget estimate to 1987 current estimate reflects costs based on 1986

actuals. The 1988 estimate reflects the same level of effort as 1987.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
2. Personnel training.....	1,055	1,643	1,570	1,631

The change from the 1987 amended budget estimate to 1987 current estimte reflects a small decrease in the level of training. Increases in the 1988 requirements are primarily to support the center's increasing computer capabilities.

II. TRAVEL.....	2,811	3,293	3,729	3,915
Summary of F Requ rements				
A. Program Travel.....	1,734	2,271	2,497	2,609
B. Scientific and Technical Development Travel.....	571	495	653	693
C. Management and Operations Travel.....	506	527	579	613
Total, Travel.....	2,811	3,293	3,729	3,915
Explanation of Fund Requirements				
A. Program Travel.....	1,734	2,271	2,497	2,609

Program travel is required for the accomplishment of the Center's missions and accounts for 67 percent of travel costs in 1988. Travel for program purposes is required for the continuing monitoring and management efforts in space research, aeronautical research and technology, flight simlation, 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 1987 amended budget estimate to the 1987 current

estimte is due to Space Station, National Aerospace Plane and the Stratospheric-Tropospheric Exchange Program. The 1988 estimte reflects the continuing 1987 level of the effort.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
B. Scientific and Technical Development Travel.....	571	495	653	693

Scientific and technical developnent 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 problem to associates. Many such meetings are working panels convened to solve certain problems for the benefit of the Govermnt. The increase from the 1987 amended budget estimte to the 1987 current estimte is based on the same level of requirements as 1986 at 1987 rates. The increase in the 1988 budget estimte from the 1987 current estimte reflects rate increases for the current level of requirements.

C. Management and Operations Travel	506	527	579	613

Management and operations travel provides for the direction and coordination of general management matters. It includes travel in such areas as personnel financial mnagement and procurement; travel of the Center's top management to NASA Headquarters, other NASA Centers, and contractor plants; and local transportation. The increases from the 1987 amended budget estimte to the 1987 current estimte and 1988 reflect nominal airfare escalation.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimte
		'(Thousands of Dollars)		
111. OPERATION OF INSTALLATION.....	**26,943**	**33,922**	**30,949**	**34,469**
S m r y of Fund Requirements				
A. Facilities Services.....	15,132	21,510	17,850	19,126
B. Technical Services.....	4,007	4,186	4,486	5,871
C. Management and Operations....	7,804	8,226	8,613	9,472
Total, Operation of Installation.....	26,943	33,922	30,949	34,469

Explanation of Fund Requirements

Operation of Installation provides a broad range of services, supplies, and equipnent 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 mnagement 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 reduction from the 1987 amended budget estimte to the 1987 current estimte is primarily due to lower than anticipated electricity rates and consumption. The 1988 estimate provides for 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 janitorial, ADP, and supply services areas.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
A. FACILITIES SERVICES.....	15,132	21,510	17,850	19,126

Ames-Moffett includes 11 mjor 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, m n y of the test facilities operate on schedules involving more than one shift, i.e., during off-peak hours.

The decrease from the 1987 amended budget to the 1987 current estimte is due to less than anticipated electricity rates, cosumption decreases and delay and deferral of purchases of supplies, mterials and equipnent. The 1988 estimte provides for increased utility rates and consumption as well as an increase in contractor workyears.

S m r y of Fund Requirements

1. Rental of Rea1 Property.....	27	47	20	21
2. Maintenance and Related Services.....	3,324	3,408	3,251	3,403
a. Facilities.....	3,254	3,361	3,209	3,359
b. Equipment.....	70	47	42	44
3. Custodial Services.....	4,149	4,365	3,863	4,082
4. Utility Services.....	7,632	13,690	10,716	11,620
Total, Facilities Services...	15,132	21,510	17,850	19,126

Explanation of Fund Requirements

1. Rental of Real Property.....	27	47	20	21

At Dryden, this item provides for the rental of trailers to provide office, shop, laboratory, and storage space in support of the Shuttle program. The decrease from the 1987 amended budget estimate to the 1987 current estimate is due to the elimination of some of the trailers. The 1988 estimte provides for the *same* level as 1987.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
2. Maintenance and Related Services	3,324	3,408	3,251	3,403

At Ames-Moffett maintenance and repair includes the maintenance of grounds and emergency repairs of heating, ventilating, and lighting equipment in the 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. At Dryden, this activity involves all facilities, including those used for Shuttle. The reduction from the 1987 amended budget estimate to 1987 current estimte reflects deferred maintenance and lower than anticipated contractor rates. The increase from the 1987 current estimate to the 1988 budget estimte reflects anticipated support contractor rate increases and expected increased price levels for supplies, equipment, and other contractual effort, and two additional workyears for maintenance at Dryden.

3. Custodial Services.....	4,149	4,365	3,863	4,082

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 over 90 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 decrease from the 1987 amended budget estimate to the 1987 current estimte reflects lower than expected suppport contractor rates and workyears. The increase in 1988 is due to expected support contract rates and four janitorial workyears to support new facilities.

4. Utility Services.....	7,632	13,690	10,716	11,620

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 services 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 40-by-80-by-120 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 estimtes are based on Air Force projections. Natural gas is purchased from Pacific Gas and Electric (PG&E). Other commodities include fuel oil, water, and sewage services.

The decrease between the 1987 amended budget estimte and the 1987 current estimtes is caused by lower than expected consumption and rates.

Research facility consumption has been adjusted for slower growth and this is reflected in the 1987 current and 1988 estimates. Lower rates in 1987 and 1988 reflect Ames' planned cost sharing negotiations with other local electricity users. Base rates are those published by WAPA.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
B. TECHNICAL SERVICES.....	4,007	4,186	4,486	5,871
S m r y of Fund Requirements				
1. Automatic Data Processing.....	2,809	3,054	3,402	4,683
a Equipment	320	200	538	869
b Operations	2,489	2,854	2,864	3,814
2. Scientific and Technical Info.....	640	572	557	613
a Library.....	71	70	73	76
b Education & Information.. .	569	502	484	537
3. Shop and Support Services.....	558	560	527	575
Total, Technical Services.....	4,007	4,186	4,486	5,871

Explanation of Fund Requirements

1. Automatic Data Processing....	2,809	3,054	3,402	4,683

This category includes the central administrative *ADP* facility equipnent and operating costs. The increase from the 1987 amended budget estimate to the 1987 current estimte is due primarily to a planned study leading to an administrative management system upgrade. The 1988 increase provides for mainframe upgrades as well as anticipated support contractor rate increases.

2. Scientific & Technical Info..	640	572	557	613

This category provides for the purchase of books, supplies, and materials for the operation of the Dryden library. Also included is a support contract to perform public informtion services, media development, and education programs. The 1987 current estimate reflects a reduction in public affairs requirements and

decreased library costs from the 1987 amended budget estimate. The 1988 estimate reflects about the same level of service at anticipated rates.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
3. Shop and Support Services....	558	560	527	575

This category includes photo and graphics, and audiovisual services primarily supporting the public affairs activity. The decrease from the 1987 amended budget estimate to the 1987 current estimte is the result of deferred purchases to remain within budget levels. The 1988 estimate provides services at the 1987 level.

C. MANAGEMENT AND OPERATIONS.....	7,804	8,226	8,613	9,472
Summary of Fund Requirements				
1. Administrative Camunications...	2,679	3,047	3,272	3,518
2. Printing and Reproduction.....	186	172	189	198
3. Transportation.....	935	924	1,018	1,130
4. Installation Common Services....	4,004	4,083	4,134	4,626
Total, Management and Operations	7,804	8,226	8,613	9,472
Explanation of Fund Requirements				
1. Administrative Camunications.....	2,679	3,047	3,272	3,518

Camunications services are provided by the General Services ministration (GSA) for the Federal Telecmnications 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 equipnent and services provided by Western Union, the lease of switchboard equipnent, and support contract for communications services. The increase from the 1987 amended budget estimate to the

1987 current estimte reflects additional support contractor workyears to upgrade the level of service coupled with commercial rate increases. The 1988 estimate reflects the same level of service at higher rates.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
2. Printing and Reproduction.....	186	172	189	198

The estimte for administrative printing includes the operating costs of the printing and reproduction facility as well as supplies, mterials, and equipnent. All common processes of duplication, including photostating, blueprinting and microfilming are included. The increase from 1987 amended budget estimte to 1987 current estimates reflect 1986 experience. The 1988 estimte provides the same level as 1987.

3. Transportation.....	935	924	1,018	1,130

The estimates include motor pool operations costs for NASA-owned and GSA-owned vehicles, Government bills of lading, and air freight costs. The increase from the 1987 amended budget to the 1987 current estimate reflects purchase of needed replacement vehicles. The 1988 estimte provides the same level as in 1987, at anticipated support contractor rates.

4. Installation Common Services.....	4,004	4,083	4,134	4,626

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, general and patent legal services, personnel, procurement, and financial management services. Medical services include the staffing of the health units, laboratory service fees, clinic supplies, and mintenance of clinic equipnent. Installation support services provide contractor support for supply and property mnagement, mail, pickup and delivery services, and postage. The increase from the 1987 amended budget estimte to the 1987 current estimte is due to the purchase of new and repair of existing administrative equipnent. The increase in 1988 provides for additional support contract workyears to inprove the level of supply services coupled with anticpated price levels.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

AMES RESEARCH CENTER

ORGANIZATION AND STAFFING CHART

CENTER TOTAL	87	88
SES	36	36
GS/GM-16	1	1
GS/GM-15	151	153
GS/GM-14	317	320
OTHER GS/GM	1204	1190
WAGE GRADE	353	353
TOTAL	2062	2062

DIRECTOR AND STAFF	87	88
SES	4	4
GS/GM-16	8	8
GS/GM-15	13	13
GS/GM-14	13	13
OTHER GS/GM	50	50
WAGE GRADE	0	0
TOTAL	88	88

DIRECTOR OF ADMINISTRATION	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	1	1
OTHER GS/GM	5	5
WAGE GRADE	0	0
TOTAL	8	8

DIRECTOR OF ENGINEERING AND TECHNICAL SERVICES	87	88
SES	2	2
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	1	1
OTHER GS/GM	1	1
WAGE GRADE	0	0
TOTAL	5	5

DIRECTOR OF AEROSPACE SYSTEMS	87	88
SES	2	2
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	1	1
OTHER GS/GM	3	3
WAGE GRADE	0	0
TOTAL	6	6

DIRECTOR OF FLIGHT OPERATIONS AND RESEARCH	87	88
SES	2	2
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	1	1
OTHER GS/GM	7	7
WAGE GRADE	0	0
TOTAL	11	11

DIRECTOR OF AEROPHYSICS	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	2	2
GS/GM-14	1	1
OTHER GS/GM	4	4
WAGE GRADE	0	0
TOTAL	8	8

DIRECTOR OF SPACE RESEARCH	87	88
SES	3	3
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	2	2
OTHER GS/GM	7	7
WAGE GRADE	0	0
TOTAL	13	13

LOGISTICS MANAGEMENT DIVISION	87	88
SES	0	0
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	1	1
OTHER GS/GM	19	19
WAGE GRADE	6	6
TOTAL	26	26

FACILITIES PLANNING OFFICE	87	88
SES	0	0
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	1	1
OTHER GS/GM	4	4
WAGE GRADE	0	0
TOTAL	5	5

ADVANCED PLANS AND PROGRAMS OFFICE	87	88
SES	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	6	6
OTHER GS/GM	2	2
WAGE GRADE	0	0
TOTAL	9	9

CHIEF ENGINEER'S OFFICE	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	0	0
OTHER GS/GM	0	0
WAGE GRADE	0	0
TOTAL	1	1

INFORMATION SCIENCES OFFICE	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	2	2
GS/GM-14	5	6
OTHER GS/GM	13	12
WAGE GRADE	0	0
TOTAL	21	21

SOLAR SYSTEM EXPLORATION PROJECTS OFFICE	87	88
SES	0	0
GS/GM-16	0	0
GS/GM-15	3	3
GS/GM-14	9	9
OTHER GS/GM	14	14
WAGE GRADE	0	0
TOTAL	26	26

FINANCIAL MANAGEMENT DIVISION	87	88
SES	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	1	1
OTHER GS/GM	50	50
WAGE GRADE	0	0
TOTAL	52	52

INFORMATION AND COMM SYSTEMS DIVISION	87	88
SES	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	4	4
OTHER GS/GM	48	48
WAGE GRADE	0	0
TOTAL	53	53

FULL SCALE AERODYNAMICS RESEARCH DIVISION	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	6	6
GS/GM-14	10	10
OTHER GS/GM	46	46
WAGE GRADE	20	20
TOTAL	83	83

DRYDEN RESEARCH AIRCRAFT OPERATIONS DIVISION	87	88
SES	2	2
GS/GM-16	0	0
GS/GM-15	5	5
GS/GM-14	4	4
OTHER GS/GM	71	71
WAGE GRADE	107	107
TOTAL	189	189

NUMERICAL AERODYNAMIC SIMULATION PROJECT OFFICE	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	7	8
OTHER GS/GM	20	20
WAGE GRADE	0	0
TOTAL	29	30

LIFE SCIENCE PROJECT OFFICE	87	88
SES	0	0
GS/GM-16	0	0
GS/GM-15	3	3
GS/GM-14	10	11
OTHER GS/GM	18	17
WAGE GRADE	0	0
TOTAL	31	31

PERSONNEL DIVISION	87	88
SES	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	3	3
OTHER GS/GM	39	39
WAGE GRADE	0	0
TOTAL	43	43

SYSTEMS ENGINEERING DIVISION	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	5	5
GS/GM-14	15	15
OTHER GS/GM	99	99
WAGE GRADE	0	0
TOTAL	120	120

ROTORCRAFT AND POWERED-LIFT FLIGHT PROJECT DIV.	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	5	5
GS/GM-14	12	12
OTHER GS/GM	28	28
WAGE GRADE	0	0
TOTAL	46	46

SCIENCE AND APPLICATIONS AIRCRAFT DIVISION	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	3	3
GS/GM-14	7	7
OTHER GS/GM	19	19
WAGE GRADE	0	0
TOTAL	30	30

AERODYNAMICS DIVISION	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	6	6
GS/GM-14	16	16
OTHER GS/GM	53	53
WAGE GRADE	29	29
TOTAL	105	105

LIFE SCIENCE DIVISION	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	5	5
GS/GM-14	21	21
OTHER GS/GM	39	39
WAGE GRADE	0	0
TOTAL	66	66

PROCUREMENT DIVISION	87	88
SES	0	0
GS/GM-16	0	0
GS/GM-15	2	2
GS/GM-14	6	6
OTHER GS/GM	75	75
WAGE GRADE	0	0
TOTAL	83	83

TECHNICAL SERVICES DIVISION	87	88
SES	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	1	1
OTHER GS/GM	26	26
WAGE GRADE	131	131
TOTAL	159	159

AEROSPACE HUMAN FACTORS RESEARCH DIVISION	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	4	4
GS/GM-14	14	14
OTHER GS/GM	23	23
WAGE GRADE	0	0
TOTAL	42	42

DRYDEN AERONAUTICAL PROJECT OFFICE	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	2	2
GS/GM-14	7	7
OTHER GS/GM	0	0
WAGE GRADE	0	0
TOTAL	10	10

COMPUTER SYSTEMS AND RESEARCH DIVISION	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	4	4
GS/GM-14	5	5
OTHER GS/GM	30	30
WAGE GRADE	0	0
TOTAL	40	40

SPACE SCIENCE DIVISION	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	21	21
GS/GM-14	16	16
OTHER GS/GM	40	40
WAGE GRADE	0	0
TOTAL	78	78

TECHNICAL INFORMATION DIVISION	87	88
SES	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	1	1
OTHER GS/GM	24	24
WAGE GRADE	3	3
TOTAL	29	29

FLIGHT SYSTEMS AND SIMULATION RESEARCH DIV.	87	88
SES	1	1
GS/GM-16	1	1
GS/GM-15	17	18
GS/GM-14	26	26
OTHER GS/GM	63	62
WAGE GRADE	0	0
TOTAL	108	108

AMES RESEARCH AIRCRAFT OPERATIONS DIVISION	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	7	7
GS/GM-14	5	5
OTHER GS/GM	30	30
WAGE GRADE	41	41
TOTAL	84	84

FLUID DYNAMICS DIVISION	87	88
SES	2	2
GS/GM-16	0	0
GS/GM-15	7	7
GS/GM-14	26	26
OTHER GS/GM	42	42
WAGE GRADE	0	0
TOTAL	77	77

CARDIOVASCULAR RESEARCH OFFICE	87	88
SES	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	2	2
OTHER GS/GM	2	2
WAGE GRADE	0	0
TOTAL	5	5

RESEARCH ENGINEERING DIVISION	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	9	9
GS/GM-14	26	26
OTHER GS/GM	128	128
WAGE GRADE	0	0
TOTAL	164	164

THERMOSCIENCES DIVISION	87	88
SES	1	1
GS/GM-16	0	0
GS/GM-15	5	6
GS/GM-14	22	22
OTHER GS/GM	36	35
WAGE GRADE	16	16
TOTAL	80	80

PROJECT CONTROL DEVELOPMENT OFFICE	87	88
SES	0	0
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	1	1
OTHER GS/GM	3	3
WAGE GRADE	0	0
TOTAL	4	4

INFRARED ASTRONOMY PROJECTS OFFICE	87	88
SES	0	0
GS/GM-16	0	0
GS/GM-15	3	3
GS/GM-14	7	7
OTHER GS/GM	17	17
WAGE GRADE	0	0
TOTAL	27	27

LANGLEY
RESEARCH CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1988 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. In addition, there are 110 acres of NASA-owned land located in the city of Newport News, Virginia, and 3,276 acres under permit from the Department of Interior. 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, 1986, was $861,100,000.

CENTER ROLES AND MISS

Lang inue to play a leading role in the development of onautics an space technology l l excellence in ifi research eas is attr t the qualit and capability of th il service staff r l to the il it of i cal ili e The principal and pp 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 and Noise Reduction - conduct research and develop a technology base related to reducing interior and exterior aircraft noise.

Aerospace Vehicle Structures and Materials - develop a technology base for potential advances.

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

Advanced Space Vehicle Configuration Technolopy - develop technology for advanced vehicle transportation systems, including orbit-on-demand vehicles, aeroassisted orbit transfer, transatmospheric vehicles, and mneuvering reentry vehicles.

Advanced Space Systems Technolopy - develop a technology base and systems analysis capability for large space antenna applications and space station system trade studies.

Sensor and Data Acquisition Technolopy - 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 mterials, structures, control and dynamics of large space structures, large space antenna systems, remote sensoring atmospheric sciences, and advanced transportation systems.

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

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

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

SUPPORTING

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

Planetary Entry Technolopy - provide planetary and entry aerothermodynamics experimental and analytical data.

Computational Fluid Dynamics - contribute to the software technology base.

Launch Vehicle Procurement - management and operation of the Scout launch vehicle system for government and commerical users.

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

LANGLEY

	1986 ACTUAL	1987 AMENDED BUDGET ESTIMATE	1987 CURRENT ESTIMATE	1988 BUDGET ESTIMATE
Space Station	77	55	79	79
Space Flight Programs	46	24	39	39
Space Trans. Capab. Dev.	9	2	16	16
Space Shuttle	37	22	23	23
Space Science and Applications	233	192	195	195
Physics and Astronomy	10	1	8	8
Life Sciences	6	6	11	11
Planetary Exploration	0	0	0	0
Space Applications	217	185	176	176
Aeronautics & Space Tech	1,743	1,889	1,846	1,846
Aeronautical Res & Tech	1,262	1,332	1,251	1,251
Space Res & Tech	481	487	478	478
Transatmospheric RST	0	70	117	117
Commercial Programs	10	9	10	10
SUBTOTAL DIRECT	2,109	2,169	2,169	2,169
Center Management & Operations	672	643	643	643
SUBTOTAL (FTP'S)	2,781	2,812	2,812	2,812
Other Controlled FTE's (PMI's/Co-ops/OTFTP's)	84	99	99	99
GRAND TOTAL (FTE)	2,865	2,911	2,911	2,911

PROGRAM DESCRIPTION

Pemnent Civi1
Service Workyears

RESEARCH AND DEVELOPMENT

SPACE STATION 79

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.

SPACE PLIGHT PROGRAMS

SPACE TRANSPORTATI CAPABIL Y DEVELOPMENT 16

Langley is responsil for evaluation of ternate crew safety strategi for near- and far space ion ios to estab safety criteria ements to meet those criteri an to form t i analytica modeling, and systems analysis d tion tasks on ting space tation technology .

SPACE SHUTTLE (Space T Sys . 23

The expendable launch program at Langley provi ali procurement of the Scout launch vehicle. In 1988, civ service sonnel will a ich includes the procurement of launch le h aunch services, ng ing, and intenance. L under this progr l be conducted fr sites located at the We and Miss Center in ifornia, F Fl ity i and San q ial Range, K , fr

SPACE SCIENCE AND LICATIONS

PHYSICS AND ASTRONOMY 8

Langley is responsible for the Heavy Nuclei Collection Project. This project will obtain data on heavy nuclei in space for use in studies of the nuclei synthesis in recent explosive processes in the Universe and for use in the fundamental nuclear physics and astrophysics studies.

LIFE SCIENCES 11

Langley has responsibility for two life science areas: bringing together an interdisciplinary program to investigate hypotheses concerning the role of wetland ecosystems in the global methane cycle and the

concentration and flux of organic carbon; and the radiation effects and protection program focuses on shielding and radiation physics through fundamental study of the interactions with and transport through mterials of radiation, including galactic and solar cosmic rays and trapped radiation.

	Pemnent Civil Service Workyears
SPACE SCIENCES AND APPLICATIONS	176

The space applications program at Langley provides a national research capability for understanding the environment and for developing related atmospheric sensing system 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 in 1988 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 conposition 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 conprehensive 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, Measurement of Air Pollution from Satellites, and Earth Radiation Budget Experiments. The Center's sensor developnent program encompasses the broadest possible range of advanced remote sensing techniques, including correlation gas filter radiometry and interferometry, laser heterodyne radiometry, lidar, and active and passive microwave techniques.

Langley is managing the Global Tropospheric Experiment which is a coordinated program of theoretical mdeling, 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 the sensor developnent, and data mnagement for the Earth Radiation Budget Experiment, a prime element in NASA's support of the National Climate Program. Preliminary radiation budget studies, based on Nimbus data, are examining the relationship of radiation budget to such climatological parameters as cloudiness, snow and ice cover, and sea surface temperature.

AERONAUTICS AND SPACE TECHNOLOGY

AERONAUTICAL RESEARCH AND TECHNOLOGY 1,251

The aeronautical and research technology program at Langley is characterized by the dynamic interaction between a broad spectrum of technical disciplines, the application of discipline research to specific technology requirements, demonstrations of particular technology applications, and the in-depth examination of future technology requirements. The unique wind tunnel, computing facilities, and flight operations capability 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 unique Langley capabilities made possible by the VPS-32 computer and recently developed cryogenic wind tunnel testing capability provided in the national transonic facility which allows the full sirmlation of flight 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 2-D and 3-D Napier-Stokes equations. Wind tunnel and flight tests will be continued on general aviation aircraft configurations having the potential for practical stall immunity and the means for spin avoidance. Basic research on the conception and development of methods for reducing turbulent skin-friction drag and the designs for both passive and active laminar flow airfoils will be pursued. A goal of the activities in the viscous drag reduction area 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 mterials, manufacturing processes, and design technology to improve the structural efficiency, reliability, and durability and to reduce design costs of airframes and components. This activity is directed toward research on advanced ccnposite mterials, advanced metallic materials, computer aided analysis and design technology, and development of analytical or semiempirical fatigue and life prediction methdology. Use of

active and passive controls for minimization of aeroelastic response, reduced static stability, and minimization of gust and maneuver loads is being pursued in both theoretical and wind tunnel studies.

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

Controls and guidance work at Langley includes research programs to advance technology developnent in aircraft guidance and navigation, aircraft control system, cockpit systems, and integration and interfacing techniques, and performance validation and verification methods for fully integrated, highly reliable flight control systems. Also, mjor efforts in aircraft flight mnagement and operating procedures technology and active controls technology for conventional takeoff and landing aircraft are being conducted in this program area. 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, intersystems cmnications 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 inproved 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 will be undertaken. The avionics integration research laboratory continues to be used for both NASA and industry research on fault tolerant systems. The impact of lightning on inducing errors in digital aircraft system will continue to be assessed.

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 developnent projects and on projects of mutual interest with a staff integrated into the NASA organization. Extensive use is made of Langley facilities in 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 ministration.

	Permanent Civil Service Workyears
SPACE RESEARCH AND TECHNOLOGY	478

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 developnent for a permanently-manned space station.

The objective in the materials area is to establish and demonstrate the required technology for application of advanced materials for a 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 stability 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 derived 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, rmlti-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 testing. 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 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 1988. 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 rmltiplexed 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 micro-G environment of space provides an opportunity to develop advanced mterials 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 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 matrix arithmetic at high speed for potential application to carplex aerospace system. Automation technology efforts will focus on conducting systems level research on remote satellite servicing and 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 objective of the Langley space vehicle and spacecraft technology program is to develop experimental and theoretical data bases to support: development of Space Transportation System (STS) vehicles for the 1990's and beyond, employing technologies advanced beyond those utilized for the space shuttle; the evolving STS program and solve operational problems as they surface; and reduction and interpretation of STS flight data. The objectives are being met through the development and application of experimental and theoretical techniques employing Langley computers and wind tunnel facilities and through comparative analyses of the resulting data with flight data as available. Disciplines include aerodynamic/thermodynamic performance, configuration optimization, flight control system assessment, mission design, planetary entry trajectory analyses, and computational flow field techniques.

The space shuttle orbiter will be utilized as a research vehicle to extend the knowledge of aerodynamics, aerothermodynamics, and basic fluid mechanics into previously inaccessible flow regimes by acquiring flight measurements during routine shuttle operations. Experiments have been developed for space shuttle flights which will provide unique measurements for direct assessment of ground-based facility measurements and theoretical techniques. The space shuttle will also be utilized as a space platform fromwhich to perform Langley-developed payload experiments extending basic research and technology development into the space environment when economically feasible or when the developnent can be achieved in space.

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, or work for potential power generation, transmission, storage, and control for future space missions.

	Permanent Civil Service Workyears
TRANSATMOSPHERIC RESEARCH AND TECHNOLOGY.	117

The activites 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 mterials 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 the conduct of studies to define and understand the integration of advanced technologies into a future class of horizontal take-off and landing aero-space plane vehicles for operation to orbit and/or hypersonic cruise within the atmosphere.

	Pemnent Civil Service Workyears
COMMERCIAL PROGRAMS AND TECHNOLOGY UTILIZATION	10

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 and development. This effort will establish an organizational focal point to initiate a program specifically intended to foster commercial use and access to space.

The NASA technology utilization program will enhance economic growth and contribute to the technological solution of public problm through the transfer of new technology, from aeronautical and space research and developnent efforts, to the nonaerospace segments of the economy.

In 1988, civil service personnel will provide support to define methods to expedite the application of new technology through the compression of the time required from generation of technology to its use in the econcmy; and encourage the use of aerospace technology in nonaerospace segments of the econcmy having problm amenable to technological solutions.

CENTER MANAGEMENT AND OPERATIONS	643

Center Management and werations provides services or support to all Langley organizations. The civil service personnel involved are:

Director and Staff - The Center Director, Deputy Director, and immediate staff; e.g., Chief Scientist, Equal Opportunity, and Public 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

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
I. Personnel and Related Costs	116,350	118,595	123,246	130,087
II. Travel	2,839	3,554	3,650	3,833
111. Operation of Installation	26,455	32,884	31,277	34,288
A. Facilities Services	(13,872)	(17,723)	(16,182)	(17,612)
B. Technical Services	(4,594)	(6,771)	(6,150)	(5,822)
C. Management and werations	(7,989)	(8,390)	(8,945)	(10,854)
Total, Fund Requirements	145,644	155,033	158,173	168,208

RESOURCES REQUIREMENTS BY FUNCTION

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estikte
		(Thousands of Dollars)		
I. **PERSONNEL AND RELATED COSTS**	116,350	118,595	123,246	130,087
Summary of Fund Requirements				
A. Compensation and Benefits				
1. Compensation				
a. Full-time permnent	100,367	101,826	103,876	104,948
b. Other than full-time permnent	1,425	1,725	1,779	1,794
c. Reimbursable detailees.	77	---	79	81
d. Overtime and other conpensation	1,215	1,283	1,285	1,290
Subtotal, Compensation	103,084	104,834	107,019	108,113
2. Benefits	12,127	12,491	14,824	20,525
Subtotal, Compensation and Benefits .	115,211	117,325	121,843	128,638
B. Supporting Costs				
1. Transfer of personnel	202	180	240	240
2. Personnel training	937	1,090	1,163	1,209
Subtotal, Supporting Costs	1,139	1,270	1,403	1,449
Total, Personnel and Related Costs . . .	116,350	118,595	123,246	130,087

Explanation of Fund Requirements

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
A. Compensation and Benefits	115,211	117,325	121,843	128,638
1. Compensation	103,084	104,834	107,019	108,113
a. Full-time permanent	100,367	101,826	103,876	104,948

The increase from the 1987 amended budget estimate to the 1987 current estimate reflects the January 1987 pay raise and the effect of the engineering special rate increases.

Basis of Cost for Civil Service Workyears

In 1988, the cost of permanent workyears will be $104,948. The increase results from the following:

Cost of full-time permnent workyears in 1987		103,876
Cost increases in 1988		3,227
Within grade and career advances:		
Full year cost of 1987 increases	1,047	
Partial year cost of 1988 actions	964	
Extra day	394	
Full year cost of the 1987 pay raise	822	
Cost decreases in 1988		-2,155
Full year effect of 1987 turnover savings	-375	
Partial year effect of 1988 turnover savings	-1,780	
Cost of full-time permanent workyears in 1988		104,948

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
b. Other than full-time permnent				
1. Cost	1,425	1,725	1,779	1,794
2. Workyears	108	133	133	133

The distribution of FY 1988 workyears is as follows:

Distribution of Other Than Full-Time Permanent Workyears

Program	Workyears
Development programs	85
Youth opportunity programs	34
Other temporary programs	14
Total	133

The increase from the 1987 amended budget estimate to the 1987 current estimte reflects the January 1987 pay raise. The 1988 budget estimte reflects the same level of effort as 1987.

c. Overtime and other conpensation	1,215	1,283	1,285	1,290

The mjor cost in this area is overtime. Also included are holiday pay, incentive awards, and bonus awards. The use of overtime and other conpensation is limited to emergency repairs and work that cannot be accomplished during normal duty hours. This includes the monitoring of on-site contracts being performed during off-duty hours and wind tunnel work required at night to take advantage of off-peak electrical rates. The increase from the 1987 current estimte to the 1988 budget estimate reflects the same level of effort.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of	Dollars)	
2. Benefits	12,127	12,491	14,824	20,525
The following are the amounts of contribution by category:				
Civil Service Retirement Fund	7,101	7,228	9,690	15,348
Employee life insurance	227	255	232	233
Employee health insurance	2,709	3,044	2,797	2,830
Workmen's conpensation	609	609	580	580
FICA	188	108	193	194
Medicare	1,289	1,232	1,322	1,330
Other benefits	4	15	10	10
Total	12,127	12,491	14,824	20,525

The net increase from the 1987 amended budget estimte to the 1987 current estimte reflects the alteration in the civil service retirement system, offset by a decrease in employee health insurance based on 1986 actuals. The 1988 increases reflect the first full year of the alteration in the civil service retirement system and the continuing application of FICA for new employees.

B. Supporting Cost.	1,139	1,270	1,403	1,449
1. Transfer of personnel.	202	180	240	240

Transfer of personnel includes actual expenses involved in the movement and temporary storage of an employee's household goods, subsistence and temporary expenses, real estate costs, and miscellaneous moving expenses. The increase from the 1987 amended budget estimate to the 1987 current estimte reflects an increased number of expected relocations.

2. Personnel training	937	1,090	1,163	1,209

The purpose of the training program is to continue the development and education of civil service employees to support Langley's roles and missions more efficiently. The 1987 current estimte and the 1988 budget estimte reflect increased training requirements for those responsible for developing, designing, implementing, and validating programs for large mainframe computers, office automation, and the Space Station program.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		'(Thousands of Dollars)		
11. TRAVEL	2,839	3,554	3,650	3,833
S m r y of Fund Requirements				
A. Program Travel	1,896	2·751	2,847	2,998
B. Scientific and Technical Development Travel. .	629	607	607	631
C. Management and werations Travel	314	196	196	204
Total, Travel	2,839	3,554	3,650	3,833
Explanation of Fund Requirements				
A. Program Travel	1,896	2,751	2,847	2,998

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 sirmlation, fluid mechanics, airborne science and applications, space applications, Space Station, and Shuttle support. The increase from the 1987 amended budget estimate to the 1987 current estimate reflects an increase due to support of the Aero-Space Plane, Laser Detection and Ranging (LIDAR) in-space technology experiment; LIDAR Atmospheric Sensing Experiment, and Control of Flexible Structure projects. The 1988 estimate reflects the 1987 level of effort.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimate	1988 Budget Estikte
		(Thousands of Dollars)		
B. Scientific and Technical Development Travel. .	629	607	607	631

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 1988 estimte reflects continuing the 1987 level of effort.

C. Management and Operations Travel	314	196	196	204

Management and operations travel is used for the direction and coordination of general mnagement mtters. It includes travel in such areas as personnel, financial mnagement, and procurement activities; travel of the Center's top mnagement to NASA Headquarters and other NASA Centers; peer group reviews; and local transportation. The 1988 estimte reflects continuing the 1987 level of effort.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
111. **OPERATION OF INSTALLATION**	26,455	32,884	31,277	34,288
Summary of Fund Requirements				
A. Facilities Services	13,872	17,723	16,182	17,612
B. Technical Services	4,594	6,771	6 150	5,822
C. Management and werations	7,989	8,390	8,945	10,854
Total, Operation of Installation	26,455	32,884	31,277	34,288

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 mjor 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 cmnications, reproduction, transportation, medical, and logistic services.

The change from the 1987 amended budget estimate to the current estimte reflects lower than anticipated utility costs. In 1988, utility consumption will increase with planned wind tunnel activity and small increases in support contract workyears are planned in the janitorial, security, and supply services areas. The 1988 estimte also provides for estimted increases in support contractor and utility rates.

A. FACILITIES SERVICES	13,872	17,723	16,182	17,612

The Langley complex encompasses 3.0 million gross square feet of buildings and structures. Included are 17 mjor 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.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimte
		(Thousands of Dollars)		
Summary of Fund Requirements				
1. Rental of Real Property	0	7	7	7
2. Maintenance and Related Services	324	562	687	829
3. Custodial Services	3,275	3,563	3,423	3,636
4. Utility Services	10,273	13,591	12,065	13,140
Total, Facilities Services	13,872	17,723	16,182	17,612

Explanation of Fund Requirements

1. Rental of Real Property	---	7	7	7

The estimate covers the cost of leasing rights of way for access to model drop zone areas at Plum Tree Island.

2. Maintenance and Related Services	324	562	687	829

This estimte provides funds for maintenance and repair of administrative facilities, roads and utility lines, and grounds maintenance. The increase from the 1987 amended budget estimate to the 1987 current estimate and the 1988 estimate reflects needed maintenance levels following severe deferrals in 1986.

3. Custodial Services	3,275	3,563	3,423	3,636

This activity provides for janitorial and security services. Also included are funds for fire protection services provided by the City of Hampton. The net decrease from the 1987 amended budget estimate to the 1987 current estimate is the result of decreases in support contractor wage rates. The 1988 estimate provides for the same level of effort at anticipated rates.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
4. Utility Services	10,273	13,591	12,065	13,140

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 Hampton for facilities located in the West Area of Langley from operation of the City of Hampton, Air Force and NASA Cooperative Refuse Burner. The net decrease from the 1987 amended budget estimate to the 1987 current estimate reflects less than anticipated rate increases for electricity, offset by a small increase in consumption and refuse burner costs. The 1988 budget estimate reflects anticipated rate increases along with a small increase in electricity consumption to meet estimted facility use.

B. TECHNICAL SERVICES	4,594	6,771	6,150	5,822
Summary of Fund Requirements				
1. Automatic Data Processing	3,850	5,910	5,249	4,594
a. Equipment	786	1,792	1,792	835
b. Operations	3,064	4,118	3,457	3,759
2. Scientific and Technical Information	744	861	901	1,228
a. Library	278	275	295	321
b. Education and Information	466	586	606	907
Total, Technical Services	4,594	6,771	6,150	5,822
Explanation of Fund Requirements				
1. Automatic Data Processing	3,850	5.910	5,249	4,594

Funds for Langley's business data complex which provides the financial and management information data are provided in this function. Included are equipment lease, purchase, and maintenance;

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		

paper and other expendable supplies; and a contract for programing and operations. The decrease from the 1987 amended budget estimate to the current estimate reflects a realignment of ADP needs. The 1988 estimate provides for expected support contractor workyear and rate increases; full year funding of support contracts; and reflects the purchase of ADP Mainframe Hardware in 1987.

2. Scientific and Technical Information	744	861	901	1,228

This estimate provides support contract assistance in the operation of the Technical Library and Visitor Informtion Center. Funding for 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 increase from the 1987 amended budget estimate to the 1987 current estimate reflects a small increase in support contractor workyears to support the Visitors Information Center. The increase in 1988 reflects exhibit upgrades and expected support contract rate increases.

C. MANAGEMENT AND OPERATIONS	7,989	8,390	8,945	10,854
Summary of Fund Requirements				
1. Administrative Communications	2,399	2,566	2,567	2,941
2. Printing and Reproduction	191	159	180	187
3. Transportation	1,836	2,244	2,739	4,049
4. Installation Common Services	3,563	3,421	3,459	3,677
Total, Management and Operations	7,989	8,390	8,945	10,054

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budnet Estikte
		(Thousands of Dollars)		

Explanation of Fund Requirements

1. Administrative Communications	2,399	2,566	2,567	2,941

Includes funds for local telephone and exchange costs, Federal Telecmnications Systems services, and datafax and telegraph service. The budget estimte for 1988 reflects the same level of service as 1987 with anticipated commercial services rate changes in addition to initial support for a telecommunications upgrade.

2. Printing and Reproduction	191	159	180	187

Provides for a support contractor and supplies for reproduction services. The increase from the 1987 amended budget estimte to the 1987 current estimte reflects 1986 experience. The 1988 estimte reflects the same level of service as 1987, adjusted for contractor rate increases.

3. Transportation	1,836	2,224	2,739	4,049

Includes the operation, mintenance, 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 mintenance of the acfninistrative aircraft. This effort includes aircraft fuel, equipment, and expendable supplies. The increase from the 1987 amended budget estimate to the 1987 current reflects the lease cost for partial year for an acfninistrative jet aircraft. The 1988 increase represents full-year cost for a leased acfninistrative jet aircraft coupled with needed vehicle replacements and support contracts at anticipated rate increases.

4. Installation Common Services	3,563	3,421	3,459	3,677

Provides for medical services, mil delivery, stock issue and warehousing, and other general administrative support. Also included are the rental and mintenance of office copy machines and equipment, minority programs, and other acfninistrative services and supplies. The increase from the 1987 amended budget estimte to the 1987 current estimte reflects a small increase in support contract workyears. The 1988 estimte reflects a small increase in support contract workyears to improve administrative support along with support contractor rate increases.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LANGLEY RESEARCH CENTER

ORGANIZATION AND STAFFING CHART

STAFFING SUMMARY	87	88
SES	32	32
GS/GM 15	172	172
GS/GM 14	335	335
OTHER GS/GM	2230	2230
WAGE	61	61
TOTAL	2830	2830

DIRECTOR & STAFF	87	88
SES	2	2
GS/GM 15	2	2
GS/GM 14	6	6
OTHER GS/GM	18	18
WAGE	0	0
TOTAL	28	28

OFFICE OF DIRECTOR FOR ELECTRONICS	87	88
SES	2	2
GS/GM 15	0	0
GS/GM 14	1	1
OTHER GS/GM	4	4
WAGE	0	0
TOTAL	7	7

OFFICE OF DIRECTOR FOR STRUCTURES	87	88
SES	1	1
GS/GM 15	0	0
GS/GM 14	1	1
OTHER GS/GM	2	2
WAGE	0	0
TOTAL	4	4

OFFICE OF DIRECTOR FOR AERONAUTICS	87	88
SES	2	2
GS/GM 15	0	0
GS/GM 14	2	2
OTHER GS/GM	2	2
WAGE	0	0
TOTAL	6	6

OFFICE OF DIRECTOR FOR MGMT OPERATIONS	87	88
SES	1	1
GS/GM 15	4	4
GS/GM 14	3	3
OTHER GS/GM	7	7
WAGE	0	0
TOTAL	15	15

OFFICE OF DIRECTOR FOR SEAO	87	88
SES	2	2
GS/GM 15	1	1
GS/GM 14	0	0
OTHER GS/GM	3	3
WAGE	0	0
TOTAL	6	6

OFFICE OF DIRECTOR FOR SPACE	87	88
SES	1	1
GS/GM 15	0	0
GS/GM 14	1	1
OTHER GS/GM	3	3
WAGE	0	0
TOTAL	5	5

OFFICE OF DIRECTOR FOR FLIGHT SYSTEMS	87	88
SES	1	1
GS/GM 15	2	2
GS/GM 14	4	4
OTHER GS/GM	15	15
WAGE	0	0
TOTAL	22	22

COMPUTERS & COMPUTATION DIVISION	87	88
SES	[illegible]	5
GS/GM 15	[illegible]	5
GS/GM 14	12	12
OTHER GS/GM	84	84
WAGE	0	0
TOTAL	[illegible]	[illegible]

STRUCTURES & DYNAMICS DIVISION	87	88
SES	1	1
GS/GM 15	7	7
GS/GM 14	10	10
OTHER GS/GM	40	40
WAGE	0	0
TOTAL	58	58

AERONAUTICAL SYSTEMS OFFICE	87	88
SES	0	0
GS/GM 15	5	5
GS/GM 14	10	10
OTHER GS/GM	18	18
WAGE	0	0
TOTAL	33	33

FINANCIAL MANAGEMENT DIVISION	87	88
SES	0	0
GS/GM 15	1	1
GS/GM 14	3	3
OTHER GS/GM	44	44
WAGE	0	0
TOTAL	48	48

SYS. SAFETY, QUAL. & RELIABILITY OFFICE	87	88
SES	0	0
GS/GM 15	2	2
GS/GM 14	2	2
OTHER GS/GM	22	22
WAGE	0	0
TOTAL	26	26

SPACE STATION OFFICE	87	88
SES	3	3
GS/GM 15	5	5
GS/GM 14	7	7
OTHER GS/GM	15	15
WAGE	0	0
TOTAL	30	30

FLIGHT MANAGEMENT DIVISION	87	88
SES	1	1
GS/GM 15	2	2
GS/GM 14	5	5
OTHER GS/GM	28	28
WAGE	0	0
TOTAL	36	36

INSTRUMENT RESEARCH DIVISION	87	88
SES	1	1
GS/GM 15	7	7
GS/GM 14	14	14
OTHER GS/GM	113	113
WAGE	0	0
TOTAL	135	135

LOADS & AEROELASTICITY DIVISION	87	88
SES	1	1
GS/GM 15	8	8
GS/GM 14	11	11
OTHER GS/GM	49	49
WAGE	0	0
TOTAL	69	69

TRANSONIC AERODYNAMICS DIVISION	87	88
SES	1	1
GS/GM 15	11	11
GS/GM 14	16	16
OTHER GS/GM	78	78
WAGE	0	0
TOTAL	106	106

MANAGEMENT SUPPORT DIVISION	87	88
SES	0	0
GS/GM 15	1	1
GS/GM 14	0	0
OTHER GS/GM	51	51
WAGE	0	0
TOTAL	52	52

FABRICATION DIVISION	87	88
SES	0	0
GS/GM 15	1	1
GS/GM 14	3	3
OTHER GS/GM	260	260
WAGE	21	21
TOTAL	285	285

ATMOSPHERIC SCIENCES DIVISION	87	88
SES	1	1
GS/GM 15	17	17
GS/GM 14	28	28
OTHER GS/GM	48	48
WAGE	0	0
TOTAL	94	94

GUIDANCE & CONTROL DIVISION	87	88
SES	1	1
GS/GM 15	5	5
GS/GM 14	19	19
OTHER GS/GM	49	49
WAGE	0	0
TOTAL	74	74

FLIGHT ELECTRONICS DIVISION	87	88
SES	1	1
GS/GM 15	5	5
GS/GM 14	11	11
OTHER GS/GM	74	74
WAGE	0	0
TOTAL	91	91

INTERDISCIPLINARY RESEARCH OFFICE	87	88
SES	0	0
GS/GM 15	2	2
GS/GM 14	2	2
OTHER GS/GM	5	5
WAGE	0	0
TOTAL	9	9

LOW-SPEED AERODYNAMICS DIVISION	87	88
SES	1	1
GS/GM 15	9	9
GS/GM 14	10	10
OTHER GS/GM	73	73
WAGE	4	4
TOTAL	97	97

PERSONNEL DIVISION	87	88
SES	0	0
GS/GM 15	1	1
GS/GM 14	4	4
OTHER GS/GM	37	37
WAGE	0	0
TOTAL	42	42

SYSTEMS ENGINEERING DIVISION	87	88
SES	1	1
GS/GM 15	6	6
GS/GM 14	18	18
OTHER GS/GM	119	119
WAGE	0	0
TOTAL	144	144

SPACE SYSTEMS DIVISION	87	88
SES	1	1
GS/GM 15	10	10
GS/GM 14	24	24
OTHER GS/GM	59	59
WAGE	0	0
TOTAL	94	94

INFORMATION SYSTEM DIVISION	87	88
SES	1	1
GS/GM 15	3	3
GS/GM 14	16	16
OTHER GS/GM	59	59
WAGE	0	0
TOTAL	79	79

ERBE/SAGE II PROJECT OFFICE	87	88
SES	0	0
GS/GM 15	1	1
GS/GM 14	0	0
OTHER GS/GM	2	2
WAGE	0	0
TOTAL	3	3

MATERIALS DIVISION	87	88
SES	1	1
GS/GM 15	8	8
GS/GM 14	15	15
OTHER GS/GM	44	44
WAGE	0	0
TOTAL	68	68

HIGH-SPEED AERODYNAMICS DIVISION	87	88
SES	1	1
GS/GM 15	12	12
GS/GM 14	11	11
OTHER GS/GM	52	52
WAGE	0	0
TOTAL	76	76

BUSINESS DATA SYSTEMS DIVISION	87	88
SES	0	0
GS/GM 15	1	1
GS/GM 14	4	4
OTHER GS/GM	9	9
WAGE	0	0
TOTAL	14	14

FACILITIES ENGINEERING DIVISION	87	88
SES	1	1
GS/GM 15	7	7
GS/GM 14	18	18
OTHER GS/GM	108	108
WAGE	0	0
TOTAL	134	134

COFS PROJECT OFFICE	87	88
SES	0	0
GS/GM 15	1	1
GS/GM 14	4	4
OTHER GS/GM	7	7
WAGE	0	0
TOTAL	12	12

ACOUSTICS DIVISION	87	88
SES	1	1
GS/GM 15	8	8
GS/GM 14	7	7
OTHER GS/GM	33	33
WAGE	0	0
TOTAL	49	49

AERO-SPACE PLANE OFFICE	87	88
SES	0	0
GS/GM 15	1	1
GS/GM 14	4	4
OTHER GS/GM	9	9
WAGE	0	0
TOTAL	14	14

ACQUISITION DIVISION	87	88
SES	0	0
GS/GM 15	1	1
GS/GM 14	5	5
OTHER GS/GM	79	79
WAGE	0	0
TOTAL	85	85

OPERATIONS SUPPORT DIVISION	87	88
SES	0	0
GS/GM 15	1	1
GS/GM 14	4	4
OTHER GS/GM	383	383
WAGE	28	28
TOTAL	416	416

LDEF PROJECT OFFICE	87	88
SES	0	0
GS/GM 15	2	2
GS/GM 14	3	3
OTHER GS/GM	1	1
WAGE	0	0
TOTAL	6	6

PROGRAMS & RESOURCES DIVISION	87	88
SES	0	0
GS/GM 15	1	1
GS/GM 14	2	2
OTHER GS/GM	23	23
WAGE	0	0
TOTAL	26	26

FACILITIES PROGRAM DEVELOP. OFFICE	87	88
SES	0	0
GS/GM 15	1	1
GS/GM 14	2	2
OTHER GS/GM	7	7
WAGE	0	0
TOTAL	10	10

SCOUT PROJECT OFFICE	87	88
SES	0	0
GS/GM 15	2	2
GS/GM 14	6	6
OTHER GS/GM	10	10
WAGE	0	0
TOTAL	18	18

RESEARCH INFO. & APPL. DIVISION	87	88
SES	0	0
GS/GM 15	1	1
GS/GM 14	3	3
OTHER GS/GM	72	72
WAGE	0	0
TOTAL	84	84

SPACE TECH. FLIGHT EXPERIMENTS OFFICE	87	88
SES	0	0
GS/GM 15	2	2
GS/GM 14	4	4
OTHER GS/GM	0	0
WAGE	0	0
TOTAL	6	6

LEWIS
RESEARCH CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1988 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 5853 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 for the use of selected facilities by federal, state and local government agencies or their contractors.

The total capital investment of Lewis and Plum Brook Station, including fixed assets in progress and contractor-held facilities at various locations, as of September 30, 1986, was $536,615,000.

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 Atlas and Centaur launch vehicle systems for Government and commercial users.

Space Propulsion Systems 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 Systems 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.

Commercial Use 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 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

	1986 ACTUAL	1987 AMENDED BUDGET ESTIMATE	1987 CURRENT ESTIMATE	1988 BUDGET ESTIMATE
Space Station	207	280	305	415
Space Flight Programs	222	193	83	17
Space Trans. Capab. Dev.	170	143	20	2
Space Shuttle	52	50	63	15
Space Science and Applications	194	130	200	180
Space Applications	194	130	200	180
Aeronautics & Space Tech	1,479	1,514	1,510	1,486
Aeronautical Res & Tech	1,079	1,099	940	916
Space Res & Tech	400	345	400	400
Transatmospheric R&T	0	70	170	170
Commercial Programs	8	11	8	8
SUBTOTAL DIRECT	2,110	2,128	2,106	2,106
Center Management & Operations	551	527	532	532
SUBTOTAL (FTP'S)	2,661	2,655	2,638	2,638
Other Controlled FTE's (PMI's/Co-ops/OTFTP's)	43	39	56	56
GRAND TOTAL (FTE)	2,704	2,694	2,694	2,694

PROGRAM DESCRIPTION

RESEARCH AND DEVELOPMENT

	Pemnent Civil Service Workyears
SPACE STATICN	415

In 1988, civil service personnel will manage the design and development activities associated with the generation, storage distribution and control of the power systems. In addition, civil service personnel will continue the activities associated with the power system test bed and the facilities needed for testing the power system.

SPACE FLIGHT PROGRAMS

SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	2

In 1988, civil service activity is primarily directed to extending knowledge and understanding of the theoretical and technical feasibility, of the behavior, technical and operational risks, technology requirements and overall costs and benefits of electrodynamic tether power and thrust generation in space.

SPACE SHUTTLE (Space Transportation Systems)	15

This program is responsible for the delivery to specified orbit of all spacecraft launched by the Atlas/Centaur vehicle. The program includes the procurement of vehicle systems hardward, launch services, and engineering and management support, as well as development, maintenance and operation of ground support equipment. In 1986 civil service personnel working in the Atlas/Centaur launch vehicle program will support one FLTSATCOM program launches. Following the final FLTSATCOM launch in the third quarter of 1987, an orderly phaseout of the Atlas/Centaur project will be initiated.

SPACE SCIENCE AND APPLICATIONS

SPACE APPLICATIONS	180

The Space Applications activity at Lewis consists principally of space cmnications research. In 1988 Civil Service personnel will continue to support studies of various advanced satellite cmnications systems concepts directed at providing additional frequency bands and inproved cmnications service. These studies are being focused on the needs of the public and private sectors, both nationally and internationally. Lewis will continue to develop technology with possible

application to both ground and space segments of future advanced civil and military communications systems.

In 1988, Lewis will 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 phenomemon in reduced gravity.

	Permanent Civil Service Workyears
AERONAUTICS AND SPACE TECHNOLOGY	
AERONAUTICAL RESEARCH AND TECHNOLOGY.....	916

Lewis' major research and technology responsibility in aeronautics is propulsion. The primary goal is to establish 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 improvements in fuel efficiency, operating cost, reliability and durability, and which will operate with acceptable environmental impact. The Lewis aeropropulsion program includes key generic discipline research, focused, 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 NASA Lewis and they jointly conduct independent research and technology development projects and other activities of mutual interest.

Generic disciplinary research includes internal computational fluid mechanics (ICFM), 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 advanced materials research is focused on super-alloys, intermetallics, coatings, ceramics and 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 focused interdisciplinary propulsion research includes icing, instrumentation and control technology, and hot section 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 all-weather capability for civil and military aircraft. 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. Hot section technology is aimed at providing improved durability and reliability of high temperature propulsion system components through the development of improved experimental and analytical tools.

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 (including a flight test planned for 1987), convertible engines, variable cycle engines, and new, innovative propulsion systems. Applications for this focused propulsion system research include subsonic transports, commuters, general aviation, rotorcraft, supersonic STOVL aircraft, 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 wind tunnels and large propulsion system altitude tanks.

SPACE TECHNOLOGY..... 400

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. This includes associated materials technology, structural analysis and life prediction technology, computational fluid dynamics, power management and distribution technology, and advanced development work in support of a space station, its evolutionary growth, satellites 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.

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 effort concentrates on thrust chamber cooling and life, critical turbomachinery components, advanced structural analysis and life prediction and diagnostics.

Another thrust is to provide the technology for improving orbital transfer propulsion systems in the areas of performance, life and reusability. Emphasis is on combustion and heat transfer, long-life lightweight reusable components, and high expansion area nozzles. Arcjets are also being investigated.

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, inert gas ions, and storable chemical engines are being developed.

Lewis does basic science and technology work and conducts 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 systems technology advances are also carried out.

Space power programs are directed toward evolutionary space station, satellite 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 at reduced cost. In solar dynamics a higher efficiency alternative that reduces weight and area relative 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.

Power component and circuit technology or power systems in the multihundred kilowatt and above range are being investigated. The interactions of the space plasma environment with 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 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.....	170

These activities at Lewis are directed toward: understanding and defining a class of airbreathing propulsion systems, using hydrogen fuel, that are applicable to aero-space plane vehicles including the necessary 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..... 8

The Space Commercialization program at Lewis will continue to assist industry in evaluating the commercial potential of space by providing the 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 1988 technology utilization program 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.

CENTER MANAGEMENT AND OPERATIONS..... 532

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

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

Management Support - Provides 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 - Provides 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.

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, inert gas ions, and storable chemical engines are being developed.

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	Permanent Civil Service Workyears
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Operations Support - Provides 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 [illegible] SOURCES REQUIREMENTS

Funding [illegible] Fun [illegible]

		1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
			(Thousands of Dollars)		
I.	Personnel and Related Costs.....	112,766	112,842	119,265	129,174
11.	Travel.....	2,548	3,198	3,101	3,256
III.	Operation of Installation.....	28,101	34,280	34,805	37,565
	A. Facilities Services.....	(20,327)	(24,202)	(22,935)	(24,840)
	B. Technical Services.....	(2,356)	(3,856)	(3,718)	(4,142)
	C. Management and Operations...	(5,418)	(6,222)	(8,152)	(8,583)
	Total, fund requirements..	143,415	150,320	157,171	169,995

RESOURCES REQUIREMENTS BY FUNCTION

	1986 Actual	1 Amended Budget Estimate	Current Estimate	1988 Budget Estimate
		(Thousands of	Dollars)	
I. PERSONNEL AND RELATED COSTS.....	**112,766**	**112,842**	**119,265**	**129,174**
Summary of Fund Requirements				
A. Compensation and Benefits				
1. Compensation				
a. Full-time permanent.....	97,358	97,152	100,225	104,361
b. Other than full-time permanent	757	816	1,099	1,115
c. Overtime and other compensation	1,674	2,059	1,926	1,942
Subtotal, Compensation.....	99,789	100,027	103,250	107,418
2. Benefits.....	11,788	11,233	14,424	20,105
Subtotal, Compensation and Benefits.....	111,577	111,260	117,674	127,523
B. Supporting Costs				
1. Transfer of personnel.....	12	15	24	23
2. Personnel training.....	1,177	1,567	1,567	1,628
Subtotal, Supporting Costs...	1,189	1,582	1,591	1,651
Total, Personnel & Related costs.....	112,766	112,842	119,265	129,174

Explanation of Fund Requirements

	1986 Actual	1987 Amended Budget Estikte	1987 Current Estimte	1988 Budget Estimate
		(Thousands of	Dollars)	
A. Compensation and Benefits.....	111,577	111,260	117,674	127,523
1. Compensation.....	99,789	100,027	103,250	107,418
a. Full-time permnent.....	97,358	97,152	100,225	104,361

The increase from the 1987 budget to the 1987 current estimate reflects the January 1987 pay raise partially offset by increased reimbursements.

Basis of Cost for Civil Service Workyears

In 1988, the cost of permnent workyears will be $104,361. The increase results from the following:

Cost of permnent workyears in 1987.....		100,225
Cost of increases in 1988.....		5,482
Within grade and career development advances:		
Full year effect of 1987 actions.....	1,126	
Partial year effect of 1988 actions.....	1,195	
Effect of 1987 decrease in offsetting reimbursements...	1,638	
Extra paid day in 1988.....	396	
Full Year Effect of 1987 pay raise.....	1,127	
Cost of decreases in 1988.....		-1,346
Turnover saving:		
Full year effect of 1987 actions.....	-482	
Partial year effect of 1988 actions.....	-864	
Cost of full-time permnent workyears in 1988.....		104,361

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of	Dollars)	
b. Other than full-time permanent				
1. cost.....	757	816	1,099	1,115
2. Workyears..	54	52	72	72

The distribution of 1988 workyears is as follows:

Distribution of Other Than Full-Time Permanent Workyears

Program..	Workyears
Development programs.....	32
Youth opportunity programs.....	16
Other temporary programs.....	24
Total.....	72

The increase from the 1987 amended budget estimate to the 1987 current estimate is due to an increase of workyears in the youth opportunity and co-op programs, and the January 1987 pay raise. The 1988 budget estimate reflects the same level of effort as 1987.

c. Overtime and other compensation	1,674	2,059	1,926	1,942

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 1987 current estimate is a refinement of estimates. The 1988 estimate reflects program requirements.

	1986 Actual	1987 Amended Budget Estimte	1987 arrent Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
2. Benefits.....	11,788	11,233	14,424	20,105
The following are the amounts of contribution by category:				
Civil Service Retirement Fund..	6,841	6,485	9,166	14,653
Employee life insurance.....	197	212	199	206
Employee health insurance.....	2,682	2,883	2,728	2,791
Workmen's compensation.....	432	469	469	510
FICA.....	417	100	628	698
Medicare.....	1,208	1,076	1,222	1,235
Other benefits.....	11	8	12	12
Total.....	11,788	11,233	14,424	20,105

The increase from the 1987 amended budget estimte to the 1987 current estimte reflects the January 1987 pay raise and the cost of implementing the new retirement system (FERS). The 1988 increase reflects the first full year cost of implementing FERS.

B. Supporting Costs.....	1,189	1,582	1,591	1,651
1. Transfer of personnel.....	12	15	24	23

The increase from the 1987 amended budget estimte to the 1987 current estimte is due to a higher number of relocations than planned.

2. Personnel training.....	1,177	1,567	1,567	1,628

The purpose of the training program is to provide for the development and education of civil service employees and to more efficiently support Lewis roles and missions. The 1987 current estimte is a result of 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 1988 budget estimte increase reflects a continuing growth in these areas at anticipated tuition costs.

	1986 Actual	1987 Amended Budget Estikte	1987 Current Estimate	1988 Budget Estikte
		(Thousands of Dollars)		
II. TRAVEL	2,548	3,198	3,101	3,256
Summary of Fund Requirements				
A. Program Travel	1,897	2,471	2,425	2,557
B. Scientific & Tech. Development Travel	330	473	342	354
C. Management & Operations Travel.	321	254	334	345
Total, Travel	2,548	3,198	3,101	3,256
Explanation of Fund Requirements				
A. Program Travel	1,897	2,471	2,425	2,557

Program travel is directly related to the accomplishment of the Center's mission and accounts for approximtely 78% of travel costs. These funds are necessary for the management of mjor contractual programs in aeronautical research and technology, Space Station, space propulsion, mterials research and development and space energy processes and systems technology. The decrease from the 1987 budget estimate to the 1987 current estimate reflects a lower number of trips. The 1988 estimte reflects approximtely the same level of activity as in 1987.

B. Scientific &Tech. Development Travel	330	473	342	354

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 problem to their associates is invaluable. Many of the meetings are working panels convened to solve problems for the benefit of the Government. The 1987 current estimate reflect 1986 experience. The 1988 estimate provides for continuation of travel at the 1987 current

level of support with anticipated rate increases.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
C. Nlanagement & Operations Travel.	321	254	334	345

Management and operations travel is required for the direction and coordination of general mnagement matters. It includes travel in such areas as personnel, financial mnagemnt, procurement, travel of the Center's top mnagemnt to NASA Headquarters and other NASA Centers, training travel, and local transportation. The 1987 current estimte reflect 1986 experience. The 1988 estimte reflects the 1987 level with anticipated rate increases.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimate	1998 Budget Estimte
		(Thousands of Dollars)		
III. OPERATION OF INSTALLATION.....	**28,101**	**34,280**	**34,805**	**37,565**
Summary of Fund Requirements				
A. Facilities Services.....	20,327	24,202	22,935	24,840
B. Technical Services.....	2,356	3,856	3,718	4,142
C. Management and Operations.....	5,418	6,222	8,152	8,583
Total, Operation of Installation	28,101	34,280	34,805	37,565

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 mintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; (2) Technical Services, the cost of automatic data processing for mnagement activities and the cost of educational and informtional programs and technical shops supporting institutional activities; and (3) Management and Operations, the cost of administrative cmnications, reproduction, printing, transportation, medical services and supplies.

The net increase from the 1987 amended budget estimate to the 1987 current estimte reflects lower utility rates than anticipated offset by increases in electricity consumption cmnications and support contracts due to changed reimbursements received. The increase in 1988 includes rate increases for energy and support contracts. Energy consumption will increase slightly with planned wind tunnel activity, and there is a further small increase in support contract workyears related to reimbursements received.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimte
		(Thousands of Dollars)		
A. FACILITIES SERVICES.....	20,327	24,202	22,935	24,840

Lewis' Cleveland Facility includes nine major technical facilities within its 2 4 million square feet of buildings and structures. The plant supports an average daily population of about 3,000 personnel. Many of the test facilities are utilized on more than one shift or during off peak hours. The Plum Brook Station's active facilities support an average daily population of about 50 personnel.

Summary of Fund Requirements

1. Maintenance & Related Services	2,733	3,532	3,304	3,859
2. Custodial Services.....	4,280	4,788	4,760	4,962
3. Utility Services.....	13,314	15,882	14,871	16,019
Total, Facilities Services..	20,327	24,202	22,935	24,840

Explanation of Fund Requirements

1. Maintenance and Related Services.....	2,733	3,532	3,304	3,859

This activity provides for the operation and maintenance of facilities at the main installation in Cleveland and at the Plum Brook Station. Facilities maintenance includes buildings and grounds maintenance and mintenance of heating, ventilating, and air-conditioning systems and equipment. The decrease from the 1987 amended budget estimate to the 1987 current estimate reflects reevaluation of maintenance activities. The 1988 estimate reflects anticipated support contractor rate increases along with a small increase in maintenance activities.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
2. Custodial Services.....	4,280	4,788	4,760	4,962

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 1987 amended budget estimate to the 1987 current estimate is due primarily to lower support service contractor rates than expected. The increase in the 1988 estimate is due to anticipated rate changes in support contracts and a small increase in workyears due to anticipated changes in reimbursements received.

3. Utility Services.....	13,314	15,882	14,871	16,019

Electrical power is provided by the Cleveland Electric Illuminating m a n y . 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 1987 amended budget estimate to the 1987 current estimate is due to lower than expected rates. The increase from 1987 to 1988 is attributable to anticipated rate increases and expected growth of support contractor rates along with a small increase in electricity consunption.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
B. TECHNICAL SERVICES.....	2,356	3,856	3,718	4,142
Summary of Fund Requirements				
1. Automatic Data Processing.....	1,587	3,085	2,817	3,023
a. Equipment...	711	1,386	1,425	1,175
b. Operations.....	876	1,699	1,392	1,848
2. Scientific and Technical Information.....	769	771	901	1,119
Total, Technical Services...	2,356	3,856	3,718	4,142
Explanation of Fund Requirements				
1. Automatic Data Processing.....	1,587	3,085	2,817	3,023

Funding provides for administrative data processing, including maintenance and periodic replacement of equipment, and operations. The decrease from the 1987 amended budget to the 1987 current estimate reflects a realignment of support contractor plans. The FY 1988 estimate reflects anticipated price levels.

2. Scientific and Technical Information.....	769	771	901	1,119

Included in this activity is the support of the Center's 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 increase from the 1987 amended budget estimate to the 1987 current estimate is the result of an accelerated VIC exhibit upgrading plan. The 1988 budget estimate provides for expected support contract rate increases and continuation of the VIC exhibit upgrading plan.

	1986 Actual	1987 Amended Budget Estimate	1987 Current ~~Estimate~~	1988 Budget Estimate
		(Thousands of Dollars)		
C. MANAGEMENT AND OPERATIONS.....	5,418	6,222	8,152	8,583
Summary of Fund Requirements				
1. Administrative Communications..	552	599	1,494	2,413
2. Transportation.....	2,239	2,110	2,620	2,478
3. Installation Common Services...	2,627	3,513	4,038	3,692
Total, Management and Operations.....	5,418	6,222	8,152	8,583
Explanation of Fund Requirements				
1. Administrative Communications..	552	599	1,494	2,413

This estimate provides local and long distance telephone service and non-telephone communications. Local telephone service, provided by a support contractor, 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 increase in the 1987 current estimate over the 1987 amended budget estimate is due to higher cost associated with a new telephone system, and rate increases in local and FTS services. The 1988 level reflects increased rates for local and FTS services and an increase in support contractor effort needed to implement the new telephone system.

2. Transportation.....	2,239	2,110	2,620	2,478

This activity includes the support contract for bus service, delivery of mail, packages, and supplies on-site, and administrative aircraft maintenance. It also includes moving and hauling services and motor vehicle purchase, lease, and maintenance. The increase from the 1987 amended budget estimate to the 1987 current estimate reflects a small increase in support contract workyears to improve on-site delivery services along with expected rate increases and a rephased funding plan. The 1988 estimates

reflect the same level of effort as **1987** with anticipated support contractor rate increases and an increase in flight hours on the administrative aircraft, offset by minor reductions in purchases.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
3. Installation Common Services...	**2,627**	**3,513**	**4,038**	**3,692**

This funding provides 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 support contractors. This function also includes funding for maintenance and periodic replacement of administrative equipment and supplies, and postage. The increase from the **1987** amended budget estimte to the **1987** current estimate is due to a change in anticipated reimbursements and the addition of a video conference center. The **1988** budget estimate reflects the completion of the video conferencing center, partially offset by anticipated price levels for goods and services.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LEWIS RESEARCH CENTER

ORGANIZATION AND STAFFING CHART

STAFFING SUMMARY

	A7	A8
SES	32	32
EXCEPTED	0	0
GS/GM-16	1	1
GS/GM-15	140	140
GS/GM-14	304	311
OTHER GS/GM	1567	1580
WAGE GRADE	563	577
TOTAL	2641	2640

DIRECTOR AND STAFF

	A7	A8
SES	2	2
EXCEPTED	0	0
GS/GM-16	1	1
GS/GM-15	18	18
GS/GM-14	22	20
OTHER GS/GM	62	60
WAGE GRADE	0	0
TOTAL	105	101

AERONAUTICS DIRECTORATE

	A7	A8
SES	3	3
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	0	0
OTHER GS/GM	2	2
WAGE GRADE	0	0
TOTAL	6	6

ADVANCED PLANNING AND ANALYSIS OFFICE

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	4	4
GS/GM-14	3	3
OTHER GS/GM	14	14
WAGE GRADE	0	0
TOTAL	21	21

INSTRUMENTATION CONTROL TECHNOLOGY OFFICE

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	4	4
GS/GM-14	11	12
OTHER GS/GM	27	27
WAGE GRADE	0	0
TOTAL	42	43

INTERNAL FLUID MECHANICS DIVISION

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	11	12
GS/GM-14	14	14
OTHER GS/GM	56	56
WAGE GRADE	0	0
TOTAL	82	83

PROPULSION SYSTEMS DIVISION

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	11	11
GS/GM-14	30	30
OTHER GS/GM	77	77
WAGE GRADE	0	0
TOTAL	119	119

AEROPROPULSION FACILITIES & EXPERIMENTS DIVISION

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	7	7
GS/GM-14	17	17
OTHER GS/GM	63	63
WAGE GRADE	0	0
TOTAL	88	88

AEROSPACE TECHNOLOGY DIRECTORATE

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	0	0
OTHER GS/GM	1	1
WAGE GRADE	0	0
TOTAL	2	2

MATERIALS DIVISION

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	10	10
GS/GM-14	15	16
OTHER GS/GM	77	78
WAGE GRADE	0	0
TOTAL	103	105

STRUCTURES DIVISION

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	10	10
GS/GM-14	12	12
OTHER GS/GM	48	48
WAGE GRADE	0	0
TOTAL	71	71

SPACE PROPULSION TECHNOLOGY DIVISION

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	6	7
EXCEPTED	15	15
OTHER GS/GM	56	55
WAGE GRADE	0	0
TOTAL	77	78

POWER TECHNOLOGY DIVISION

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	10	10
GS/GM-14	20	20
OTHER GS/GM	71	71
WAGE GRADE	0	0
TOTAL	104	102

SPACE COMMUNICATIONS DIVISION

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	5	5
GS/GM-14	13	13
OTHER GS/GM	56	56
WAGE GRADE	0	0
TOTAL	75	75

SPACE STATION SYSTEMS DIRECTORATE

	A7	A8
SES	2	2
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	1	1
OTHER GS/GM	4	4
WAGE GRADE	0	0
TOTAL	7	7

OFFICE [redacted]

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	3	3
OTHER GS/GM	7	7
WAGE GRADE	0	0
TOTAL	11	11

SYSTEMS ENGINEERING INTEGRATION OFFICE

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	4	4
GS/GM-14	5	5
OTHER GS/GM	23	23
WAGE GRADE	0	0
TOTAL	33	33

PHOTOVOLTAIC POWER MODULE OFFICE

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	2	2
GS/GM-14	3	3
OTHER GS/GM	23	23
WAGE GRADE	0	0
TOTAL	28	

SOLAR DYNAMIC POWER MODULE DIVISION

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	2	2
GS/GM-14	8	9
OTHER GS/GM	13	13
WAGE GRADE	0	0
TOTAL	23	24

ELECTRICAL SYSTEMS DIVISION

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	4	4
OTHER GS/GM	23	23
WAGE GRADE	0	0
TOTAL	28	28

POWER SYSTEMS ORIENTATION DIVISION

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	2	2
GS/GM-14	6	6
OTHER GS/GM	23	24
WAGE GRADE	0	0
TOTAL	31	32

SPACE FLIGHT SYSTEMS DIRECTORATE

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	0	0
OTHER GS/GM	1	1
WAGE GRADE	0	0
TOTAL	2	2

ACTS PROJECT OFFICE

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	5	5
GS/GM-14	3	3
OTHER GS/GM	28	28
WAGE GRADE	0	0
TOTAL	37	37

SPACE EXPERIMENTS OFFICE

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	6	7
GS/GM-14	11	11
OTHER GS/GM	50	50
WAGE GRADE	0	0
TOTAL	68	69

SPACE SYSTEMS ANALYSIS OFFICE

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	5	5
GS/GM-14	4	4
OTHER GS/GM	23	23
WAGE GRADE	0	0
TOTAL	33	33

SHUTTLE/CENTAUR PROJECT OFFICE

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	2	2
OTHER GS/GM	5	5
WAGE GRADE	0	0
TOTAL	8	9

ATLAS/CENTAUR PROJECT OFFICE

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	2	2
OTHER GS/GM	6	6
WAGE GRADE	0	0
TOTAL	10	10

ENGINEERING DIRECTORATE

	A7	A8
SES	2	2
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	2	2
GS/GM-14	0	0
OTHER GS/GM	1	1
WAGE GRADE	0	0
TOTAL	5	5

SOFTWARE ENGINEERING OFFICE

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	1	1
OTHER GS/GM	0	0
WAGE GRADE	0	0
TOTAL	1	1

ENGINEERING SUPPORT OFFICE

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	1	1
OTHER GS/GM	0	0
WAGE GRADE	0	0
TOTAL	2	2

ELECTRONICS & CONTROL SYSTEMS DIVISION

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	4	4
OTHER GS/GM	41	41
WAGE GRADE	0	0
TOTAL	46	46

PROPULSION AND FLUID SYSTEMS DIVISION

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	3	4
GS/GM-14	6	6
OTHER GS/GM	51	51
WAGE GRADE	0	0
TOTAL	61	62

STRUCTURAL SYSTEMS DIVISION

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	3	3
GS/GM-14	17	18
OTHER GS/GM	37	37
WAGE GRADE	0	0
TOTAL	58	59

TECHNICAL SERVICES DIRECTORATE

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	0	0
OTHER GS/GM	3	3
WAGE GRADE	0	0
TOTAL	4	4

TEST INSTALLATIONS DIVISION

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	2	2
OTHER GS/GM	42	42
WAGE GRADE	0	0
TOTAL	45	45

FACILITIES OPER & MAINTENANCE DIVISION

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	14	14
OTHER GS/GM	107	107
WAGE GRADE	0	0
TOTAL	126	126

FABRICATION SUPPORT DIVISION

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	2	2
GS/GM-14	2	2
OTHER GS/GM	50	50
WAGE GRADE	0	0
TOTAL	63	63

FACILITIES ENGINEERING DIVISION

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	5	5
GS/GM-14	14	14
OTHER GS/GM	64	64
WAGE GRADE	0	0
TOTAL	84	84

ADMINISTRATION AND COMPUTER SERVICES DIR.

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	0	0
OTHER GS/GM	4	4
WAGE GRADE	0	0
TOTAL	6	6

PERSONNEL DIVISION

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	2	2
OTHER GS/GM	42	42
WAGE GRADE	0	0
TOTAL	45	45

COMPUTER SERVICES DIVISION

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	4	4
GS/GM-14	14	14
OTHER GS/GM	107	107
WAGE GRADE	0	0
TOTAL	126	126

HEALTH, SAFETY & SECURITY DIVISION

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	2	2
GS/GM-14	2	2
OTHER GS/GM	58	58
WAGE GRADE	0	0
TOTAL	63	63

LOGISTICS MANAGEMENT DIVISION

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	1	1
OTHER GS/GM	42	42
WAGE GRADE	0	0
TOTAL	43	43

TECHNICAL INFORMATION SERVICES DIVISION

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	1	1
OTHER GS/GM	38	38
WAGE GRADE	0	0
TOTAL	45	45

OFFICE OF THE COMPTROLLER

	A7	A8
SES	1	1
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	0	0
OTHER GS/GM	1	1
WAGE GRADE	0	0
TOTAL	2	2

RESOURCES ANALYSIS & PROCUREMENT OFFICE

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	5	5
OTHER GS/GM	23	23
WAGE GRADE	0	0
TOTAL	29	29

FINANCIAL MANAGEMENT DIVISION

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	1	1
OTHER GS/GM	33	33
WAGE GRADE	0	0
TOTAL	35	35

PROCUREMENT DIVISION

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	0	0
GS/GM-14	6	6
OTHER GS/GM	86	86
WAGE GRADE	0	0
TOTAL	92	92

PROGRAM COORDINATION OFFICE

	A7	A8
SES	0	0
EXCEPTED	0	0
GS/GM-16	0	0
GS/GM-15	1	1
GS/GM-14	4	4
OTHER GS/GM	2	2
WAGE GRADE	0	0
TOTAL	7	7

NASA HEADQUARTERS

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1988 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 miss o Headquarters is to plan an provide executive ines for the imp ame of nat onal space and aeronautics a consistent v he objectives stated in the N tic Aeronauti and Space f of 1 as amended. These tiv are to:

Extend our knowledge of the Earth its envi onmen , the solar system, and the universe;
--Expand practical applicat of a technology;
-D p , and impro d n unma space vehicles;
Impro tl i il d l usefulness of onau l ehicl il minimizing tl
l s and rgy tion;
-Disseminate pertinent findings to l t s and
--Promote international cooper t in p fu ti i space.

The following offic at Headquarters assist mnagement in carryi out the technical aspects of the mission:

Office o Space ght - Plans r c executes, and evaluates the research developnent, s qui on l ation of space fl ght ograms d in these programs is the Space Shuttle a key l of the National Space Tr y (NSTS The NSTS t located t , and his two eput located at the Centers have full esponsibility and authority for operations and conduct of the NSTS including b g , schedule, ogram equir nt , engine ing, a l f s ı report directly to the Assoc Admini t f Sp i Also incl l in h N are related ograms such as t use of p Launch es for NASA and other civil government programs, at, p stages, advance programs and other developmental space-based transporta programs. This office also it ionships with in tr international organizat g entities, ties the ci ific y and her government agencies th respect to space fli programs ı coordination wi the Office of External Re

Office of Space Station - Includes the recently established Space Station ProgramOffice and is responsible for the overall technical direction and content of the Space Station program, including systems engineering and analysis, program planning and control, configuration magement and the integration of all the elements into an operating system. Greater emphasis on policy coordination will be required because of the number of interested parties both within and outside of NASA including the international partners. User interfaces and operational implications on the system will be focused in this office as well.

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 developnt 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 infomtion systems.

Office of Aeronautics and Space Technolopy - 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. In 1988, greater emphasis will be placed on increasing NASA's space technology base through the Civil Space Technology Initiative. The NASA portion of the National Aero-Space Plane (NASP) 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 Tracking and Data Systems - Develops, implements, and operates tracking, data acauisition, command, communications, and data processing facilities. svstems and services reauired for support of all NASA flight missions.. This office also performs a management overview function for NASA administrative communications.

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

enchance operational success of NASA programs. The Office also provides for overall technical review of NASA programs and projects to ensure that developnent 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 responsibilites 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.

- ministering, operational and logistical support to those Headquarters elements concerned with carrying out the mission of the National Aeronautics and Space ministration.

- 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 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 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 cmnications, printing, equipment, transportation, occupational medicine and health, and other administrative support services.

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

HEADOUARTERS

	1986 ACTUAL	1987 AMENDED BUDGET ESTIMATE	1987 CURRENT ESTIMATE	1988 BUDGET ESTIMATE
Space Station	66	68	68	173
Space Flight Programs	147	146	147	175
Space Trans. Capab. Dev.	23	22	23	23
Space Shuttle	124	124	124	152
Space Science and Applications	175	178	178	192
Physics and Astronomy	49	50	50	55
Life Sciences	25	25	25	26
Planetary Exploration	25	25	25	26
Space Applications	76	78	78	85
Aeronautics & Space Tech	91	100	100	122
Aeronautical Res 6 Tech	55	58	57	60
Space Res & Tech	36	40	40	55
Transatmospheric R6T	0	2	3	7
Commercial Programs	32	38	38	39
Safety, Reliability and Quality Assurance	27	0	33	60
Tracking and Data Programs	48	48	48	60
SUBTOTAL DIRECT	586	578	612	821
Center Management 6 Operations	665	664	634	691
SUBTOTAL (FTP'S)	1,251	1,242	1,246	1,512
Other Controlled FTE's (PMI's/Co-ops/OTFTP's)	103	115	107	111
GRAND TOTAL (FTE)	1,354	1,357	1,353	1,623

SUMMARY OF RESOURCES REQUIREMENTS

Funding Plan by Function

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
	(Thousands of Dollars)			
I. Personnel and Related Cost	74,033	73,701	79,820	93,357
11. Travel	4,652	5,911	6,345	8,385
111. Operation of Installation	41,764	58,784	59,575	57,717
A. Facilities Services	(10,965)	(18,691)1/	(19,454)	(16,256)
B. Technical Services	(17,376)	(26,370)2/	(25,141)	(25,388)
C. Management and Operations	(13,423)	(13,723)	(14,980)	(16,073)
Total, fund requirement	120,449	138,396	145,740	159,459

1/ The $5.0 million Hazardous Substances Release Assessment funding shown in the 1987 Budget as part of the Agencywide Activities is included in Headquarters since the funds will be managed by the Facilities Engineering Division.

2/ $5.5 million of the $7.5 million Automated System Development funding shown in the 1987 Budget as part of the Agencywide Activities is included in Headquarters since the funds will be managed by the Office of Management. The other $2.0 million is shown at the Johnson Space Center for development of the NASA Personnel and Payroll System since JSC is the lead center in its developnent.

RESOURCES REQUIREMENTS BY FUNCTION

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimate
	(Thousands of Dollars)			
I. **PERSONNEL AND RELATED COSTS**	74,033	73,701	79,820	93,357
Summary of Fund Requirements				
A. Compensation and Benefits				
1. Compensation				
a. Full-time permnent	57,203	57,454	58,389	66,598
b. Other than full-time permnent	2,955	2,809	3,089	3,154
c. Reimbursable detailees	676	724	700	700
d. Overtime and other compensation	2,078	1,875	2,267	2,478
Subtotal, Compensation	62,912	62,862	64,445	72,930
2. Benefits	7,205	7,044	8,306	14,083
Subtotal, Carpensation & Benefits	70,117	69,906	72,751	87,013
B. Supporting Costs				
1. Transfer of personnel	676	365	3,325	2,206
2. Office of Personnel Management Services	916	881	885	924
3. Personnel training	2,324	2,549	2,859	3,214
Subtotal, Supporting Costs	3,916	3,795	7,069	6,344
Total, Personnel and Related Costs	74,033	73,701	79,820	93,357

Explanation of Fund Requirements

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
A. Compensation and Benefits	70,117	69,906	72,751	87,013
1. Carpensation	62,912	62,862	64,445	72,930
a. Full-time permanent	57,203	57,454	58,389	66,598

The increase in Carpensation and Benefits in 1987 from the h n d e d Wldget Estimate to the Current Estimte results primrily from the January 10, 1987 pay raise and the costs associated with implementation of the new Federal Employee Retirement System.

Basis of Cost for Civil Service Workyears

In 1988 the cost of pemnent workyears will be $66,598,000. The increase from 1987 results from the fo1lowing:

Cost of full-time permanent workyears in 1987		58,389
Cost increases in 1988		9,559
Within grade and career advances:		
Full year cost of 1987 increases	517	
Partial year cost of 1988 actions	836	
Extra day	219	
Full year cost of the 1987 pay raise	487	
Additional FTE in 1988	7,500	
Cost decreases in 1988		-1,350
Full year effect of 1987 turnover savings	-396	
Partial year effect of 1988 turnover savings	-954	
Cost of full-time pemnent workyears in 1988		66,598

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
b. Other than full-time pemnent				
(1) Cost	2,955	2,809	3,089	3,154
(2) Workyears	134	137	130	130

The distribution of 1988 workyears is as follows:

Distribution of Other Than Full-Time Pemnent Workyears

Program	Workyears
Development programs	24
Summer enployment programs	7
Youth opportunity programs	23
Other temporary	76
Total	130

The net increases from the 1987 h n d e d Budget Estimate to the 1987 Current Estimte and the 1988 Budget Estimate reflect the January, 1987 pay raise offset by decreases in consultant and non-ceiling employment costs.

c. Reimbursable detailees	676	724	700	700

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 1988 Budget Estimte reflects essentially a level program from 1987.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
d. Overtime and other coupensation.....	2,078	1,875	2,267	2,478

The increase from the 1987 Amended Budget Estimte to the 1987 Current Estimte more accurately reflects 1986 experience and the changing role of Headquarters in Agency management as well as the January 1987 pay raise.

2. Benefits.....	7,205	7,044	8,306	14,083

The following are the amounts of contribution by category:

Civil Service Retirement.....	4,058	4,091	5,423	10,710
Employee life insurance.....	128	143	130	153
Employee health insurance.....	1,155	1,266	1,185	1,413
Workmen's coupensation.....	805	531	505	536
FICA.....	234	197	243	251
Medicare.....	656	654	670	870
Other benefits.....	169	162	150	150
Total.....	7,205	7,044	8,306	14,083

The increase from the 1987 Amended Budget Estimte to the 1987 Current Estimte is due primrily to the cost of the Federal Employee Retirement Systemwith other adjustments resulting from the January 1987 pay raise. The increase from 1987 to the 1988 Budget Estimte results from the Federal Ehployee Retirement System, benefit costs to support the Headquarters staffing augmentation and the 1987 pay raise.

B. Supporting Costs.....	3,916	3,795	7,069	6,344
1. Transfer of personnel.....	676	365	3,325	2,206

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 1987 Amended Budget Estimte to the 1987 Current Estimte reflects a revised number of

expected relocations associated with the movement of Space Station programmanagement activities and personnel from field centers to Headquarters. The 1988 Budget Estimate provides for relocation costs resulting from the Headquarters staffing augmentation.

	1986 Actual	1987 Amended Budget Estikte	1987 Current Estimate	1988 Budget Estimate
	(Thousands of Dollars)			
2. Office of Personnel Management services..	916	881	885	924

Headquarters reimburses the Office of Personnel Management (OPM) for investigat on of new hires and security recertifications 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.

3. Personnel training.....	2,324	2,549	2,859	3,214

The mintenance and expansion of skills is essential in carrying out the Agency's many conplex technical program. Part of the training consists of courses offered by other Government agencies, usua ly for a fee. The reminder 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 he cost of seminars and workshops. The increases in the 1987 Current Estimate and the 1988 Budget Estimate are due to the need to provide training opportunities for an expanded staff supporting the changing role of Headquarters in Agency Management and Space Station development.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
II. TRAVEL	4,652	5,911	6,345	8,385
Summary of Fund Requirements				
A. Program Travel	1,813	4,061	2,910	4,382
B. Scientific and Technical Development Travel	569	768	634	803
C. Management and Operations Travel	2,270	1,082	2,801	3,200
Total, Travel	4,652	5,911	6,345	8,385
Explanation of Fund Requirements				
A. Program Travel	1,813	4,061	2,910	4,382

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 52 percent of the Headquarters travel requirements for 1988. The decrease from the 1987 Amended Budget Estimte to the 1987 Current Estimte results from alterations in the accounting system for assessing categories of travel. The 1988 estimte provides for increased programmatic travel in accordance with the return of the Shuttle to flight status, requirements of the Space Station Program Office, and Safety, Reliability and Quality Assurance activities and to support the additional civil service staff.

B. Scientific and Technical Development Travel	569	768	634	803

Scientific and technical development travel permits enployees 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 problem to their associates. Many of these meetings are working panels convened to solve certain problem for the benefit of the Government. The decrease from the 1987 Amended Budget Estimte to the 1987 Current Estimte reflects 1986 experience. The 1988 Budget Estimte covers the costs

of providing scientific and technical developnent opportunities for additional professional scientific and technical personnel.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
C. Management and Operations Travel.....	2,270	1,082	2,801	3,200

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 magers in such areas as personnel, financial management, and procurement to assure Agency policies and procedures are being implemented throughout the agency, as well as local transportation and congressional travel are also included. The increase to the 1987 Current Estimate from the 1987 Amended Budget Estimate reflects the change in per-diem rate regulations which went into effect in 1986 and an alteration in the accounting system for assessing categories of travel. The new per-diem regulations impact career development travel significantly more than other categories because of the long duration of those program. The increase from 1987 to the 1988 Budget Estimate covers the expected increase in travel resulting from the planned reorganization and centralization of management controls at Headquarters.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
	(Thousands of Dollars)			
111. **OPERATION OF INSTALLATION**	41,764	58,784	59,575	57,717
Summary of Fund Requirements				
A. Facilities Services	10,965	18,691	19,454	16,256
B. Technical Services	17,376	26,370	25,141	25,388
C. Management and Operations	13,423	13,723	14,980	16,073
Total, Operation of Installation	41,764	58,784	59,575	57,717

Explanation of Fund Requirements

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 includes rental of real property, acquisition, maintenance and repair of institutional facilities and equipment, and the cost of custodial services; Technical Services includes the cost of automatic data processing for mnagement activities, and the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations includes the cost of administrative cmnications, printing, transportation, medical supplies, and related services.

A. FACILITIES SERVICES	10,965	18,691	19,454	16,256

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 ministration (GSA) in accordance with P.L. 92-313. The cost of tenporary use of off-site facilities is also included in this category.

Summary of Fund Requirements

	1986 Actual	1987 hnded Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
1. Rental of Real Property.....	8,111	10,648	10,629	12,896
2. Maintenance and Related Services...	2,118	7,266	8,048	2,544
a. Facilities...	2,118	7,266	8,048	2,544
b. Equipment	---	---	---	---
3. Custodial Services.....	736	777	777	816
Total, Facilities Services.....	10,965	18,691	19,454	16,256

Explanation of Fund Requirements

1. Rental of Real Property.....	8,111	10,648	10,629	12,896

Public Law 92-313 requires that agencies be charged for space and related services provided by the General Services ministration at approximately equivalent commercial rates. These funds provide for the cost of office space used by NASAHeadquarters personnel. The increase from 1987 to the 1988 Budget Estimate is for the cost of additional office space required to support the significant growth in Headquarters staff as well as the rate increases estimated by GSA.

2. Maintenance and Related Services.....	2,118	7,266	8,048	2,544

This estimate includes maintenance, repair and alterations of buildings such as partition changes, auxilliary air conditioning systems for ADP equipment, telephone changes and general buildings maintenance. The 1987 hnded Budget Estimate and the Current Estimate provide funding to continue studies and assessments of enviromntal hazards at NASA field installations and to design and implement remedial projects for environmental compliance. These are agencywide activities funded at Headquarters for management control. These activities will be funded in 1988 in the Construction of Facilities appropriation.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
	(Thousands of Dollars)			
3. Custodial Services.....	736	777	777	816

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 equipnent in the NASA Headquarters buildings. FY 1988 reflects GSA projected rates for essentially the same level of support as 1987.

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimate
	(Thousands of Dollars)			
A. TECHNICAL SERVICES	17,376	26,370	25,141	25,388
Summary of Fund Requirements				
1. Automation Data Processing	12,632	22,089	20,630	20,853
a. Equipment	773	6,460	4,391	2,918
b. Operations	11,859	15,629	16,239	17,935
2. Scientific and Technical Information	3,018	3,306	3,347	3,511
a. Library	489	508	578	534
b. Education and Informtion	2,529	2,798	2,769	2,977
3. Shop and Support Services	1,726	975	1,164	1,024
Total, Technical Services	17,376	26,370	25,141	25,388
Explanation of Fund Requirements				
1. Automatic Data Processing	12,632	22,089	20,630	20,853

This estimte provides for the lease, purchase, maintenance, programming and operations services of automatic data processing (ADP) equipment. The decrease from the 1987 Amended Budget Estimate to the 1987 Current Estimte is the net result of revised estimates for 1986 experience, reduced requirements for agencywide automated systems development, and realignment of non-capitalized equipnent costs to ADP operations. The 1988 Budget Estimte provides for continuation of agencywide automation initiatives and costs for the replacement of an administrative mainframe computer initiated in 1987.

2. Scientific and Technical Informtion	3,018	3,306	3,347	3,511

The activities contained in this subfunction are educational-informational programs and the NASA Headquarters technical library.

The education and infomtion programs provide for gathering and disseminating 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 gathering and disseminating newsworthy material in support of their requests, and takes such forms as press kits, news releases, television and radio infomtion tapes and clips, and feature material. Research, developnent, 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. The agency provides assistance to over 1,000 teacher workshops and professional education meetings and participates in science fairs. This activity also provides equal employment opportunity exhibits and films to high schools, colleges and the general public to demonstrate the key roles that women and minorities have in the United States space program.

The **1988** Wldget Estimate funds essentially the same level of service as in **1987.**

	1986 Actual	1987 Amended Budget Estikte	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
3. Shop and Support Services.....	**1,726**	**975**	**1,164**	**1,024**

These funds provide for the continuation of studies on parts applications, NASA-wide safety, reliability, quality assurance standards, graphic and photo processing services. The increase in the **1987** Current Estimate from the **1987** h n d e d Budget Estimate is due to the large scale management studies initiated in the wake of the Challenger accident. The **1988** reduction reflects the phasing down **of** these studies as implementation of the recommendations continues.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
	(Thousands of Dollars)			
C. MANAGEMENT AND OPERATIONS	13,423	13,723	14,980	16,073
Summary of Fund Requirements				
1. Administrative Communications	3,372	3,257	3,478	3,876
2. Printing and Reproduction	1,131	1,339	1,357	1,388
3. Transportation	475	673	657	665
4. Installation Common Services	8,445	8,454	9,488	10,144
Total, Management and Operations	13,423	13,723	14,980	16,073
Explanation of Fund Requirements				
1. Administrative Camunications	3,372	3,257	3,478	3,876

Included in this category are the costs of leased lines, long distance tolls, telephone exchange services, and other communications. The increase in the 1987 Current Estimte fran the 1987 Amended Wldget Estimte reflects 1986 experience with communications rates and expected service increases related to the expanded Headquarters role in programmanagement and direction. The increase fran 1987 to the 1988 Wldget Estimte provides for service increases resulting from the growth in Headquarters staff as well as expected rate increases.

2. Printing and Reproduction	1,131	1,339	1,357	1,388

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 1988 estimate reflects essentially the same effort as 1987 at expected 1988 rates.

	1986 Actual	1987 Amended Wldget Estimate	1987 Current Estimate	1988 Wldget Estimate
	(Thousands of Dollars)			
3. Transportation.	475	673	657	665

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 mintaining the adninistrative aircraft which is assigned to the Jet Propulsion Laboratory. The increase in **1988** is based on **1987** levels at expected **1988** rates.

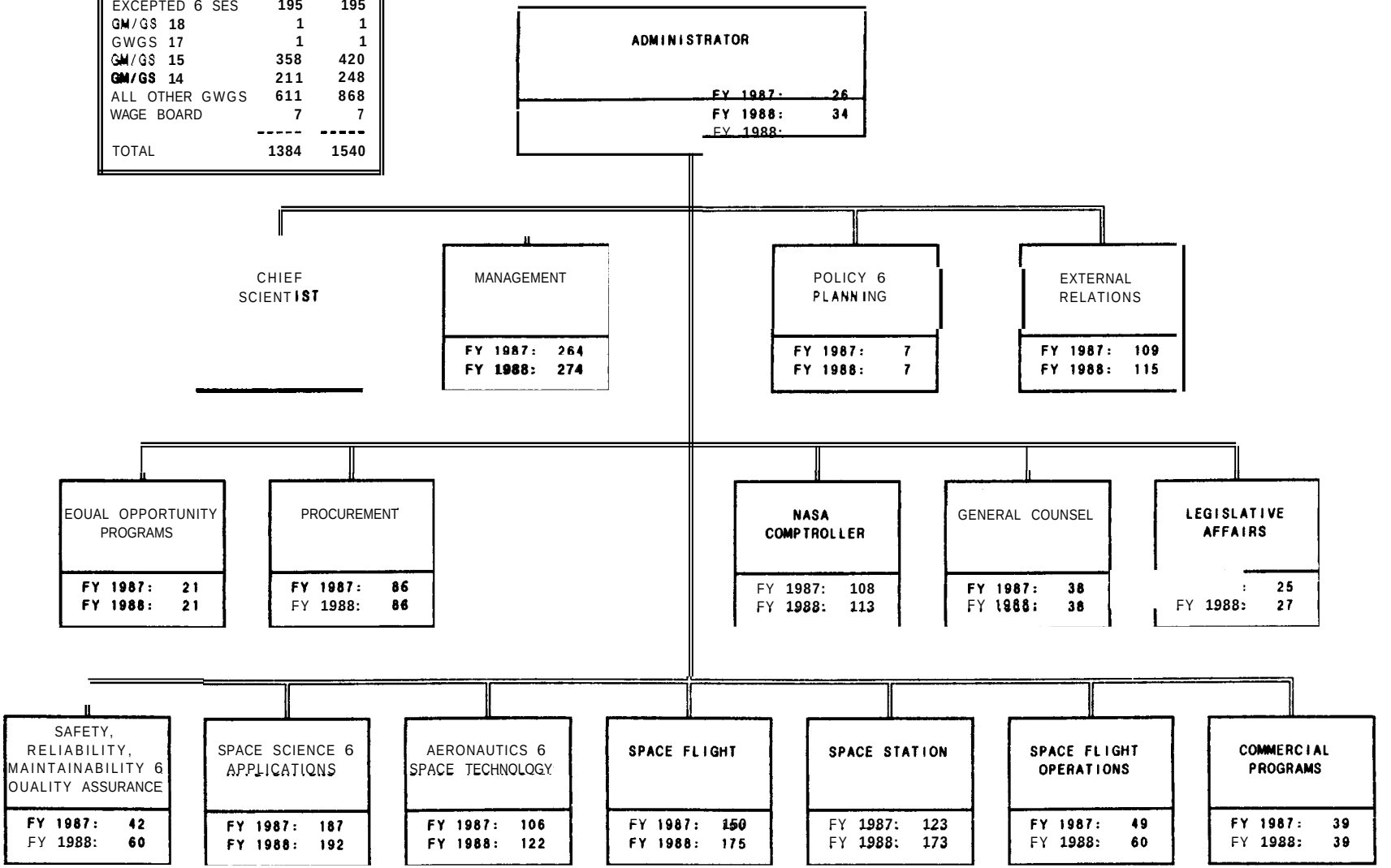
4. Installation Common Services.....	8,445	8,454	9,488	10,144

This function provides for those services which support the Headquarters, such as: patent services, mintenance and repair of office equipnent 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 ahinistration support and documentation; and adminstrative supplies, materials and equipnent. The increase from the **1987** Amended Budget Estimate to the Current Estimate is indicative of sane of the costs of organizational realignments recommended following investigations into the Space Shuttle Accident. The **1988** Wldget Estimate provides for the cost of additional goods and services necessary to support the Headquarters staffing augmentation and the Space Station Program Office growth.

HEADOUARTERS SUMMARY STAFFING	FY 87	FY 88
EXCEPTED 6 SES	195	195
GM/GS 18	1	1
GWGS 17	1	1
GM/GS 15	358	420
GM/GS 14	211	248
ALL OTHER GWGS	611	868
WAGE BOARD	7	7
TOTAL	1384	1540

ORGANIZATION AND STAFFING

NASA HEADOUARTERS



INSPECTOR GENERAL

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1988 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 Marshal1 Space Flight Center, Alabama.

OFFICE F IN GENERAL ROLES AND MISSIONS

The NASA created in 1978 by an Act of Congress .L. 95-452) as an independent and objective unit thin the Agency The p and mission of the OIG are :

-- onduct and p audi and nvesti s relating to NASA s a operations;

-- Promote economy, efficiency, and effectiveness in the administration of these program 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 program, deficiencies relating to the ahinistration of such programs, and the necessity for and progress of corrective actions.

Distribution of Pemnent Civil Service Workyears

	1986 Actual	1987 Amended Wldget Estimate	1987 Current Estimte	1988 Budget Estimate
Permanent full-time workyears.....	97	97	101	126
Other than full-time.....	10	10	10	10
Total workyears.....	107	107	111	136

SUMMARY OF RESOURCES REQUIREMENTS

Funding Plan by Function

		1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)			
I.	Personnel and Related Cost.....	4,827	5,008	5,448	7,161
II.	Travel.....	216	270	275	368
III.	Operation of Installation.....	281	216	310	420
	A. Facilities Services.....	(---)	(---)	(---)	(---)
	B. Technical Services.....	(236)	(151)	(243)	(350)
	C. Management and Operations..	(45)	(65)	(67)	(70)
	Total, fund requirement..	5,324	5,494	6,033	7,949

RESOURCES REQUIREMENTS BY FUNCTION

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
	(Thousands of Dollars)			
I. PERSONNEL AND RELATED COSTS	4,827	5,008	5,448	7,161
Summary of Fund Requirements				
A. Compensation and Benefits				
1. Compensation				
a. Full-time permanent	4,004	4,024	4,457	5,706
b. Other than full-time permanent	162	185	169	171
c. Overtime and other compensation	5	5	5	5
Subtotal, Compensation	4,171	4,214	4,631	5,882
2. Benefits	466	479	607	823
Subtotal, Compensation & Benefits	4,637	4,693	5,238	6,705
B. Supporting Costs				
1. Transfer of personnel	156	270	175	415
2. Personnel training	34	45	35	41
Subtotal, Supporting Costs	190	315	210	456
Total, Personnel and Related Costs	4,827	5,008	5,448	7,161

Explanation of Fund Requirements

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
A. Carpensation and Benefits	4,637	4,693	5,238	6,705
1. Compensation	4,171	4,214	4,631	5,882
a. Full-time pemnent	4,004	4,024	4,457	5,706

The increase in compensation and benefits fran the Amended Budget Estimte to the Current Estimte in 1987 results from the January 1987 pay raise, implementation of the Federal Employee Retirement System and the increased ceiling for the Office of the Inspector General.

Basis of Cost for Civil Service Workyears

In 1988 the cost of pement workyears will be $5,706,000. The increase fran 1987 results fran the following:

Cost of full-time pemnent wlorkyears in 1987		4,457
Cost Increases in 1988		1,318
Within-grade and career advances:		
Full year cost of 1987 actions	42	
Partial year cost of 1988 actions	85	
Extra day	17	
Full Year Cost of 1987 Pay Raise	37	
Additional FTE in 1988	1,137	
Cost Decreases in 1988		-69
Full year effect of 1987 turnover savings	-13	
Partial year effect of 1988 turnover savings	-56	
Cost of full-time permanent workyears in 1988		5,706

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
b. Other than full-time permanent				
(1) cost	162	185	169	171
(2) **Workyears**	10	10	10	10

The change from the 1987 Amended Budget Estimate to the 1987 Current Estimate reflects 1986 actual experience.

The distribution of 1988 workyears is as follows:

Distribution of Other Than Full-Time Permanent Workyears

Program	Workyears
Summer employment programs	1
Other temporary	9
Total	10

The 1988 estimate is essentially level with 1987 but reflects the January 1987 pay raise.

c. Overtime and other compensation	5	5	5	5
2. Benefits	466	479	607	823

The following are the amounts of contribution by category:

Civil Service Retirement Fund	271	286	387	554
Employee life insurance	8	10	9	11
Employee health insurance	76	88	84	110
Workmen's compensation	53	36	62	64
FICA	15	13	17	22
Medicare	43	46	48	62
Total	466	479	607	823

The increases from the 1987 Amended Budget Estimate to the 1987 Current Estimate and from 1987 to the 1988 Budget Estimate are due to the expanded OIG staff and the January 1987 pay raise as well as the 1987 changes to the Federal Employee Retirement System.

	1986 Actual	1987 Prnended Budget Estirmte	1987 Current Estirmte	1988 Budget Estimate
	(Thousands of Dollars)			
B. Supporting Costs.....	**190**	**315**	**210**	**456**
1. Transfer of personnel.....	**156**	**270**	**175**	**415**

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 change fran the **1987** Prnended Budget Estirmte to the **1987** Current Estimte reflects **1986** actual experience. The **1988** Budget Estirmte reflects an increase fran **1987** associated with the increased personnel ceiling in the Office of the Inspector General.

2. Personnel training.....	**34**	**45**	**35**	**41**

The mintenance and expansion of skills is essential in carrying out the Inspector General's Mission. Part of the training consists of courses offered by other Government agencies, usually for a fee. The reminder 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 decrease fran the **1987** Prnended Budget Estirmte to the **1987** Current Estirmte reflects **1986** experience. The **1988** Budget Estirmte increases fran **1987** to support the larger OIG staff.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
	(Thousands of Dollars)			
11. TRAVEL.....	216	270	275	368
Summary of Fund Requirements				
Management and Operations Travel.....	216	270	275	368
Total, Travel.....	216	270	275	368
Explanation of Fund Requirements				
Management and Operations Travel.....	216	270	275	368

Travel funding is required to carry out audits, investigation and management duties. The FY 1988 costs are higher due to the anticipated travel associated with the increased personnel ceilings and expanded OIG caseload.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
	(Thousands of Dollars)			
III. **OPERATION OF INSTALLATION**.....	281	216	310	420
Summary of Fund Requirements				
Technical Services.....	236	151	243	350
Management and Operations.....	45	65	67	70
Total, Operation of Installation...	281	216	310	420

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 increase from the 1987 Amended Budget Estimate to the 1987 Current Estimate and the 1988 Budget Estimate is due to equipment acquisition costs associated with a larger OIG staff.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
	(Thousands of Dollars)			
B. Technical Services.....	236	151	243	350
Summary of Fund Requirements				
1. Automated Data Processing.....	236	151	243	350
Operations.....	236	151	243	350
Total, Technical Services.....	236	151	243	350
Explanation of Fund Requirements				
1. Automated Data Processing...	236	151	243	350

This estimate provides for the lease, purchase, maintenance, programming and operations services of automated data processing (ADP) equipment. The increase from the 1987 Amended Budget Estimate to the Current Estimate reflects the effort to modernize and automate the OIG audit capabilities and to extend these capabilities to an expanding OIG staff. Equipment acquisitions for the cadre of new people has caused the increased requirement in 1988.

C. Management and Operations.....	45	65	67	70
Summary of Fund Requirements				
1. Administrative Communications.....	23	22	24	25
2. Printing and Reproduction.....	3	3	3	3
3. Installation Common Services.....	19	40	40	42
Total, Management and Operations...	45	65	67	70

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
	(Thousands of Dollars)			
Explanation of Fund Requirements				
1. Administrative Communications.....	23	22	24	25

Included in this category are the costs of local telephone services for the Inspector General's office at NASAHeadquarters.

2. Printing and Reproduction.....	3	3	3	3

Costs of printing and reproduction services used by the Office of Inspector General at NASA Headquarters are included.

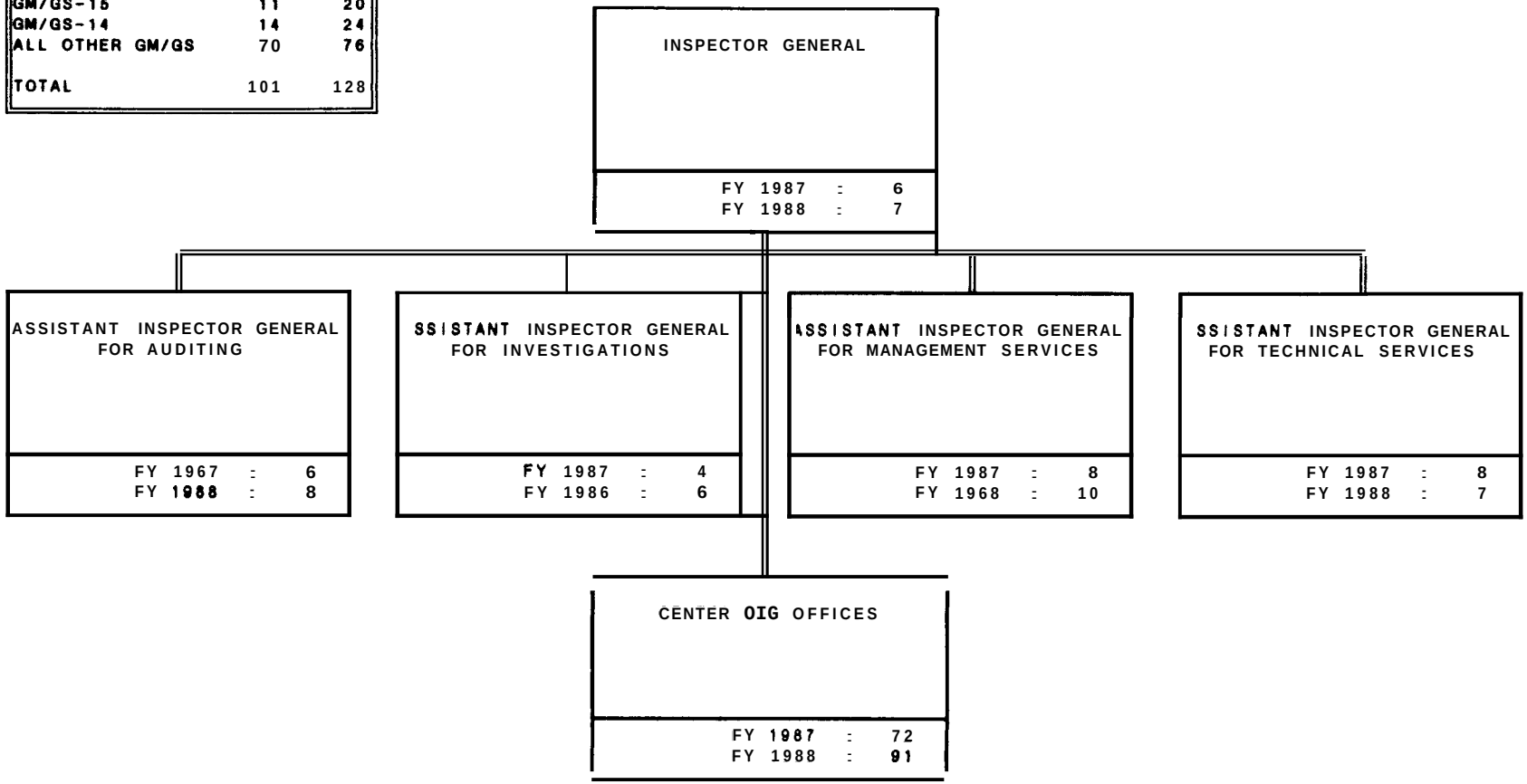
3. Installation Common Services.....	19	40	40	42

The Inspector General's direct use of adninistrative supplies, mterials and equipnent is covered in this subcategory. These requirements are essentially level from 1987 to 1988, reflecting only a slight increase in 1988 due to a larger OIG staff.

ORGANIZATION AND STAFFING

OFFICE OF INSPECTOR GENERAL

INSPECTOR GENERAL SUMMARY		
	FY 87	FY 88
EXCEPTED & SES	6	6
GM/GS-15	11	20
GM/GS-14	14	24
ALL OTHER GM/GS	70	76
TOTAL	101	128



SPECIAL
ANALYSES

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1988

JET PROPULSION LABORATORY

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 (propellant formulation and 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, 1986, was $530,743,266.

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 Research and Development and the Space Flight, Control, and Data Communications appropriations, except for the lease or purchase of 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.

ROLES AND MISSIONS

In principal roles the Jet Propulsion Laboratory is 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 system, 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, and research and analysis.

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 mnagement 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.

In the continuing series of planetary missions, JPL has management responsibility for the Voyager missions. 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 that both spacecraft would remain in good operating condition following the Saturn encounters, and in consequence the Voyager mission has been considerably extended 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 on to arrive at 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 instrumented 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 magement 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 the 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 fran a 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 mterials, examine the mjor 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 which has established a data base comprised of photometric data collected from asteriods, stars and galaxies in four wave bands from near infrared to far infrared. This is totally unique data base of such magnitude that years of analysis will be required.

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 the French, 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.

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 mjor instrument, the Shuttle Imaging Spectrometer Experiment (SISEX), is under development.

Other important areas of research in space applications include geodynamics and plate tectonics, and flight experiments for microgravity research in glasses and fluid behavior.

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 a Mission Control and Computing Center. The DSN tracking stations are located in California, Spain, and Australia, and support projects involving flights beyond near-Earth orbit. The Mission Control and Carputing Center is located at JPL, and is the location of actual day-to-day operations of deep-space missions. JPL has also implemented the Network Consolidation Program which co-locates mjor facilities of the Space Tracking and Data Network (STDN) near-Earth tracking stations with the three DSN stations. These consolidated facilities are managed by JPL and will provide a more 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 advanced development, autonomous system, space power and propulsion systems, micro-electronics, information system, and basic research in such fields as fluid physics, polymer mterials, and applied mathematics. The Laboratory participation includes not only the performance of scientific investigations, but also a significant commitment 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, Earth and ocean physics, and microgravity. These activities involve broad collaboration with the scientific and academic communities and with staff members from other NASA field installations.

SIMULATED RESEARCH AND PROGRAM MANAGEMENT BUDGET

FUNDING PLAN BY FUNCTION

	1986 Actual	1987 Amended Budget Estimte	1987 Current Estimte	1988 Budget Estimte
	(Thousands of Dollars)			
I. Personnel and Related Costs.....	207,736	194,675	218,821	235,731
11. Travel.....	9,768	8,250	10,269	11,071
111. Operation of Installation.....	54,051	55,228	57,108	59,529
A. Facilities Services..	(30,335)	(30,133)	(32,213)	(32,268)
B. Technical Services.....	(8,838)	(9,279)	(9,252)	(10,242)
C. Management and Operations..	(14,878)	(15,816)	(15,643)	(17,019)
Total, Fund Requirements.....	271,555	258,153	286,198	306,331

EXPLANATION OF FUND REQUIREMENTS

I. PERSONNEL AND RELATED COSTS	207,736	194,675	218,821	235,731

The increase from the 1987 Budget Estimte to the 1987 Current Estimte is due to the change in estimated workforce levels, revised salary estimates based on 1986 experience, and related benefits costs. The increase from the 1987 Current Estimte to the 1988 Estimte is due to normal salary increases, associated increase in personnel benefits and the change in the estimted workforce level.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
II. TRAVEL.....	9,768	8,250	10,269	11,071

The increase from the 1987 Budget Estimate to the 1987 Current Estimate is due to the reassessment of travel requirements based on current programmatic activities and anticipated travel associated with Galileo and Ulysses checkouts, tests and launches. The increase from the 1987 Current Estimate to the 1988 Budget Estimate reflects an increase to normal levels as a result of FY 1988 launch activities including Mage1lan.

111. OPERATION OF INSTALLATION.....	54,051	55,228	57,108	59,529
A. Facilities Services.....	(30,335)	(30,133)	(32,213)	(32,268)

The net increase from the 1987 Current Estimte to the 1988 Budget Estimate is due to anticipated higher utilities costs offset by reduced building lease costs due to the opening of the Central Engineering Building (CEB) and the completion of the Earth and Space Sciences Laboratory (ESSL) in FY 1987.

B. Technical Services.....	(8,838)	(9,279)	(9,252)	(10,242)

The increase from the 1987 Current Estimate to the 1988 Budget Estimate is due to increased contractor costs for design/development of a JPL-wide management information system and computer hardware and software maintenance.

C. Management and Operations..	(14,878)	(15,816)	(15,643)	(17,019)

The decrease fran the 1987 Budget Estimte to the 1987 Current Estimte is based on the 1986 experience. The increase from the 1987 Current Estimate to the 1988 Budget Estimate for supplies, equipment and other necessities for the operation of the new Central Engineering Building and the Earth Space Sciences Laboratory (ESSL) when it is completed.

DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
RESEARCH AND DEVELOPMENT	1,798	1,675	1,834	1,857
Space Station	43	35	60	66
Space Transportation Capability Development	14	8	23	12
Space Science and Applications	1,517	1,377	1,511	1,528
Physics and Astronomy	113	128	145	158
Life Science	13	25	15	25
Planetary Exploration	933	752	974	956
Space Applications	458	472	377	389
Commercial Programs	1	-	4	7
Technology Utilization	1	-	4	7
Aeronautics and Space Technology	156	173	158	162
Aeronautics	2	2	2	-
Space	154	171	156	162
Tracking and Data Advanced Systems	67	82	78	82
SPACE FLIGHT, CONTROL AND DATA COMMUNICATIONS	370	344	312	324
Space Transportation Operations	8	12	9	7
Space and Ground Network, Communications and Data System	362	332	303	317
Subtotal, Direct Workyears	2,168	2,019	2,146	2,181
DIRECT SUPPORT	457	475	459	473
CENTER MANAGEMENT AND OPERATIONS	1,098	1,140	1,116	1,144
Total, Permanent Workyears	3,723	3,634	3,721	3,798

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1988 ESTIMATES

SUMMARY OF AIR TRANSPORTATION

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimate	1988 Budget Estimate
		(Thousands of Dollars)		
Research and development	337,257	398,500	398,500	408,000
Construction of facilities	12,450	29,200	19,200	29,900
Research and program management	249,602	278,400	271,295	287,247
Total	599,309	706,100	688,995	725,147
Number of direct workyears associated with air transportation	3,350	3,514	3,376	3,355

The goal of the NASA aeronautical research and technology program is to conduct effective and productive aeronautical research and develop technology which contributes materially to the enduring preeminence of U.S. civil and military aviation. This goal is supported by five comprehensive program objectives: (1) identify and concentrate on those emerging technologies with potential for order-of-magnitude advances in aircraft capability and performance that will enhance U.S. industrial conpetitiveness; (2) sustain the excellence of NASA's research centers by modernizing and enhancing the efficiency of national facilities, advancing scientific and engineering computational capabilities, and enhancing staff technical excellence by selecting highly qualified personnel and providing them with challenging career opportunities; (3) ensure timely and efficient transition of research results to the U.S. aerospace community through reports, conferences, workshops, and active participation of industry in contractual and cooperative 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 mjor aeronautical programs. These revolutionary advances require a broad program of fundamental research that focuses on critical technologies and accelerates technology readiness for future vehicles.

The NASA aeronautical research and technology program is intended to provide results well in advance of specific applications through long-term independent research and technology 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 directed at interaction among disciplines, conponents, and subsystems. Ongoing and planned research in the program represents a mjor contribution to the technological foundation for securing and maintaining world leadership in aeronautics for the United States.

The FY 1988 aeronautical research and technology program has been redirected to emphasize and focus on those technological opportunities which have potential for order-of-magnitude increases in vehicle capabilities and substantive impact on U.S. conpetitiveness. Previous progress in hypersonic technologies has led to the creation of the joint DOD/NASA national aero-space plane program. The aero-space plane program is being supported over the entire spectrum of fundamental disciplinary research and technology in the aeronautics program. The ongoing turbine engine hot section technology (HOST) and the ceramics for turbine engines systems technology programs have been combined and augmented into a high-temperature propulsion materials program aimed at revolutionary advances in engine thrust-to-weight ratio applicable to a broad range of aerospace vehicles. The demand for NASA's unique aeronautics research and test facilities is growing with the emergence of the national aero-space plane program and a new generation of military aircraft requiring extensive wind tunnel testing. In order to meet growing demand for development and new research needs with aging facilities, NASA is accelerating its wind tunnel modernization program, while also launching a broad study to identify the highest priority needs to guide future facilities enhancements.

NASA, in conjunction with the Department of Defense, is developing the technology for future aerospace vehicles in the joint national aero-space plane 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 low-cost access to space.

Ongoing activities in the national aero-space plane program include technology development in subsonic, supersonic, and hypersonic hydrogen-fueled propulsion technology; advanced high-temperature materials and lighweight, high-strength, thermal structural concepts; and conputational fluid dynamics, which remain the three critical technologies for all transatmospheric vehicle applications. The engine and airframe contracted efforts will be supported by an extensive focused technology effort at NASA centers (Ames, Langley and Lewis) and other government laboratories. Work will continue on conputational fluid dynamics calculations, including the refinement of conputer models based on test data. Modeling using supercomputers will include external/internal aerodynamics, aerothermodynamics, kinetics and thermal-structural considerations, and nozzle/plume conputer codes for analyzing chemically reacting hypersonic nozzle/plume flows. Work will continue on development of, and mnufacturing technology for, lightweight, high-temperature advanced mterials. For example, processing techniques for fabricating ceramic matrix composite

panels will be demonstrated. Engine corrponent and subsystem testing will continue over the wide speed range of interest, and flight research vehicle test planning will be initiated. Tests will be conducted on subscale component integration models of scramjet concepts over the speed range of Mach 3.5 to Mach 8. Contractors will concentrate on developing and refining their vehicle concepts, the construction and testing of critical structural components of the airframe cryogenic tankage and vehicle, and propulsion/airframe integration of both engines into their respective vehicle configurations. In addition, the airframe contractors will focus on critical technologies including nose cap and leading-edge materials, actively cooled structures, computational fluid dynamics code validation, and flight instrumentation.

The research and program management funding in FY 1988 provides for the salaries and travel of 3,355 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 1988 OBLIGATIONS FOR EQUIPMENT TO BE PLACED AT NASA INSTALLATIONS

Proaram Budaet Line Item	1988 (Thousands of Dollars)
Research and Development	232.734
Space Station	(86.843)
Space Transportation Capability Development	(30.639)
Physics and Astronomy	(22.398)
Planetary Exploration	(7.197)
Life Sciences	(710)
Space Applications	(7.181)
Aeronautical Research and Technology	(69.159)
Space Research and Technology	(8.257)
Safety. Reliability. and Quality Assurance	(350)
Space Fliaht. Control. and Data Communications	(90.993)
Shuttle Production and Capability Development	(53.373)
Space Transportation Operations	(28.670)
Space and Ground Networks. Communication and Data Systems	(8.950)
GRAND TOTAL	323.727

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH AND DEVELOPMENT

ESTIMATED FY 1988 OBLIGATIONS FOR EQUIPMENT TO BE PLACED AT NASA INSTALLATIONS

Program Budaet Line Item	1988 (Thousands of Dollars)
Research and Development	211.734
Space Station	(86.843)
Space Transportation Capability Development	(30.639)
Physics and Astronomy	(1.398)
Planetary Exploration	(7.197)
Life Sciences	(710)
Space Applications	(7.181)
Aeronautical Research and Technology	(69.159)
Space Research and Technology	(8.257)
Safety. Reliability. and Quality Assurance	(350)
Space Flight. Control. and Data Communications	(90.993)
Shuttle Production and Capability Development	(53.373)
Space Transportation Operations	(28.670)
Space and Ground Networks. Communication and Data Systems	(8.950)
GRAND TOTAL	302,727

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE STATION	NASA HEAOOUARTERS LOCATION 1000-00, 88-000810	HFAOQUARTERS TECH. MGT. INFO SYS. (TMIS)	SUPPORTS PROGRAM MANAGEMENT/INTEGRATION	$400	
SPACE STATION	AMES RESEARCH CENTER LOCATION 21R1-96, 88-001725	PURCHASED HAROWARE EDIOIS	SUPPORTS PROGRAM MANAGEMENT/INTEGRATION, AND AERONAUTICS R&T EASE	$432	
SPACE STATION	LEVIS RESEARCH CENTER LOCATION 2200-00, 88-004250	PSCN & TOMA HAROWARE	SUPPORTS SYSTEM DEFINITION	$570	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7201-XX, 88-008775	CENTER INFORMATION SVSTEM ACOUISITION (IMS FUNDED)	SUPPORTS SYSTEM DEFINITION	S1.024	
SPACE STATION	JOIMSON SPACE CENTER LOCATION 7201-XX. 88-008785	LEASE 10 OWN SPERRV COMPUTFRS	SUPPORTS SYSTEM DEFINITION	$797	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7201-XX. 88-008790	LEASE XEROX 9700	SUPPORTS SYSTEM DEFINITION	$88	
SPACE STATION	JOIINSON SPACE CENTER LOCAIION 7201-XX. 88-008795	LEASE SPERRV PERIPHERAL EOUIPMENT (IMS FUNDED)	SUPPORTS SYSTEM DEFINITION	$405	
SPACE STATION	JOHNSON SPACE CENTER LOCAIION 7201-WX. 88-008830	IBM PERIPHERAL UPGRADE (IMS FUNDED)	SUPPORTS SYSTEM DEFINITION	$132	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7201-XX. 88-008835	AUGMENT CENTER INFORMATION SYSTEM (IMS FUNOEO)	SUPPORTS SYSTEM DEFINITION	587	
SPACE STATION	JOIMSON SPACE CENTER LOCATION 7201-XX. 88-008865	CENTER INFO NETWORK HAROWARE PURCHASE (IMS FUNDED)	SUPPORTS SYSTEM DEFINITION	558	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7210-XX. 88-007655	CSTAR COMPUTER SYSTEM	SUPPORTS ADVANCED OEVEIOPMENT	$370	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EOUIPMENT ACOUISITION OBLIGATIONS INCLIJOEO IN FY1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION. AND ADP/EAD CONTROL NUMBER	EOUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7210-XX. 88-007660	AUGMENT GUIDANCE E NAVIGATION COMPUTER CAPACITY	SUPPORTS ADVANCED OEVECOPMENT	$800	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7210-XX. 88-008975	FLIGHT DATA SYSTEM UPGRADE (IMS FUNDED)	SUPPORTS SYSTEM DEFINITION	$100	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7210-XX. 88-008980	AUGMENT AVIONICS SYSTEMS COMPUTERS	SUPPORTS UTILIZATION	$150	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7210-XX. 88-008985	POWER MANAGEMENT a DISTRIBUTION UPGRADE	SUPPORTS SYSTEM DEFINITION	$70	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7220-XX. 88-009005	UPGRADE SPACE STATION PROPULSION/POWER ANALYSIS	SUPPORTS SYSTEM OEFINITION	$160	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7222-XX. 88-009020	THERMAL SYSTEMS CAD/CAM/CAE UPGRADES (IMS FUNOEO)	SUPPORTS SYSTEM OEFINITION	$815	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7222-XX. 88-009040	AUGMENT THERMAI MFASUREMENT LABS (IMS FUNDED)	SUPPORTS SYSTEM DEFINITION	$925	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7236-XX. 88-009085	ENGINEERING COMPUTER	SUPPORTS SYSTEM DEFINI ION	$380	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7236-XX. 88-009100	SPECTRAGRAPHICS COMFUTER UPGRADE	SUPPOR S SYSTEM DEFINI ION	$350	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7244-XX. 88-007690	MANIUPLATOR DEVELOPMENT FACILITY REMOTE SYSTEM	SUPPORTS ADVANCED DEVELOPMENT	$1,500	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7244-XX. 88-009110	AUGMENT ENGINEERING E OFFICE AUTOMATION SYSTEMS	SUPPORTS SYSTEM DEFINITION	$638	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACOUISITION OBLIGATIONS INCLUDED IN FY1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION. AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7248-XX. 88-009135	MISC HARDWARE & NEW SPACE STATION SUPPORT HOST	SUPPORTS SYSTEM DEFINITION	$100	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7257-XX. 88-009140	CLASS VI HARDWARE LEASE (IMS FUNDEO)	SUPPORTS SYSTEM DEFINITION	$962	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7257-XX. 88-009145	CLASS VI COMPUTER (IMS FUNDEO)	SUPPfIRTS SYSTEM DEFINITION	$9,365	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7257-XX. 88-009150	DISPLAY UPGRADES	SUPPORTS SYSTEM DEFINITION	$240	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7257-XX. 88-009155	AUGMENT ARTIFICIAL INTELLIGENCE COMPUTERS	SUPPORTS SYSTEM DEFINITION	$ 195	
SPACE STATION	JOIINSON SPACE CENTER LOCATION 7257-XX. 88-009165	CYBER 5 YEAR LEASE/ PURCHASE	SUPPORTS SYSTEM DEFINITION	$399	
SPACE STATION	JOIINSON SPACE CENTER LOCATION 7257-XX. 88-009170	AUGMENT ROBOTICS & AUTOMATION INTEGRATION LAB	SUPPORTS SYSTEM DEFINITION	$584	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7263-XX. 88-009200	DEC VAX 11/750 HARDWARE (IMS FUNOEO)	SUPPORTS SYSTEM DEFINITION	$100	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7263-XX. 88-009205	AUGMENT NETWORK/ TERMINALS/COMM'TIONS (IMS FUNDED)	SUPPORTS SYSTEM DEFINITION	$315	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7265-XX. 88-009220	PERIPHERAL UPGRADES (IMS FUNDEO)	SUPPORTS SVSTEM DEFINITION	$350	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7283-XX. 88-007780	TECHNICAL MANAGEMENT INFORMATION SYSTEM, PHASE 2	SUPPORTS PROGRAM MANAGEMENT/INTEGRATION	$13,400	

NATIONAL AERONAUTICS AND SPACE AOMINISTRATION

SUMMARV OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLIJOEO IN FY1988 BUDGET

PROGRAM RUDGET LINE I EM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7283-XX. 88-009350	CONTINUE TTECH. MGI INFO. SVS.	SUPPORTS PROGRAM MANAGEMENT/INTEGRATION	$550	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7283-XX. 88-009355	SPACE STATION PHASE 1	SUPPORTS PROGRAM MANAGEMENT/INTEGRATION	$350	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7285-XX. 88-007785	ONROARO COMPUTER & INTFRFACES	SUPPORTS ADVANCED DEVELOPMENT	$3,000	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7285-XX. 88-007835	SOFTWARE SUPPORT ENVIRONMENT MAINFRAME	SUPPORTS PROGRAM MANAGEMENT/INTEGRATION	S4.621	
SPACE STATION	JOHNSON SPACE CENTER LOCATION 7285-XX. 88-009365	SOFTWARE SUPPORT ENVIRONMENT WORKTATIONS	SUPPORTS PROGRAM MANAGEMENT/INTEGRATION	s459	
SPACE STATION	KENNEOY SPACE CENTER LOCATION 7602-00. 88-009445	COMPUTER AIDED DEV/ COMPUTER AIDED ENG-DEVELOPMENT	SUPPORTS PROGRAU MANAGEMENT/INTEGRATION	S1.641	
SPACF STATION	KENNEDY SPACE CENTER LOCATION 7602-00, 88-009470	GOMS DEVELOPMENT	SUPPORTS OPERATIONAL READINESS	$31,737	
SPACE STATION	KENNEDY SPACE CENTER LOCATION 7602-00. 88-009715	SOFTWARE SUPPORT ENVIRONMENT SUPPORT - DEVELOPMENT	SUPPORTS OPERATIONAL READINESS	$8,224	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER, LOCATION 6201-01, 88-006870	ENGINEERING ANALYSIS & DATA SYSTEM	SUPPORTS RESEARCH AND TEST OPERATIONS.	$12,000	
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER, LOCATION 6202-01, 88-006960	UNISERVO SUBSYSTEM REPLACEMENT	SUPPORTS RESEARCH AND TEST OPERATIONS, AND FLIGHT HARDWARE.	$342	
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER, LOCATION 6206-00, 88-007080	INTERACT, GRAPHICS DESIGN SYS CENTRL SYS REQUIREMENT	SUPPORTS RESEARCH AND TEST OPERATIONS	$525	
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER, LOCATION 6206-CU, 88-007065	INTERACTIVE GRAPHICS DESIGN SYS MODIF BLDG 4487	SUPPORTS RESEARCH AND TEST OPERATIONS.	$599	
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER, LOCATION 6207-XX, 88-007095	INTERACTIVE GRAPHICS DESIGN SYSTEM, BLDG 4610	SUPPORTS RESEARCH AND TEST OPERATIONS	$118	
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER, LOCATION 6208-45, 88-007105	INTERACTIVE GRAPHICS DESIGN SYS WODIF. BLDG	SUPPORTS RESEARCH AND TEST OPERATIONS, AND PERFORMANCE AUGMENTATION	$480	
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER:-LOCATION 6209-GD, 88-007125	INTERACTIVE GRAPHICS DESIGN SYSTEM MODIF BLDG 4610	SUPPORTS RESEARCH AND TEST OPERATIONS	$293	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER, LOCATION 6209-XX, 88-DO7140	TETHERED SATELLITE SIMULATOR	SUPPORTS TETHERED SATELLITE SYSTEM (TSS)	$400	
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER, LOCATION 6210-GD, 88-007150	INTERACTIVE GRAPHICS DESIGN SYS MODIF.	SUPPORTS RESEARCH AND TEST OPERATIONS	$845	
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER, LOCATION 6213-XX, 88-007175	INTERACTIVE GRAPHICS DESIGN SYS BLDG 4712	SUPPORTS RESEARCH AND TEST OPERATIONS	$238	
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER O&C BLDG, 76-88-02	VIDEO SWITCHER	PROVIDES RAPID SWITCHING CAPABILITY FOR PAYLOAD REQUIREMENTS	$1,658	
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER LOCATION 7601-P3, 88-009605	COMPUTER AIDED ENGINEERING AMENDMENT 4	SUPPORTS LAUNCH SYSTEMS OPERATIONS	$135	
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	NATIONAL SPACE TECH LABS, LOCATION 6405-00 88-007370	ADP OFFICE AUTOMATION (WORKSTATIONS)	SUPPORTS OPERATIONS SUPPORT	$399	
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	NATIONAL SPACE TECH LABS, LOCATION 6405-52 88-007380	CAD/D SYSTEM	SUPPORT OPERATIONS SUPPORT	$300	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	NATIONAL SPACE TECH LABS, LOCATION 6405-52 88-007385	IBM 4341 COMPUTER AUGMENT	SUPPORTS OPERATIONS SUPPORT	$90	
SPACE TRANSPORTATION CAPABILITY DEVELOPMENT	NATIONAL SPACE TECH LABS. LOCATION 6406-00, 88-007245	NROSS COMPUTER HARDWARE	SUPPORT OPERATIONS SUPPORT	$4,300	

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
PHYSICS AND ASTRONOMY	AMES RESEARCH CENTER DRYDEN FLIGHT RESEARCH FACILITY, 21-88-06	DC-8 AIRCRAFT	MULTI-JET TRANSPORT AIRCRAFT WITH REQUIRED UPGRADINGS FOR R&D INVESTIGATIONS	$14,000	
PHYSICS AND ASTRONOMY	AMES RESEARCH CENTER DRYDEN FLIGHT RESEARCH FACILITY, 21-88-07	ER-2 AIRCRAFT	SINGLE JET HIGH-ALTITUDE AIRCRAFT WITH INSTRUMENT PLATFORM FOR R&D OBSERVATIONS	$7,000	
PHYSICS AND ASTRONOMY	AMES RESEARCH CENTER LOCATION 21VO-74, 88-003005	SYSTEM REPLACEMENT OMMADA	SUPPORTS AIRBORNE RESEARCH	$160	
PHYSICS AND ASTRONOMY	GODDARO SPACE FLIGHT CENTER. LOCATION 5103-CA. 88-005740	COBE INTEGRATION & TEST SYSTEM	SUPPORTS COSMIC BACKGROUND EXPLORER (COBF)	$35	
PLANETARY EXPLORATION	JET PROPULSION LABORATORY, LOCATION 5506-SS, 88-006390	NOT SELECTED: MARS OBSERVER GROUND DATA PROC	SUPPORTS MISSION OPERATIONS 6 OATA ANALVSIS	$1,538	
PLANETARY EXPLORATION	JET PROPULSION LABORATORY, LOCATION 5506-SS. 88-006400	NOT SELECTED: MAGELLAN GROUND DATA PROCESSING	SUPPORTS MISSION OPERATIONS 6 OATA ANALVS1S	$2,255	
PLANETARY EXPLORATION	JET PROPULSION LABORATORY, LOCATION 5506-SS. 88-006405	NOT SELECTED SPACE FLI OPS CENTER GROUND OATA SYS	SUPPORTS MISSION OPERATIONS 6 DATA ANALYSIS	$2,826	
PLANETARY EXPLORATION	JET PROPULSION LABORATORY. LOCATION 5507-IP. 88-006395	COMPUTER & IM PROC HW	SUPPORTS MISSION OPERATIONS 6 DATA ANALVS IS	$578	
LIFE SCIENCES	AMES RESEARCH CENTER LOCATION 21H1-85, 88-000890	COMM MONITOR & GATEWAY FXPANSION EDN233	SUPPORTS LIFE SCIENCES SR&T	$710	

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE APPLICATIONS	GOOOARO SPACE FLIGHT CENTER, LOCATION 5101 AA. 88-004945	SCIENCE COMPUTING FACILITY	SUPPORTS DATA SYSTEMS.	$279	
SPACE APPLICATIONS	GOOOARO SPACE FIIGHT CENTER, LOCATION 5101-AA. 88-004950	SCIENCE COMPUTING FACILITY	SUPPORTS DATA SYSTEMS.	$317	
SPACE APPLICATIONS	GODOARD SPACE FLIGHT CENTER. LOCATION 5101-AB. 88-005040	NATIONAL SPACE SCIFNCE DATA CENTER	SUPPORTS DATA SYSTEMS.	$996	
SPACE APPLICATIONS	GDDOARO SPACE FLIGHT CENTER. LOCATION 5101-AM. 88-005235	VECTOR PROCESSING FACILITY	SUPPORTS DATA SYSTEMS.	$1,085	
SPACE APPLICATIONS	GOODARO SPACE FLIGHT CENIER. LOCATION 5101-AM. 88-005240	VECTOR PROCESSING FACILITY	SUPPORTS DATA SYSTEMS.	$1.198	
SPACF APPLICATIONS	JET PROPULSION LARORATORY. LOCATION 5505-MC. 88-006280	PROPOSED IBM 3090 CPU PURCHASE	SUPPORTS APPL SYSTEMS ANALYSES AND STUDIES.	$378	
SPACE APPLICATIONS	JET PROPULSION LABORATORY. LOCATION 5505-MC. 08-006285	2ND PROPOSED 1100/91 CPU PURCHASE	SUPPORTS APPL SYSTEMS ANALYSES AND STUDIES.	$472	
SPACE APPLICATIONS	JET PROPULSION LABORAIORY, LOCATION 5505 MC. 88-006290	1ST PROPOSED 1100/91 CPU PURCHASE	SUPPORTS APPL SYSTEMS ANALYSES AND STUOIES.	$530	
SPACE APPLICATIONS	JET PROPULSION LABORATORY. LOCATION 5507-OD. 88 006350	1 DEQ VAX 11/785 & 5 NOT SELECTED	SUPPORTS SCATTEROMETER	$1.538	
SPACE APPLICATIONS	JET PROPULSJON LABORATORY, LOCATION 5508-IG, 88-006310	3 COMPUTERVISION SYSTEMS	SUPPORTS APPL SYSTEMS ANALYSES AND STUOIES.	$348	

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
AERONAUTICAL RESEARCH AND TECHNOLOGY	AMES RESEARCH CENTER BLDG. 258, 21-84-03	NUMERICAL AERODYNAMIC SIMULATION PROCESSING SYSTEM NETWORK	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	$17,259	
AERONAUTICAL RESEARCH AND TECHNOLOGY	AMES RESEARCH CENTER BLDG. N-211, 21-85-04	B-200 SUPER KING AIR AIRCRAFT	PROVIDES INFLIGHT MONITORING OF RESEARCH AIRCRAFT OPERATIONS AND RELATED LOGISTICS SUPPORT FOR RESEARCH PROGRAMS	$413	
AERONAUTICAL RESEARCH AND TECHNOLOGY	AMES RESEARCH CENTER BLDG. N-243, 21-87-04	SIMULATION COMPUTER SYSTEM REPLACEMENT	UPGRADE SIMULATION COMPUTATIONAL CAPABILITIES TO SUPPORT ONGOING AND FUTURE PROGRAMS, REPLACING OBSOLETE EQUIPMENT	$1,700	
AERONAUTICAL RESEARCH AND TECHNOLOGY	AMES RESEARCH CENTER BLDG. N-233, 21-87-05	LAYERED, INTERACTIVE FRONT-END COMPUTER SYSTEM	INTEGRATES SCIENTIFIC PROGRAMMING ENVIRONMENT PROVIDED BY THE CENTRAL COMPUTER FACILITY, PROVIDING PROCESSING SUPPORT FOR WORK STATIONS, INTERACTIVE PASS-THROUGH TO SUPERCOMPUTERS, AND OTHER INTERACTIVE CAPABILITIES	$500	

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
AERONAUTICAL RESEARCH AND TECHNOLOGY	AMES RESEARCH CENTER BLDG. 257, 21-87-06	AIRCRAFT SYSTEM MODELING AND CONTROL/ADVANCED CONCEPTS SIMULATOR	REPLACES AIRCRAFT SYSTEMS MODELING CONTROL COMPUTER USED TO ORIVE THE ADVANCED CONCEPTS FLIGHT SIMULATOR, TO PROVIDE INCREASED CAPACITY AND RESPONSE TIME TO PILOT INPUTS AND SIMULATED EXTERNAL EVENTS FOR BETTER SIMULATION OF A REAL-TIME FLIGHT ENVIRONMENT	$140	
AERONAUTICAL RESEARCH AND TECHNOLOGY	AMES RESEARCH CENTER 21-88-01	DIGITAL TELECOMMUNICATIONS SYSTEMS	REPLACES CURRENT CENTREX TELEPHONE SYSTEM AND PROVIDES DATA SWITCHING NETWORK CAPABILITY. THE SYSTEM ALSO PROVIDES NEW AND ENHANCED VOICE AND DATA COMMUNICATIONS FEATURES WITH FLEXIBLE LOCAL CENTRAL CONTROL	$4,900	
AERONAUTICAL RESEARCH AND TECHNOLOGY	AMES RESEARCH CENTER 40X80 FOOT WIND TUNNEL HIGH BAY (BLDG. N-221), 21-88-02	LARGE ROTOR TEST APPARATUS	ALLOWS THE TESTING OF LARGE ROTOR SYSTEMS FOR TECHNOLOGY DEVELOPMENT OF ROTORCRAFT IN THE AREAS OF IMPROVED AERODYNAMIC PERFORMANCE, LOW NOISE AND VIBRATION, AND ENHANCED STABILITY	$605	

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
AERONAUTICAL RESEARCH AND TECHNOLOGY	AMES RESEARCH CENTER DRYDEN INTEGRATED TEST FACILITY, 21-88-03	INTEGRATED TEST FACILITY TESTING AND INTERFACE EQUIPMENT	PROVIDES THE ABILITY TO PERFORM COMPLETE INTEGRATED SYSTEM TESTING OF ADVANCED RESEARCH AIRCRAFT. THE EQUIPMENT WILL SUPPORT THE CRUCIAL OEVELOPMENTAL PHASE OF A PROGRAM, PRIOR TO FIRST FLIGHT, AS WELL AS PROVIDE SUPPORT TO SYSTEMS TESTING DURING THE FLIGHT TEST PROGRAM, THEREBY MINIMIZING FLIGHT TEST RISK.	$1,350	
AERONAUTICAL RESEARCH AND TECHNOLOGY	AMES RESEARCH CENTER BLDG. N-221, 21-88-04	CENTRAL PROCESSING UNIT UPGRADE	PROVIDES EXPANDED CAPABILITY TO MEET RESEARCH DEMANDS IN THE NATIONAL FULL-SCALE AERODYNAMICS COMPLEX.	$260	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1299, 23-87-018925	COMPUTER-AIDED DESIGN/ ENGINEERING CAPABILITY FOR ELECTRONIC SYSTEMS	PROVIDES FOR ELECTRONIC DESIGN/INSTRUMENTATION IN SUPPORT OF OVER 30 PROJECTS IN AIRCRAFT FLIGHT, SPACE-FLIGHT, AND AERODYNAMIC RESEARCH	$228	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1268, 23-87-02	MID-RANGE COMPUTERS	UPGRADES 6 MID-RANGE PROCESSORS TO REPLACE OBSOLETE EQUIPMENT AND TO PROVIDE A MODEST IMPROVE-MENT IN COMPUTING POWER TO ACCOMMODATE RESEARCH REQUIRE-MENTS	$3,000	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1212B, 87-008870 23-87-03	7X10-FT. HIGH-SPEED TUNNEL OATA SYSTEM	UPGRADES CURRENT SYSTEM TO SUPPORT RESEARCH DEMANDS	$600	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1220, 23-87-04	AVIONICS INTEGRATION RESEARCH LABORATORY	UPGRADES EXISTING SYSTEM TO PROVIDE ADDITIONAL STORAGE CAPACITY	$180	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1251, 23-87-08	UNITARY PLAN WIND TUNNEL DATA SYSTEM	UPGRADES CURRENT SYSTEM TO SUPPORT RESEARCH DEMANDS	$110	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1148, 23-87-10	STRUCTURES RESEARCH LABORATORY DATA SYSTEM	REPLACES CURRENT SYSTEM TO PROVIDE EXPANDED CAPABILITIES TO MEET RESEARCH DEMANDS	$87	

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1265, 23-87-008925	8-FT. HIGH-TEMPERATURE STRUCTURES TUNNEL DATA SYSTEM	UPGRADES CURRENT SYSTEM TO SUPPORT RESEARCH DEMANDS	$550	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1268, 23-88-01	REAL-TIME SIMULATION SYSTEM	PROVIDES ADVANCED FIBER OPTIC DIGITAL NETWORK AND SWITCHING SYSTEM TO REPLACE ANTIQUATED SIMULATION COMMUNICATION SYSTEM LINKING SIMULATOR COCKPITS WITH HOST COMPUTERS	$260	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1192C, D, E COMPLEX 23-88-02	SUPERCOMPUTER WORKSTATION SUBSYSTEM	PROVIDES MODERN WORKSTATIONS TO SUPPORT COMPUTATIONAL FLUID DYNAMICS TECHNOLOGY DEVELOPMENT	$800	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 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, SUPERMANEUVERABLE AIRCRAFT, AEROSPACE PLANE, AND SPACE ROBOTICS APPLICATION	$2,300	

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1268A, BLDG. 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 SIMULATOR RESEARCH EFFORTS	$450	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1146, 23-88-05	16-FT. TRANSONIC TUNNEL DATA AND CONTROL SYSTEM	UPGRADES CURRENT SYSTEM TO SUPPORT RESEARCH DEMANDS	$10	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1268. 23-88-06	MASS STORAGE	AUGMENTS EXISTING EQUIPMENT IN CENTRAL SCIENTIFIC COMPUTER COMPLEX WITH NEW TECHNOLOGY TO MEET INCREASED ARCHIVAL REQUIREMENTS	$200	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1148, 23-88-07	ELECTRON OPTICAL SURFACE ANALYSIS EQUIPMENT	PROVIDES CAPABILITY FOR QUANTITATIVE CHEMICAL ANALYSIS OF THIN SECTIONS OR FILMS ON STRUCTURAL MATERIAL SURFACES REQUIRED FOR FUTURE AEROSPACE VEHICLE STRUCTURES	$300	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LANGLEY 'RESEARCH CENTER BLDG. 1268, 23-88-08	SUPERCOMPUTER AUGMENTATION	AUGMENTS CAPABILITY THROUGH ACQUISITION AND INTEGRATION OF A NEW CENTRAL PROCESSING UNIT TO SUPPORT PROJECTED RESEARCH REQUIREMENTS IN SUCH AREAS AS COMPUTATIONAL FLUID DYNAMICS, STRUCTURES, AND MATERIALS	$4,000	

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER BLDG. 142, 22-84-03	TRADAR III SYSTEM IMPLEMENTATION	REPLACES OBSOLETE TRANSIENT DATA RECORDING HARDWARE AND PROVIDES A CENTRAL SYSTEM WITH 200-CHANNEL CAPACITY	$750	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER BLDG. 142, 22-88-01	CLUSTER CENTRAL PROCESSING UNIT	EXPANDS CAPABILITY TO MEET INCREASED RESEARCH DEMANDS	$700	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER BLDG. 142, 22-88-02	ESCORT III DATA LINKING	AUGMENTS SYSTEM CAPABILITY BY IMPROVING SYSTEM USER RESPONSE TIME FOR INTER-COMMUNICATION OF ESCORT III COMPUTERS	$300	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER BLDG. 142, 22-88-03	MASS STORAGE DEVICE	PROVIDES FOR INTEGRATED MASS STORAGE FACILITY AND INCREASED CAPACITY TO MEET RESEARCH DEMANDS	$500	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER BLDG. 142, 22-88-04	CRAY XMP HARDWARE	PROVIDES FOR CONTINUED LEASE OF CRAY HARDWARE TO SUPPORT MATHEMATICAL ANALYSIS IN AERONAUTICS	$3,665	

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

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AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER BLDG. 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	$3,000	
AERONAUTICAL RESEARCH AND TECHNOLOGY	LEWIS RESEARCH CENTER BLDG. 142. 22-88-06	NUCLEAR MAGNETIC RESONANCE SPECTROMETER	PROVIDES SUPPORT FOR POLYMER RESEARCH WITH THE CAPABILITY OF GENERATING REQUIRED HIGH-FREQUENCY NUCLEAR MAGNETIC RESONANCE SPECTROMETRY	$400	

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1232, 23-88-09	SECURE COMPUTER-AIDED DESIGN FACILITY	PROVIDES EQUIPMENT, PERIPHERALS AND SOFTWARE IN AN ELECTRONICALLY AND ACOUSTICALLY SECURE ENVIRONMENT TO SUPPORT MULTIDISCIPLINARY ADVANCED TRANSPORTATION CONCEPTUAL DESIGN PROGRAMS	$200	
SPACE RESEARCH AND TECHNOLOGY	LANGLEY RESEARCH CENTER BLDG. 1265, 23-88-10	MINICOMPUTER HOST SYSTEM FOR AEROTHERMAL LOADS COMPLEX	PROVIDES FOR A LOCAL COMPUTER SYSTEM TO INTERFACE WITH DATA ACQUISITION SYSTEMS OF VARIOUS HIGH-TEMPERATURE RESEARCH AND WIND TUNNEL FACILITIES TO ENABLE MORE RAPID DATA ANALYSIS TO MEET INCREASED DEMANDS	$557	
SAFETY, RELIABILITY, AND QUALITY ASSURANCE	LANGLEY RESEARCH CENTER BLDG. 1230, 23-88-11	NONDESTRUCTIVE EVALUATION (NDE) EQUIPMENT	DEVELOPS REAL ACCEPT/REJECT CRITERIA FOR AEROSPACE COMPONENTS	$350	

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLIJDED IN FY1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION. AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	JOHNSON SPACE CENTER, LOCATION 7203-XX, 88-007645	MCC UPGRADE-NAS 9-17551 AIR FORCE PROJECT	SUPPORTS ORBITER. (REIMB.)	$943	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	JOHNSON SPACE CENTER. LOCATION 7203-XX. 88-007650	MISSION CONTROL CENTER UPGRADE	SUPPORTS LAUNCH AND MISSION SUPPORT.	$2,290	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	JOHNSON SPACE CENTER, LOCATION 7208-XX. 88-008950	SHUTTLE MISSION SIMULATOR COMPUTER LEASE	SUPPORTS LAUNCH AND MISSION SUPPORT.	$3.186	
SPACE SHUTTLE PRODUCTION AND CAPABILITV DEVELOPMENT	JOHNSON SPACE CENTER, LOCATION 7208-XX, 88-008955	REPLACE SHUTTLE MISSION SIMULATOR COMPIJTERS	SUPPORTS LAUNCH AND MISSION SUPPORT.	$2.917	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	JOHNSON SPACE CENTER. LOCATION 7210-XX, 88-007665	AUGMENT INERTIAL SYSTEMS CAB	SUPPORTS ORBITER.	$220	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	JOHNSON SPACE CENTER, LOCATION 7234-XX. 88-009050	AUGMENT & REPLACE EXISTING PERIPHERALS	SUPPORTS LAUNCH AND MISSION SUPPORT.	$129	
SPACE SHUTTLE PRODUCTION AND CAPABILITV DEVELOPMENT	JOHNSON SPACE CENTER. LOCATION 7278-XX. 88-007770	SOFTWARE DEVELOPMENT FACILITY PERIPHERALS	SUPPORTS ORBITER.	$500	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	JOHNSON SPACE CENTER BLDGS. 30 AND 35, 72-87-05	RELIABILITY REPLACEMENT	REPLACES MCC AND SMS EQUIPMENT THAT HAS REACHED THE END OF ITS LIFE CYCLE	$17.751	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER, LOCATION 7602-00, 88-009490	CHECKOUT CONT. & MON SUBSVS II(CCMS) H/W UPGR	SUPPORTS LAUNCH 'SITE EWIPMENT.	$1,000	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEOV SPACE CENTER, LOCATION 7602-00, 88-009495	CHECKOUT CONT. & MON SUBSVS. II(CCMS) SURVIVAL	SUPPORTS LAUNCH SITE EQUIPMENT.	$3,643	
SPACE SHUTTLE PROOUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER, LOCATION 7602-00, 88-009500	USAF CENTRAL DATA SUBSVS. (COS) COMPUTER SYS (VLS)	SUPPORTS ORBITER. (REIMB.)	$8,790	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER, LOCATION 7602-00, 88-009510	LAUNCH PROCESSING SYSTEM(LPS) LAB EOUIP	SUPPORTS LAUNCH SITE EQUIPMENT.	S1.243	

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SUMMARY OF MAJOR EQUIPMENT CQUISI1 ON OBLIGA IONS INCLUOED IN FY1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION. AND ADP/EAD CONTROL NUMBER	EOUIPMENT OESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	NASA HEADOUARTERS. LOCATION 1001-00, 88-000610	PURCHASE OF ADP HARDWARE	SUPPORTS LAUNCH AND MISSION SUPPORT.	$250	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER. LOCATION 6202-01. 88-006970	EXTERNAL TANK-UTS TERMINAL AUG PURCHASE	SUPPORTS EXTERNAL TANK.	$17	
SPACE SHUTTLE PRODUCTION AND CAPABILITY OEVELOPMENT	MARSHALL SPACE FLIGHT CENTER. LOCATION 6202-01, 88-006975	EXTERN TANK DATA PATH INC TRANSACTOR TERM AUG PUR	SUPPORTS EXTERNAL TANK.	$500	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER. LOCATION 6202-01. 88-006985	DCP/40 PURCHASE	SUPPORTS EXTERNAL TANK.	$302	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER. LOCATION 6202-01, 88-006995	FR 80 REPLACEMENT	SUPPORTS EX ERNAL TANK.	$648	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER. LOCATION 6202-01, 88-007005	RFMOTE CONCENTRATOR PURCHASE	SUPPORTS EX ERNAL TANK.	$275	
SPACE SHUTTLE PRODUCTION AND CAPABILITY OEVELOPMENT	MARSHALL SPACE FLIGHT CENTER, LOCATION 6206-OB. 88-007070	AOIO FLOATING POINT EXPANSION FOR HDWR SIMUL LAB	SUPPORTS SPACE SHUTTLE MAIN ENGINE (SSME).	$250	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	MARSHALL SPACE FIIGHT CENTER. LOCATION 6206-XX. 88-007075	CI 5000 ANALOG EQUIPMENT REPLACEMENT	SUPPORTS SPACE SHUTTLE MAIN ENGINE (SSME).	$70	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER. LOCAIION 6208-46. 88-007110	UPGRADE VAX 8600 FOR MATERIALS DATA BASE	SUPPORTS SOLID ROCKET BOOSTER. SPACE SHUTTLE MAIN ENGINE (SSME). AND FLIGHT HARDWARE.	$950	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER. LOCATION 6208-73. 88-007115	EXPANSION OF VAX 11/780 TO VAX 8600	SUPPORTS SOLID ROCKET BOOSTER.	$100	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	MARSHALL SPACE FLIGHT CENTER. LOCATION 6213-00. 88-007180	HIGH-SPEED DATA TRANSFER SYSTEM	SUPPORTS SPACE SHUTTLE MAIN ENGINE (SSME).	$650	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER LOCATION 7602-D4, 88-009525	KENNEDY AVIONICS TEST SET	SUPPORTS LAUNCH SITE EQUIPMENT	$414	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER LOCATION 7602-M1, 88-009475	USAF MMC CK. CTL. MON. SUBSYS. (CCMS) OPS (VLS)	SUPPORTS ORBITER (REIMB.)	$1,000	
SPACE SHUTTLE PRODUCTION AND CAPABILITY DEVELOPMENT	KENNEDY SPACE CENTER KSC LANDING SITE, 76-88-01	MOBILE PRECISION LASER TRACKING SYSTEM (PLTS)	CERTIFIES SHUTTLE MICROWAVE SCANNING BEAM LANDING SYSTEMS	$1,785	

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER BLDG. 16, 72-88-01	MULTIFUNCTIONAL ELECTRONIC SCENE GENERATOR VISUAL SYSTEM	PROVIDES VISUAL CUES TO SIMULATE PROMTS INTERACTIVE MOCKUP	$1,750	
SPACE TRANSPORTATION OPERATIONS	KENNEDY SPACE CENTER CCAFS, 76-86-01	AIRCRAFT REFUELER NOMINAL 5,000 GALLON	TRANSPORTS AVIATION TURBINE FUELS	$350	
SPACE TRANSPORTATION OPERATIONS	KENNEDY SPACE CENTER CLS, 76-87-01	RECHARGER	REPLACES A COSMODYNE RECHARGER WITH MORE CAPABILITY	$375	
SPACE TRANSPORTATION OPERATIONS	KENNEDY SPACE CENTER LOCATION 7601-P3, 88-009850	COMPUTER AIDED ENGINEERING/ COMPUTER AIDED DESIGN	SUPPORTS LAUNCH AND LANDING OPERATIONS	$552	
SPACE TRANSPORTATION OPERATIONS	KENNEDY SPACE CENTER LOCATION 7601-01, 88-009450	OFFICE AUTOMATION	SUPPORTS LAUNCH AND LANDING OPERATIONS, AND OPERATIONAL READINESS	$1.240	
SPACE TRANSPORTATION OPERATIONS	KENNEDY SPACE CENTER LOCATION 7602-00, 88-009540	INTELLIGENT WORKSTATIONS LOCKHEED SP OPNS CONTRACT	SUPPORTS LAUNCH AND LANDING OPERATIONS	$1,500	
SPACE TRANSPORTATION OPERATIONS	KENNEDY SPACE CENTER LOCATION 7603-A3, 88-009580	ARTEMIS AMENDMENT 5	SUPPORTS LAUNCH AND LANDING OPERATIONS	$230	
SPACE TRANSPORTATION OPERATIONS	KENNEDY SPACE CENTER LOCATION 7601-01. 88-009590	OFFICE AUTOMATION	SUPPORTS SPACELAB OPERATIONS	$113	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7234-XX, 88-009075	ENHANCE DATA ACQUISITION SYS CAD/CAM (IMS FUNDED)	SUPPORTS FLIGHT OPERATIONS	$290	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7258-XX, 88-007720	AUGMENT DATA ACQUISITION AND CONTROL SYS (IMS FUNDED)	SUPPORTS FLIGHT OPERATIONS	$658	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7266-XX, 88-007735	MISSION OPS DIRECTORATE INFORMATION SYS PURCHASE	SUPPORTS FLIGHT OPERATIONS	$700	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7266-XX 88-007740	UPGRADE AND EXPAND STARNET SYSTEM	SUPPORTS FLIGHT OPERATIONS	$225	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7266-XX, 88-009255	VAX TECHNOLOGY APPLICATION EQUIPMENT	SUPPORTS FLIGHT OPERATIONS	$465	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER LOCATION 7274-XX 88-009275	SPERRY 1100 LEASE	SUPPORTS FLIGHT OPERATIONS	$687	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER CENTERWIDE AND ELLINGTON FIELD, 72-87-02	CENTER TELECOMMUNICATIONS SYSTEM	REPLACES OUTDATED TELEPHONE SYSTEM	$5.400	

NATIONAL AERONAUTICS AND SPACE AOMINISTRATION

SUMMARY OF MAJOR EOUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EOUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATEO FACILITIES PROJECT
SPACE TRANSPORTATION OPERATIONS	MARSHALL SPACE FLIGHT CENTER, LOCATION 6201-27. 88-006905	SHIJTTLE NODE AUGMENTATION	SUPPORTS FLIGHT HARDWARE	$300	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER. LOCATION 7201-XX. 88-007795	LEASE TO OWN SPERRV COMPUTERS (IMS FUNDED)	SUPPORTS FLIGHT OPERATIONS.	$1.772	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER. LOCATION 7201-XX, 88-007800	DATA COMM. LINES	SUPPORTS FLIGHT OPERATIONS.	$69	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER, LOCATION 7201-XX. 88-007805	SPERRV EOUIPMENT LEASE	SUPPORTS FLIGHT OPERATIONS.	$901	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER, LOCATION 7201-XX. 88-008780	CENTER INFORMATION SYSTEM (IMS FUNDED)	SUPPORTS FLIGHT OPERATIONS.	$2,278	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER. LOCATION 7201-XX. 88-008810	CENTER INFORMATION NETWORK HARDWARE	SUPPORTS FLIGHT OPERATIONS.	$128	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER. LOCATION 7201-XX. 88-008820	IBM PERIPHERAL UPGRADE (IMS FUNOEO)	SUPPORTS FLIGHT OPERATIONS.	S295	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER. LOCATION 7201-XX. 88-008855	AUGMENT CENTER INFORMATION SYSTEM (IMS FUNDED)	SUPPORTS FLIGHT OPERATIONS.	$193	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER. LOCATION 7208-XX. 88-008945	SHUTTLE MISSION SIMULATOR HARDWARE LEASE	SUPPORTS FLIGHT OPERATIONS.	$2,573	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER. LOCATION 7234-XX. 88-009065	REPLACE DATA ACOUISISTION SVS BLDG 33 (IMS FUNOEO)	SUPPORTS FLIGHT HARDWARE.	$75	
SPACE TRANSPORTATION OPERATIONS	JOHNSON SPACE CENTER, LOCATION 7234-XX. 88-009070	REPLACE DATA ACOUISITION SVS BLDC 32 !IMS FUNDED)	SUPPORTS FLIGHT OPERATIONS.	$865	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 OBLIGATIONS ($ IN THOUSANDS)	COF RELATED FACILITIES PROJECT
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	AMES RESEARCH FACILITY, DRYDEN FLIGHT RESEARCH FACILITY, 21-88-05	TELEMETRY/RADAR ACQUISITION AND PROCESSING SYSTEM	SUPPORTS FLIGHT MISSIONS AT THE WESTERN AERONAUTICAL TEST RANGE	$800	
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEWS	GODDARD SPACE FLIGHT CENTER, BLDG. 14, 51-80-02	PROJECT OPERATIONS CONTROL CENTER	SUPPORTS MISSION CONTROL WORKLOAD	$700	
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER, BLDG. 23, 51-82-04	UNIVAC 1100/82 COMPUTER AND PERIPHERALS	SPACELAB OUTPUT PROCESSOR	$100	
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER, BLDG. 14, 51-82-06	COMMAND MANAGENENT SYSTEM	PROVIDES COMPUTING CAPABILITY FOR PROJECT OPERATIONS CONTROL CENTERS (POCC'S)	$2,700	
SPACE AND GROUND NETWORKS COMMUNICATIONS AND DATA SYSTEMS	GODOARD SPACE FLIGHT CENTER, BLOG. 14, 51-82-07	ORBIT COMPUTATION SYSTEM	PROVIDES MISSION OPERATIONS OPERATIONS ORBIT COMPUTING SUPPORT	$500	
SPACE AND GROUND NETWORKS COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER, BLDG. 23, 51-84-03	GAMMA RAY OBSERVATORY (GRO) DATA CAPTURE SYSTEM	CAPTURES SCIENCE DATA FROM THE GRO SPACECRAFT	$1,000	
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 EQUIPMEHT	FLIGHT MISSION SUPPOKT	$800	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1988 BUDGET

PROGRAM BUDGET LINE ITEM	RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER	EQUIPMENT DESCRIPTION	PROGRAMMATIC PURPOSE	FY88 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 TDM DATA CAPTURE SYSTEM	SUPPORTS COMMUNICATIONS AND DATA SYSTEMS	$1,000	
SPACE AND GROUND NETWORKS, COMMUNICATIONS AND DATA SYSTEMS	GODDARD SPACE FLIGHT CENTER, LOCATION 5104-AA, 88-005825	COMMUNICATIONS SIJITCHING SYSTEM	SUPPORTS COMMUNICATIONS AND DATA SYSTEMS	$1,350	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1988 ESTIMATES

SUMMARY OF CONSULTING SERVICES ESTIMATES

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimte
		(Thousands of Dollars)		
Research and Program Management				
Consultants Employed by NASA.....	916	500	1,000	1,000
Contractual Services.....	996	800	1,000	1,000
Subtotal.....	1,912	1,300	2,000	2,000
Research and Development				
Contractual Services.....	1,341	2,900	2,900	2,900
Total, NASA.....	3,253	4,200	4,900	4,900

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 a 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:

Research and Program Management				
Consultants Employed by NASA.....	916	500	1,000	1,000

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

problem in order to give top management the widest possible range of views before making mjor decisions. The increase from the 1987 amended budget estimate to the current estimate reflects 1986 experience and the agency's internal management studies.

	1986 Actual	1987 Amended Budget Estimate	1987 Current Estimte	1988 Budget Estimate
		(Thousands of Dollars)		
Contractual Services.....	996	800	1,000	1,000

NASA contracts with consulting services firms for studies of mnagement policies and programs in such areas as ADP, EEO, and the NASA Management Study Group (S.C. Phillips Study). The increase from the 1987 amended budget estimate to the current estimate reflects the 1986 experience and the agency's need for mnagement studies. In 1988, studies will continue to provide independent assessment and expertise.

Research and Development

Contractual Services.....	1,341	2,900	2,900	2,900

In consonance with its legislative charter, NASA seeks advice from many sources in the private sector on what would be the most productive future programs. The purpose for seeking such advice is to assure the widest review of that programmatic thrust is available. Funds are required to provide external expertise and input into organizational decisions, and evaluation of program effectiveness. In 1988, 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.

RESEARCH AND PROGRAM MANAGEMENT
FY 1988 CONGRESSIONAL BUDGET
DETAIL OF PERMANENT POSITIONS

	FY 1986	FY 1987	FY 1988
EXECUTIVE LEVEL II	1	1	1
EXECUTIVE LEVEL III	1	1	1
EXECUTIVE LEVEL V	1	1	1
SUBTOTAL	3	3	3
ES-6	45	45	45
ES-5	110	110	110
ES-4	232	232	232
ES-3	60	60	60
ES-2	20	20	20
ES-1	10	10	10
SUBTOTAL	477	477	477
GS-18	1	1	1
GS-17	1	1	1
GS-16	4	4	4
GSIGM-15	1,560	1,751	1,825
GS/GM-14	3,003	3,056	3,108
GSIGM-13	4,895	4,921	5,097
GS-12	2,756	2,712	2,813
GS-11	2,034	2,039	2,179
GS-10	305	314	315
GS-9	1,257	1,240	1,300
GS-8	298	315	317
GS-7	910	1,005	1,010
GS-6	637	637	640
GS-5	1,193	1,180	1,200
cis-4	391	389	390
GS-3	118	102	104
GS-2	33	32	37
SUBTOTAL	19,497	19,699	20,341
SPEC UNGRADED POSITIONS ESTABLISHED BY ADMINISTRATOR	8	4	4
UNGRADED	1,215	1,192	1,175
TOTAL PERMANENT POSITIONS	21,200	21,375	22,000

PERSONNEL SUMMARY

	FY 1986 ACTUAL	FY 1987 ESTIMATE	FY 1988 ESTIMATE
AVERAGE GS/GM GRADE	11.3	11.4	11.4
AVERAGE GS/GM SALARY	38,624	38,550	39,100
AVERAGE ES SALARY	68,266	63,200	65,200
AVERAGE SALARY, GRADES ESTABLISHED BY THE NASA ADMINISTRATOR	66,661	67,700	68,000
AVERAGE SALARY QF UNGRADED POSITIONS	29,184	29,690	30,250

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