NASA
National Aeronautics and
Space Administration

# Budget Estimates

FISCAL YEAR 1990

**Volume III**

**Research and Program Management**

**Special Analyses**

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FISCAL YEAR 1990 ESTIMATES

VOLUME I

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SPECIAL ANALYSES



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RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1989 ESTIMATES

GENERAL STATEMENT

The Research and Program Management appropriation funds the performance and management of research, technology and test activities at NASA installations, and the planning, management and support of contractor research and development tasks necessary to meet the Nation's ongoing objectives in aeronautical and space research. The objectives of the activities funded by the Research and Program Management appropriation are to (1) provide a civil service staff with the technical and management skills to conduct the full range of programs for which NASA is responsible, (2) provide base maintenance of facilities in support of research and development programs, and (3) provide effective and efficient technical and administrative support for the research and development programs. For 1990, an appropriation of $2,032,200,000 is requested.

During the summer of FY1988 NASA conducted an in-depth review of its manpower requirements. The results of the study indicated that based on Space Station program needs as well as Research and Technology base requirements NASA would need a significant increase to its current workforce. In discussions with the OMB relative to the results of the manpower review OMB agreed that NASA's FTE ceilings be increased in FY1989 to 23,734 and to 24,007 FY1990. Current budget levels will not allow NASA to meet OMB approved higher ceilings, thus this budget is predicated on NASA's ability to fund FTE levels of 23,150 in FY1989 and 23,846 in FY1990 including the IG. NASA remains committed to achieving OMB approved ceilings for both FY1989 and FY1990. Every possible effort will be made to secure funding so that planned programmatic activities can be realized.

The 1990 Research and Program Management appropriation request provides funding for 23,700 permanent and temporary civil service full time equivelent (FTE) at eight major installations and Headquarters. This civil service workforce is NASA's most important resource and is vital to future space and aeronautics research activities. Approximately 60% precent of the requested funding provides for the salaries and related costs of the civil service workforce. Two and one half percent is for travel, critical to manage successfully the agency's in-house and contracted programs. The remaining amount of the Research and Program Management appropriation provides support for the research, test and operational facility support, and for related goods and services necessary to operate efficiently and effectively the NASA installations and to accomplish NASA's approved missions.

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

Office of Space Flight:

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

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

Marshall Space Flight Center: Management of the Space Shuttle main engine, solid rocket booster and external tank projects; management of the Advanced Solid Rocket Motor (ASRM) and Propulsion system of the Advanced Launch System (ALS); management of the Advanced Propulsion Technology for Earth Orbit applications; management of NASA's activities on the Spacelab project; management of large automated spacecraft projects such as the Hubble Space Telescope; conduct and development of experiments in materials processing in space; and management of the Space Station habitation, logistics and laboratory modules.

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

Office of Space Science and Applications

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

Office of Aeronautics and Space Technology:

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

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

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

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

1. Personnel and Related Costs ($1,222,040.0001: Includes salaries and benefits, the government's contribution to personnel benefits for NASA permanent and temporary civil service employees (including the government's cost of the Federal Employees Retirement System (FERS) and the Civil Service Retirement System (CSRS)), and for personnel of other Government agencies detailed to NASA. In 1990, the budget provides for an additional 550 FTE. The additional FTE will provide staffing to support Space Station, development, increased Shuttle flight rates and new requirements in research and technology. This category also includes other personnel related costs, such as moving expenses (excluding the associated travel of people), recruiting and personnel investigation services provided by the Office of Personnel Management, and the training of NASA civil service employees.

2. Travel ($50.957.000): Includes the cost of transportation, per diem, and related travel expenses of civil service employees who travel for coordination and management of NASA program activities including overseas: contract management; flight mission support; meetings and technical seminars and symposia; and for permanent and temporary relocations.

3. Operation of Installation ($759.203.000): Provides a broad range of services, supplies, and equipment in support of each center's institutional activities. These are divided into three major subfunctional areas as follows:

A. Facilities Services ($305.468.0001: Includes rental of real property; the cost of maintenance, repair and related activities for facilities and equipment; custodial services; minor modifications and alterations; and utilities services.

B. Technical Services ($195,671,000): Includes the cost of general purpose automatic data processing for management activities (including development of agencywide automated systems); education and informational programs; other essential technical services.

C. Management and Operations ($258,064,000): Includes the cost of administrative communications; printing and reproduction; administrative supplies; general purpose materials and equipment; transportation of equipment and supplies (including payments to interagency motor pools); medical services and other support.

## SUMMARY OF THE BUDGET PLAN BY FUNCTION

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. Personnel and Related Costs...... | 1,084,759 | 1,131,008 | 1,171,513 | 1,222,040 |
| 11. Travel.......................... | 40,168 | 51,000 | 47,116 | 50,957 |
| III. Operation of Installation........ | 637,233 | 732,992 | 672,971 | 759,203 |
| A. Facilities Services.......... | (260,375) | (302,588) | (270,302) | (305,468) |
| B. Technical Services........... | (164,337) | (183,958) | (166,714) | (195,671) |
| C. Management and Operations.... | (212.521) | (246,446) | (235,955) | (258.064) |
| Total NASA............... | 1,762.160 | 1,915,000 | 1.891.600 | 2,032,200 |
| IG................. | (7.116) | (9.447) | (8.576) | 8,795 |

**SUMMARY OF CHANGES FROM THE 1989 BUDGET TO THE 1989 CURRENT ESTIMATE**

The 1989 Budget request of $1,915 million has been revised to $1,973.7 million to reflect additional requirements. The current R&PM plan of $1891.6 million results from the following actions:

| | |
|---|---|
| 1989 Budget Request............... | 1,915.0 |
| Pay Raises...................... | 33.8 |
| Health Benefits Increase.......... | 6.6 |
| FTS/PSCN Increase................. | 2.9 |
| DOD Transfer (ALS)................ | 6.6 |
| OMB Approved Increase FTE's....... | 10.0 |
| Agency 1989 Requirement........... | 1,974.9 |
| Required Reductions/Absorptions... | 83.3 |
| FY 1989 Program Plan............. | 1,891.6 |

The appropriation reduction of $60.0 million coupled with the full absorption of in 1989 pay raises and the added requirements in R&PM related to the transfer of ALS work from DOD, increases related to health benefits and FTS, the funding of an additional 200 FTE (approved by OMB), and the transfer of $30M from the Construction of Facilities appropriation results in a net change in 1989 of $83.3 million.

## BASIS OF THE 1990 ESTIMATE

The 1990 Budget estimate of $2,032,200,000, an increase of $140.6 million over the current 1989 R&PM plan, provides for: a civil service ceiling of 23,700 workyears (an increase of 550 FTE from 1989), the funds needed to restore 1989 reductions, the full year cost of the 1989 pay raises, funding for the second phase of the OMB required "centralized" Financical and Accounting System; continuation of a NASA Project Management Institute; a minimum level of travel to support Agency missions and programs; support service contractor effort at the anticipated wage-rates; utility usage consistent with programmatic requirements at projected rates; and supplies, materials, equipment and other minor contracts and services at anticipated price levels consistent with the increased rate of Space Shuttle Flights.

The Research and Program Management appropriation request for 1990, by functional category is summarized below.

1. Personnel and Related Costs ($1,222,040,000): The 1990 estimate for Personnel and Related Costs is $50.5 million higher than 1989. Of the increase, $12 million is for the full year cost of 1989 pay increases, $24.8 million for the compensation, benefits and supporting costs for the 550 additional FTE, and the balance, $13.7 million, is for reduced reimbursements, increased career development costs and other changes in salaries and benefits paid. The additional 550 FTE will complete the staffing requirements for STS recovery to support increased launch rates, Space Station development, and strengthen NASA's ability to meet expanded research activities.

2. Travel ($50,957,000): The vast majority of NASA program funds are spent for activity in the private sector. Travel for both programmatic and management purposes is integral to the effective and economical accomplishment of program objectives. In addition, because NASA's civil service workforce is so heavily technical (over 65 percent of NASA's permanent personnel are professional employees) travel to scientific and technical, and professional meetings, seminars and symposia is important for the interchange of

information and maintenance of their technical currency. In 1990, the growth in travel over 1989 is associated with the added 550 FTE and the expected rise in the general cost of transportation, per diem and miscellaneous travel expenses, as well as the anticipated demands of project and other management travel.

3. Operation of Installation ($759.203.000): The 1990 plan provides for anticipated changes in the price levels of support service contractor wage rates and utility rates, increases in the funding plans from reimbursable launch vehicles activities, the change in price levels for supplies, materials, and equipment, and minor changes in the levels of support provided as center requirements change and Space Shuttle flights resume.

A. Facilities Services ($305,468,000): The 1990 estimate, an increase of $35.1 million over the 1989 current estimate, covers the anticipated rate and price increases for utilities support contractor wage rates, supplies, materials, equipment and minor contractual effort, changes to support levels, principally needed to support increased Space Shuttle flights, increased civil service staff and increased Space Station activities.

B. Technical Services ($195.671.000): The $28.9 million increase in 1990 covers anticipated increased support service contractor wage-rates, the anticipated increased cost of supplies, materials, equipment and other contractual efforts, support the increased civil service staff and to fund the "centralized" Financial and Accounting System.

C. Management and Operations ($258,064,000): The $22.1 million increase in this subcategory is the result of the support for increased civil service staffing, increased costs of supplies, materials, equipment and minor contractual effort, the anticipated increases in support service contractor wage-rates, and the changes in levels of support required, driven chiefly by the increase in Space Shuttle flights.

In summary, the 1990 budget requirement of $2,032,200,000 is to provide for 23,700 full-time equivalent civil service workyears and to support the activities at eight NASA installations and Headquarters, and Space Station Level II activities in Reston, Virginia consistent with the Research and Development, Space Flight, Control and Data Communications, and Construction of Facilities program plans.

## DETAIL OF CONTENTS BY FUNCTION

### I. PERSONNEL AND RELATED COSTS

A. COMPENSATION AND BENEFITS:

1. Compensation

a. Permanent Positions: This part of Personnel and Related Costs covers the salaries of the full-time permanent civil service workforce and is the largest piece of this functional category.

b. Other Than Full-Time Permanent Positions: This category includes the salaries of NASA's non-permanent workforce. Programs such as students participating in cooperative training, summer employment, youth opportunity, and temporary clerical support are covered in that is category.

c. Reimbursable Detailees: In accordance with existing agreements, NASA reimburses the parent Federal organization for the salaries and related costs of persons detailed to NASA.

d. Overtime and Other Compensation: Overtime, holiday, post and night differential, and hazardous duty pay are included in this category. Also included are incentive awards for outstanding achievement and superior performance.

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

B. SUPPORTING COSTS:

1. Transfer of Personnel: Provided under this category are relocation costs required by law, such as the expenses of selling and buying a home, and the movement and storage of household goods.

2. Office of Personnel Management Services: The Office of Personnel Management is reimbursed for activities such as security investigations on new hires, recruitment advertising, and career-maturity surveys.

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

## 11. TRAVEL

A. Program Travel:

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

B. Scientific and Technical Development Travel

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

C. Management and Operations Travel:

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

## 111. OPERATION OF INSTALLATION

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

A. Facilities Services:

1. Rental of Real Property: Rental of real property includes the rental of building space directly by NASA or through the General Services Administration to meet offsite office, warehousing, and other requirements which cannot otherwise be provided in existing buildings at the NASA Installation. Most of the funding is required for rental of the NASA Headquarters complex of buildings in the District of Columbia, and nearby Maryland and Virginia that are either Government-owned or leased. NASA must provide rental payments to the General Services Administration in accordance with P.L. 92-313 for these facilities.

2. Maintenance and Related Activities: Maintenance and related activities include the recurring day-to-day maintenance of facilities (grounds, buildings, structures, etc.) and equipment accomplished by non-Civil Service personnel. This involves the mowing and care of grassy areas, care of trees and shrubs, elevators, cranes, pressure vessel inspections, painting and protective coatings, general buildings maintenance, and the maintenance of installed mechanical, electrical, and other systems. In addition, this item includes feasibility studies, project design, construction supervision, inspection, and other institutional facility engineering functions. Included also are any applicable costs associated with recurring facility work as well as materials, hardware, and equipment used in facility maintenance activities, whether accomplished by civil service personnel or contractors. In the cost of equipment, related maintenance and other services are reflected for office, shop, laboratory and other facilities equipment as well as administrative internal communications and television monitoring equipment.

3. Custodial Services: Custodial services include janitorial and building cleaning services, pest control, fire protection services, security services including badging and identification, lock and safe repair, trash and refuse handling, window blinds and light fixture cleaning, and laundry and dry cleaning of facility related items.

4. Utilities Services: Utilities services include the purchase of utilities such as electricity, natural gas, fuel oil, coal, steam, propane, and other fuel commodities as well as water and sewage treatment services. Also included are the related maintenance and operating costs of the utility plants and systems.

B. Technical Services:

1. Automatic Data Processing:

a. Equipment: This category provides for the lease, purchase and maintenance of general purpose data processing equipment which supports institutional operations at each installation. Excluded is equipment dedicated to specific research or operational systems which is funded from the Research and Development or the Space Flight, Control and Data Communications appropriations.

b. Operations: Operations services include programming, computer operations and related services for institutional applications including payroll, financial management, security, maintenance, personnel, logistics, and procurement records and reports.

2. Scientific and Technical Information and Educational Programs:

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

b. Education and Information Programs: The educational and informational programs provide for the documentation and dissemination of information about the Agency's programs to the general public, the educational community at the elementary and secondary levels, and the mass communications media. Assistance to the mass communications media includes the assembly and exposition of newsworthy material in support of requests in the form of press kits, news releases, television and radio information tapes and clips, and feature material.

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

C. Management and Operations

1. Administrative Communications: Included in this category are costs not dedicated to a specific program or project, and cover leased lines, long distance tolls (including FTS charges), teletype services, and local telephone service.

2. Printing and Reproduction: Included in this category are the costs for duplicating, blueprinting, microfilming, and other photographic reproductions. Also included in this category are Government Printing Office printing costs, contractual printing and the related composition and binding operations.

3. Transportation: Transportation services include the operation and maintenance of all general purpose motor vehicles used by both civil service and support contractor personnel and the operation of the NASA administrative aircraft fleet. The cost of movement of supplies and equipment by commercial carriers and payments to interagency motor pools are also in this category.

4. Installation Common Services: Installation common services include support activities at each installation such as: occupational medicine and environmental health; mail service; supply management; patent services; administrative equipment; office supplies and materials; and postage.

DISTRIBUTION OF PERMAMENT CIVIL SERVICE WORKYEARS BY INSTALLATION

| | 1988 ACTUAL | 1989 BUDGET ESTIMATE | 1989 CURRENT ESTIMATE | 1990 BUDGET ESTIMATE |
|---|---|---|---|---|
| JOHNSON SPACE CENTER......... | 3,302 | 3.460 | 3,463 | 3,605 |
| KENNEDY SPACE CENTER......... | 2,167 | 2,324 | 2,331 | 2,357 |
| MARSHALL SPACE FLIGHT CENTER. | 3,351 | 3,461 | 3,481 | 3,607 |
| STENNIS SPACE CENTER......... | 140 | 159 | 166 | 174 |
| GODDARD SPACE FLIGHT CENTER.. | 3,585 | 3,504 | 3,618 | 3,651 |
| AMES RESEARCH CENTER......... | 2,065 | 2,068 | 2,097 | 2,153 |
| LANGLEY RESEARCH CENTER...... | 2,811 | 2,812 | 2,835 | 2,888 |
| LEWIS RESEARCH CENTER........ | 2,640 | 2,646 | 2,664 | 2,743 |
| HEADOUARTERS................. | 1,320 | 1,416 | 1,403 | 1,431 |
| INSPECTOR GENERAL............ | 119 | 151 | 136 | 0 |
| SUBTOTAL, FULL-TIME PERMANENT WORKYEARS | 21,500 | 22,081 | 22,194 | 22,609 |
| OTHER THAN FULL-TIME PERMANENT WORKYEARS | 682 | 726 | 738 | 743 |
| SUBTOTAL, CEILING CONTROLLED FTE | 22,182 | 22,807 | 22,932 | 23,352 |
| SPACE STATION (RESTON, VA) | 144 | 143 | 218 | 348 |
| TOTAL, CEILING CONTROLLED FTE | 22,326 | 22,950 | 23,150 | 23,700 |

NOTE: THE INSPECTOR GENERAL'S OFFICE WAS GRANTED ITS OWN APPROPRIATION, THUS IG WORKYEARS (146) WILL NOT APPEAR IN FY 1990 TOTALS

SUMMARY OF BUDGET PLAN BY INSTALLATION
(THOUSANDS OF DOLLARS)

| | 1988 ACTUAL | 1989 BUDGET ESTIMATE | 1989 CURRENT ESTIMATE | 1990 BUDGET ESTIMATE |
|---|---|---|---|---|
| JOHNSON SPACE CENTER......... | 281,951 | 301,526 | 301,755 | 323,171 |
| KENNEDY SPACE CENTER......... | 241,856 | 270,475 | 263,430 | 279,263 |
| MARSHALL SPACE FLIGHT CENTER. | 237,456 | 249,104 | 249,873 | 265,709 |
| STENNIS SPACE CENTER......... | 20,533 | 23,348 | 24,297 | 25,883 |
| GODDARD SPACE FLIGHT CENTER.. | 242,781 | 256,823 | 253,013 | 271,239 |
| AMES RESEARCH CENTER......... | 165,214 | 179,398 | 178,328 | 186,961 |
| LANGLEY RESEARCH CENTER...... | 177,940 | 185,255 | 189,149 | 201,495 |
| LEWIS RESEARCH CENTER........ | 181,902 | 191,453 | 194,200 | 207,790 |
| HEADQUARTERS................. | 205,411 | 248,171 | 228,979 | 270,689 |
| INSPECTOR GENERAL............ | 7,116 | 9,447 | 8,576 | 0 |
| TOTAL, RESEARCH AND PROGRAM MANAGEMENT | 1,762,160 | 1,915,000 | 1,891,600 | 2,032,200 |

DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM
NASA AGENCY TOTAL

| | FY 1988 ACTUAL | FY 1989 BUDGET ESTIMATE | FY 1989 CURRENT ESTIMATE | FY 1990 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION.......................... | 1,658 | 1,952 | 1,897 | 2,296 |
| SPACE FLIGHT PROGRAMS................... | 5,651 | 5,920 | 5,904 | 5,830 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 1,488 | 1,389 | 1,644 | 1,605 |
| SPACE SHUTTLE...................... | 4,163 | 4,531 | 4,260 | 4,225 |
| SPACE SCIENCE AND APPLICATIONS.......... | 3,807 | 3,720 | 3,813 | 3,866 |
| PHYSICS AND ASTRONOMY............... | 1,950 | 1,933 | 1,945 | 2,007 |
| LIFE SCIENCES...................... | 271 | 248 | 295 | 298 |
| PLANETARY EXPLORATION............... | 168 | 190 | 196 | 206 |
| SPACE APPLICATIONS.................. | 1,418 | 1,349 | 1,371 | 1,355 |
| AERONAUTICS AND SPACE TECHNOLOGY........ | 4,823 | 4,892 | 4,938 | 5,152 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 3,033 | 3,124 | 3,081 | 3,163 |
| SPACE RESEARCH AND TECHNOLOGY....... | 1,480 | 1,455 | 1,536 | 1,667 |
| TRANSATMOSPHERIC RESEARCH & TECH.... | 310 | 313 | 321 | 322 |
| COMMERCIAL PROGRAMS.................... | 141 | 150 | 156 | 154 |
| SAFETY, RELIABILITY a QUALITY ASSURANCE. | 79 | 60 | 94 | 103 |
| TRACKING AND DATA PROGRAMS.............. | 674 | 684 | 678 | 713 |
| SUBTOTAL DIRECT................... | 16,833 | 17,378 | 17,480 | 18,114 |
| CENTER MANAGEMENT AND OPERATIONS........ | 4,667 | 4,703 | 4,714 | 4,495 |
| SUBTOTAL (FULL-TIME PERMANENTS).... | 21,500 | 22,081 | 22,194 | 22,609 |
| OTHER CONTROLLED FTE'S.................. (PMI's/CO-OPS/OTFTP's) | 682 | 726 | 738 | 743 |
| SUBTOTAL (FTE) | 22,182 | 22,807 | 22,932 | 23,352 |
| SPACE STATION PROJECT OFFICE (LEVEL II) FTP | 144 | 143 | 218 | 348 |
| GRAND TOTAL FTE | 22,326 | 22,950 | 23,150 | 23,700 |

NOTE: THE INSPECTOR GENERAL'S OFFICE WAS GRANTED ITS OWN APPROPRIATION, THUS IG WORKYEARS (146) WILL NOT APPEAR IN FY 1990 TOTALS.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND PROGRAM MANAGEMENT - FY 1990 ESTIMATES
DISTRIBUTION OF BUDGET PLAN BY FUNCTION BY INSTALLATION

| FUNCTION | TOTAL NASA | JOHNSON SPACE CENTER | KENNEDY SPACE CENTER | MARSHALL SPACE FLIGHT CENTER | STENNIS SPACE CENTER | GODDARD SPACE FLIGHT CENTER | AMES RESEARCH CENTER | LANGLEY RESEARCH CENTER | LEWIS RESEARCH CENTER | HEADQUARTERS | INSPECTOR GENERAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PERSONNEL AND RELATED COSTS: | | | | | | | | | | | |
| 1988 ACTUAL | 1,084,759 | 172,754 | 106.319 | 163,235 | 6.717 | 173,405 | 106,144 | 127,236 | 125.457 | 96,963 | 6,529 |
| 1989 BUDGET | 1,131,008 | 180,476 | 115.907 | 171,331 | 8,041 | 179.592 | 108,006 | 129,281 | 127.546 | 102,027 | 8,801 |
| 1989 CURRENT | 1,171,000 | 189.596 | 117,780 | 172,963 | 8.687 | 181,017 | 112.823 | 134,939 | 131.885 | 113.380 | 7.930 |
| 1990 BUDGET | 1,222,040 | 200.065 | 120.602 | 182,623 | 9.298 | 186,143 | 117.808 | 140.120 | 138.343 | 127,038 | 0 |
| TRAVEL | | | | | | | | | | | |
| 1988 ACTUAL | 40.168 | 6,066 | 2,999 | 6,538 | 346 | 5.571 | 3.704 | 3.683 | 3,332 | 7,603 | 326 |
| 1989 BUDGET | 51.000 | 8,331 | 5.338 | 8,196 | 457 | 6,200 | 4,335 | 4,198 | 3.767 | 9.833 | 345 |
| 1989 CURRENT | 47,116 | 7,003 | 4.315 | 6,779 | 477 | 5,734 | 4,197 | 3,856 | 3.445 | 10,965 | 345 |
| 1990 BUDGET | 50,957 | 7.533 | 4,522 | 7,287 | 506 | 6,098 | 4,483 | 4,143 | 3,719 | 12.666 | 0 |
| OPERATION OF INSTALLATION | | | | | | | | | | | |
| 1988 ACTUAL | 637,233 | 103.131 | 132,538 | 67,683 | 13,470 | 63,805 | 55,366 | 47.021 | 53,113 | 100,845 | 261 |
| 1989 BUDGET | 732,992 | 112,719 | 149.230 | 69.577 | 14,850 | 71,031 | 67,057 | 51,776 | 60.140 | 136.311 | 301 |
| 1989 CURRENT | 673,484 | 105.156 | 141.335 | 70,131 | 15,133 | 66,262 | 61.308 | 50,354 | 58,870 | 104.634 | 301 |
| 1990 BUDGET | 759,203 | 115,573 | 154,139 | 75,799 | 16,079 | 78,998 | 64,670 | 57.232 | 65,720 | 130,985 | 0 |
| TOTAL | | | | | | | | | | | |
| 1988 ACTUAL | 1,762,160 | 281,951 | 241.856 | 237,456 | 20,533 | 242.781 | 165.214 | 177.940 | 181,902 | 205,411 | 7.116 |
| 1989 BUDGET | 1,915,000 | 301,526 | 270,475 | 249,104 | 23.348 | 256,823 | 179,398 | 185.255 | 191,453 | 248.171 | 9,447 |
| 1989 CURRENT | 1,891,600 | 301.755 | 263,430 | 249,873 | 24,297 | 253.013 | 178,328 | 189,149 | 194.200 | 228,979 | 8.576 |
| 1990 BUDGET | 2,032,200 | 323,171 | 279,263 | 265.709 | 25,883 | 271,239 | 186,961 | 201,495 | 207.790 | 270,689 | 0 |

NOTE:
A SEPARATE APPROPRIATION WAS CREATED FOR THE INSPECTOR GENERAL'S OFFICE. BEGINNING IN FY 1990, THE IG FUNDING WILL NOT BE INCLUDED IN THE R&PM APPROPRIATION. IG FUNDING FOR FY 1990 IS $8,759,000.

# NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

## PROPOSED APPROPRIATION LANGUAGE

### RESEARCH AND PROGRAM MANAGEMENT

For necessary expenses of research in Government laboratories, management of programs and other activities of the National Aeronautics and Space Administration, not otherwise provided for, including uniforms or allowances therefor, as authorized by law (5 U.S.C. 5901-5902); awards; lease, hire, purchase of one aircraft for replacement only (lor which partial payment may be made by exchange of at least one existing Administrative aircraft and such other existing aircraft as may be considered appropriate), maintenance and operation of administrative aircraft; purchase (not to exceed thirty-three for replacement only) and hire of passenger motor vehicles; and maintenance and repair of tad and personal property, rnd not in excess of 1100,000 per project for construction of new facilities and additions to existing facilities, repairs, and rehabilitation and modification of facilities; [$1,855,000,000] *$2,032,200,000*: *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 pear: *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. *(Department of Housing and Urban Development-Independent Agencies Appropriation Act. 1989; additional authorizing legislation to be proposed.)*

INSTALLATION
JUSTIFICATION

JOHNSON
SPACE CENTER

**RESEARCH AND PROGRAM MANAGEMENT**

**FISCAL YEAR 1990 ESTIMATES**

**LYNDON B. JOHNSON SPACE CENTER**

## DESCRIPTION

The Lyndon B. Johnson Space Center (JSC) is located approximately 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, 1988 was $780,400,000.

## 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 towards 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 Freedom program. To meet this responsibility, JSC has developed unique areas of recognized technical excellence within the civil service staff and facilities of superior merit, which constitute a National resource. The principal and supporting roles are:

Principal Roles:

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

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

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

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

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

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

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

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

Payload Integration - involved with integrating the Intertial 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.

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

Life Science - perform medical research to establish human baseline data, investigate and develop countermeasures to solve space medicine problems, and develop information techniques and equipment to support medical operation and medical experiments; develop nutritional requirements and food preparation and packaging systems in support of human space flight 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 - manage the Orbiter experiments program; define and develop experiments in areas consistent with other JSC space roles.

FY 1990 CONGRESSIONAL BUDGET
DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM

| JOHNSON SPACE CENTER | 1988 ACTUAL | 1989 BUDGET ESTIMATE | 1989 CURRENT ESTIMATE | 1990 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION | 535 | 663 | 679 | 817 |
| SPACE FLIGHT PROGRAMS | 2,143 | 2,164 | 2,143 | 2,131 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 625 | 525 | 692 | 678 |
| SPACE SHUTTLE | 1,518 | 1,639 | 1,451 | 1,453 |
| SPACE SCIENCE AND APPLICATIONS | 141 | 136 | 136 | 143 |
| PHYSICS AND ASTRONOMY | 20 | 23 | 16 | 5 |
| LIFE SCIENCES | 76 | 70 | 82 | 71 |
| PLANETARY EXPLORATION | 30 | 32 | 30 | 36 |
| SPACE APPLICATIONS | 15 | 11 | 8 | 31 |
| AERONAUTICS AND SPACE TECHNOLOGY | 39 | 34 | 46 | 52 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 0 | 0 | 0 | 0 |
| SPACE RESEARCH AND TECHNOLOGY | 39 | 34 | 46 | 52 |
| TRANSATMOSPHERIC RESEARCH & TECH | 0 | 0 | 0 | 0 |
| COMMERCIAL PROGRAMS | 10 | 11 | 12 | 13 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE. | 0 | 0 | 0 | 0 |
| TRACKING AND DATA PROGRAMS | 0 | 0 | 0 | 0 |
| SUBTOTAL DIRECT | 2,868 | 3,008 | 3,016 | 3,156 |
| CENTER MANAGEMENT AND OPERATIONS | 434 | 452 | 447 | 449 |
| SUBTOTAL (FULL-TIME PERMANENTS) | 3,302 | 3,460 | 3,463 | 3,605 |
| OTHER CONTROLLED FTE'S (PMI's/CO-OPS/OTFTP's) | 102 | 104 | 117 | 112 |
| GRAND TOTAL (FULL-TIME EQUIVALENTS) | 3,404 | 3,564 | 3,580 | 3,717 |

## PROGRAM DESCRIPTION

| | Permanent Civil Service Workyears |
|---|---|
| **RESEARCH AND DEVELOPMENT** | |
| SPACE STATION.................................................................................... | 817 |

As one of NASA's four major development centers for the Space Station Freedom program, JSC is responsible for the design, development, test, and certification of specific elements, systems, and subsystems necessary to meet the baseline configuration capability. With the start of JSC's development funding, the staffing for FY 1990 provides for the management of initial development activities through the Preliminary Design Review.

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

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

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

| | |
|---|---|
| SPACE FLIGHT PROGRAMS................................................. ............... | 2,131 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT............................................ | 678 |

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

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

The Engineering and Technical Base (ETB) provides the base capability necessary to support ongoing and future efforts. The ETB supports a one-shift operation of the JSC laboratories and a two-shift operation of the Central Computer Facility. Operation of the new class VI computer and support to the shuttle SR&QA program is also included.

Payload operations and support equipment 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. In addition, support to the space station required by the shuttle is provided.

The advanced programs activities at JSC are planned and administered to support current and future Agency programs. Major activities at JSC are designed to promote more efficient operations of the STS and emphasis has been placed on developing and enhancing satellite services. Support to the development of upper stages and the integration of payloads have been and will continue to be major. Supporting technology activities are conducted to advance the use of artificial intelligence and its applications to Space Station and to the realtime 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.............. .... .......................................... | 1,453 |

The 1990 staffing provides for continuation of the Shuttle activities to support a schedule consistent with the major program milestones. It also provides development, integration, and operations support for the Mission Control Center (MCC) and the Shuttle Mission Simulator (SMS).

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

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

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

The successful flight and operations performance of the Space Shuttle is dependent on the proper functioning of integrated electronic equipment. Collectively, these are termed the Integrated Avionics System. Avionics provides the Shuttle pilots and crew with the total assessment and command capability necessary to manage, fly, operate and land the vehicle. Because of the critical nature of this system, very close attention is given to the identification of performance requirements and integrated performance.

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

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

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

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

Specific flight planning activity encompasses the flight design, flight analysis, and software preparation activities. The flight design tasks include supporting the crew training simulations and development of flight techniques. Flight design products include conceptual flight profiles and operational flight profiles which are issued for each flight. The software activities include the development, formulation, and verification support for the guidance, targeting, and navigation systems software requirements in the Orbiter and MCC. In addition, the flight dependent data co-located in the erasable memory (mission-to-mission changes) is developed from the flight design process for incorporation into the Orbiter software and MCC systems.

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

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

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

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

| | Permanent Civil Service Workyears |
|---|---|
| **SPACE SCIENCE AND APPLICATIONS** ......................... ...................... | 143 |
| PHYSICS AND ASTRONOMY ...................................................... | 5 |

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

| | |
|---|---|
| LIFE SCIENCES ...................... .... .. .......... ........... | 71 |

The Center has the lead role in evaluating human physiological changes associated with the space environment and providing effective countermeasures to assure crew health and optimal performance, for example, the space adaption syndrome activity 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 reai-time human experiments. To this end, science experiments have been selected, and experiment hardware development has been initiated. JSC has mission management responsibility for the life sciences payloads, which includes systems management and engineering of the payload equipment and operation of the payload during flights.

| | Permanent Civil Service Workyears |
|---|---|
| PLANETARY EXPLORATION ................................................ ............... | 36 |

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

| | |
|---|---|
| SPACE APPLICATIONS.... .............................................. | 31 |

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

| | |
|---|---|
| SPACE RESEARCH AND TECHNOLOGY................................................... | 52 |

JSC is completing the study of a family of technologies for the Space Station era and for improved STS operations, and is initiating a new family of technologies to support possible future missions such as Shuttle II and a Lunar Base or Manned Mars Mission. The technologies include: improvement of man-machine interactions in space, advanced thermal concepts, evaluation of ADA language in NASA flight systems, environmentally controlled life support systems efficiencies, development of docking/berthing systems required for large space systems, data system architectural designs, methodologies to improve cost effectiveness of guidance, navigation and control systems and techniques to make use of extraterrestrial materials. Experiments compatible with STS operational capabilities are being developed to obtain research and technology data in flight regimes applicable to advanced transportation systems. This effort also includes automation and robotics, which is part of the Civil Space Technology Initiative program. The Pathfinder effort includes the following technologies: sample acquisition and preservation, in-space assembly, high-energy aerobraking, and autonomous operations.

Permanent Civil
Service Workyears

COMMERCIAL PROGRAMS........................................................................ 13

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

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

CENTER MANAGEMENT AND OPERATIONS SUPPORT.................... ... ........ 449

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 management, and management systems and analysis.

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

## SUMMARY OF RESOURCES REQUIREMENTS

### Funding Plan by Function

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| I. Personnel and related costs.................. | 172,754 | 180,476 | 189,596 | 200,065 |
| II. Travel........................................ | 6,066 | 8,331 | 7,003 | 7,533 |
| III. Operation of installation................... | 103,131 | 112,719 | 105,156 | 115,573 |
| A. Facilities services..................... | (34,124) | (41,803) | (32,954) | (37,107) |
| B. Technical services....................... | (33,370) | (27,576) | (32,348) | (37,197) |
| C. Management and operations................ | (35,637) | (43,340) | (39,854) | (41,269) |
| Total, fund requirement.................. | 281,951 | 301,526 | 301,755 | 323,171 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| **I. PERSONNEL AND RELATED COSTS** | 172.754 | 180.476 | 189.596 | 200,065 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | | | | |
| 1. Compensation | | | | |
| a. Full-time permanent | 139.266 | 143.726 | 150.115 | 158.213 |
| b. Other than full-time permanent | 2.003 | 2.113 | 2.446 | 2.365 |
| c. Reimbursable detailees | 5.379 | 5.211 | 5.596 | 6.170 |
| d. Overtime and other compensation | 2.444 | 2.785 | 2.950 | 2.996 |
| Subtotal. Compensation | 149.092 | 153.835 | 161.107 | 169.744 |
| 2. Benefits | 21.203 | 23.457 | 25.209 | 27.098 |
| Subtotal. Compensation and Benefits | 170.295 | 177.292 | 186.316 | 196.842 |
| B. Supporting.Costs | | | | |
| 1. Transfer of personnel | 824 | 938 | 1.034 | 880 |
| 2. Personnel training | 1,635 | 2.246 | 2.246 | 2.343 |
| Subtotal. Supporting Costs | 2.459 | 3.184 | 3.280 | 3.223 |
| Total. Personnel and Related Costs | 172,754 | 180.476 | 189.596 | 200.065 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| A. Compensation and Benefits | 170,295 | 177.292 | 186.316 | 196,842 |
| 1. Compensation | 149,092 | 153,835 | 161.107 | 169.744 |
| a. Full-time permanent | 139,266 | 143,726 | 150,115 | 158,213 |

The increase in the 1989 Current Estimate from the 1989 Budget Estimate is due to an increase in civil service workforce, pay raises in January 1988 and 1989, associated increases in benefits, a 26 percent increase in health insurance costs and an increase in military detailee funding. The 1990 Estimate includes funding for additional civil service workforce, a full year effect of the 1989 pay raise and increased health benefits.

Basis of Cost for Full-time Workvears

In 1990, the cost of full-time workyears will be $158,213,000,an increase of $8 million from 1989. The change is calculated as follows:

| | | |
|---|---|---|
| Cost of full-time permanent workyears in 1989 | | 150,115 |
| Cost changes in 1990 | | 9,222 |
| Within Grade and Career Advances: | | |
| Full year effect of 1989 actions | 1,773 | |
| Partial year effect of 1990 actions | 1,162 | |
| Additional FTE | 6,287 | |
| Changes in reimbursements | 0 | |
| Turnover effect | | -1,124 |
| Full year 1989 effect | -1,164 | |
| Part year 1990 effect | 40 | |
| Cost of FTP workyears in 1990 | | 158,213 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| b. other than full-time permanent | | | | |
| 1. cost.................................. | 2,003 | 2,113 | 2,446 | 2,365 |
| 2. Workyears............................. | 144 | 150 | 162 | 157 |

The distribution of 1989 workyears is as follows:

Distribution of Other than Full-Time Workvears

| Program | Workyears |
|---|---|
| Development programs............................. | 79 |
| Summer programs.................................. | 16 |
| Other temporary programs......................... | 21 |
| Youth Opportunity Programs....................... | 46 |
| Total............................................ | 162 |

The increase from the 1989 Budget Estimate to the 1989 Current Estimate is primarily the result of an increase in the temporary program, the pay raise and an increase in the summer programs. The 1990 Estimate reflects a decrease of 5 workyears in the temporary program.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| c. reimbursable detailees..................... | 5,379 | 5,211 | 5,596 | 6,170 |

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 increase from the 1989 Budget Estimate to the 1989 Current Estimate is due to the FY 1989 pay raise and an increase in the number of astronaut detailees. The 1990 Budget Estimate reflects the full year effect of the 1989 pay raise and funding for the full year cost of additional FY 1989 detailees.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| d. Overtime and other compensation............. | 2,444 | 2,785 | 2,950 | 2,996 |

Overtime in 1989 will be used primarily to support Shuttle flights, e.g., crew training, trajectory optimization, data reduction and integration activities, and related support activities. The increase from the 1989 Budget Estimate to the 1989 Current Estimate is based on the support that will be required for the latest shuttle manifest. The 1990 Budget Estimate reflects an increased level of effort to support the greater flight rate and training requirements associated with the manifest.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Benefits.............................. | 21,203 | 23.457 | 25,209 | 27,098 |

The following are the amounts of contribution by category

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| Retirement Fund and Thrift Plan.................. | 11,990 | 14,470 | 13,803 | 14,867 |
| Employee Life Insurance......................... | 271 | 305 | 290 | 305 |
| Employee Health Insurance....................... | 4,730 | 3,707 | 6,334 | 6,874 |
| Workmen's Compensation.......................... | 678 | 740 | 740 | 700 |
| FICA............................................ | 2,030 | 2,456 | 2,418 | 2,471 |
| Medicare........................................ | 1,457 | 1,743 | 1,576 | 1,833 |
| Other Benefits.................................. | 47 | 36 | 48 | 48 |
| Total........................................... | 21,203 | 23.457 | 25.209 | 27.098 |

The increase from the 1989 Budget Estimate to the 1989 Current Estimate is due to increased health insurance costs. The increase in 1990 is due to the full year effect of the pay raise and additions to the civil service workforce at JSC.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| B. Supporting Costs | 2.459 | 3,184 | 3.280 | 3,223 |
| 1. Transfer of Personnel......................... | 824 | 938 | 1.034 | 880 |

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 from the 1989 Budget Estimate to the 1989 Current Estimate reflects an increase in the number of new employees eligible for these benefits. The decrease from the 1989 current estimate to the 990 budget estimate reflects a decease for these permanent change of station costs as less costly moves are anticpated since most 1990 hires will be college fresh-outs.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Personnel Training............................. | 1.635 | 2 246 | 2.246 | 2.343 |

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 1990 Budget Estimate reflects an increase of training over the 1989 level due to increased Civil Service Workforce plus increases in tuition and other costs.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| I. TRAVEL.......................................... | 6.066 | 8,331 | 7.003 | 7,533 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel................................ | 4,824 | 6,895 | 5,617 | 6,097 |
| B. Scientific and Technical Development Travel..... | 341 | 355 | 302 | 313 |
| C. Management and Operations Travel................ | 901 | 1.081 | 1,084 | 1.123 |
| Total, Travel................................ | 6.066 | 8.331 | 7,003 | 7.533 |

Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel.................................. | 4,824 | 6,895 | 5.617 | 6,097 |

Program Travel is specifically required for the accomplishment of the Center's mission and accounts for approximately 80 percent of the travel budget for 1990. The decrease from the 1989 Budget Estimate to the 1989 Current-Estimate is based on an overall budget constaint and changes in program schedules. The increase from 1989 to 1990 is required to support operations activity including launch, mission suppport, coordination of engineering and technical activities, support of payload techical integration, an increase in the planned flight rate and travel to support increased technical civil service workforce.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Scientific and Technical Development Travel........ | 341 | 355 | 302 | 313 |

Scientific and technical development travel permits employees to participate in meetings and technical seminars with other representatives of the aerospace community. The decrease from 1989 Budget Estimate to the 1989 Current Estimate is based on Budget constraints. The 1990 estimate reflects essentially the same level of travel as 1989 at anticipated rates.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| C. Management and Operations Travel.................. | 901 | 1,081 | 1,084 | 1,123 |

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, procurement activities, travel of the Center's top technical management to NASA Headquarters and other NASA Centers and local transportation. The 1990 estimate reflects an increase over the FY 1989 current estimate due to anticipated rates.

| | | | | | |
|---|---|---|---|---|---|
| III. | **OPERATION OF INSTALLATION**.................... | 103.131 | 112,719 | 105,156 | 115.573 |

Summary of Fund Requirements

| | | | | | |
|---|---|---|---|---|---|
| A. | Facilities Services.......................... | 34,124 | 41,803 | 32,954 | 37,107 |
| B. | Technical Services........................... | 33,370 | 27,576 | 32,348 | 37,197 |
| C. | Management and Operations.................... | 35.637 | 43,340 | 39,854 | 41,269 |
| | Total, Operation of Installation............. | 103.131 | 112.719 | 105,156 | 115.573 |

Explanation of Fund Requirements

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

The decrease from the FY 1989 Budget Estimate to the FY 1989 Current Estimate reflects reductions in the planned level of contractor support and deferrals of ADP purchases and other equipment purchases due to budget reductions. The increase from the 1989 Current to the 1990 Estimate is restoration of some deferred purchases and upgrades to the financial systems as well as support to the planned larger on-site workforce.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. FACILITIES SERVICES | 34,124 | 41,803 | 32,954 | 37.107 |

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

### Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property | 862 | 547 | 309 | 311 |
| 2. Maintenance and Related Services | 12,399 | 14,008 | 11,135 | 12,719 |
| 3. Custodial Services | 7,390 | 9,916 | 6,731 | 8,673 |
| 4. Utility Services | 13.473 | 17.332 | 14,779 | 15.404 |
| Total, Facilities Service | 34,124 | 41.803 | 32.954 | 37.107 |

### Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property | 862 | 547 | 309 | 311 |

Provides for the rental of buildings off-site for source evaluation boards, rental of hanger space at El Paso, Texas International Airport for the T-38 and Shuttle training vehicles, and rental of warehouse storage in Bell, California for tooling and assemblv for the Shuttle. The decrease from the 1989 Budget to the 1989 Current Estimate is due to the decrease in the use of off-site buildings for source evaluation boards and other off-site meetings.

| | 1388 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Maintenance and Related Services.................. | 12.399 | 14,008 | 11,135 | 12,719 |

This activity involves routine maintenance and facilities support for JSC at Houston, as well as White Sands Test Facility and Ellington Air Force Base, and includes such activities as support for utility systems; administrative facility alterations and painting; ground maintenance; and other facility and system design and modification tasks. The decrease in the FY 1989 Current Estimate from the FY 1989 Budget Estimate is based on reductions in planned maintenance in order to accommodate budget reductions. The increase from the 1989 Current Estimate to the 1990 Estimate reflects the restoration of some minor construction projects and adds funding to support additional civil service workforce.

| | | | | |
|---|---|---|---|---|
| 3. Custodial Services........................... | 7,390 | 9.916 | 6.731 | 8.673 |

This activity involves support contractor effort at JSC to provide security guard services such as protection of government facilities, equipment, and classified information and badging for all on-site personnel and official visitors; janitorial services (including highly specialized clean-room services); and fire protection services such as maintenance of alarms and fixed fire fighting equipment and industrial safety and inspection. The decrease from the FY 1989 Budget Estimate to the FY 1989 Current Estimate is due to reductions in the planned level of schedule of custodial services to accommodate the budget reduction. There is also an adjustment in the funding of shop support to fully reflect realignments between program and institutional appropriations. The increase in the 1990 Estimate includes restoration of budget reductions.

| | | | | |
|---|---|---|---|---|
| 4. Utility Services.............................. | 13.473 | 17.332 | 14,779 | 15.404 |

This category includes purchased utilities and support contractor effort for the operation and maintenance of the utility distribution system. The decrease from the FY 1989 Budget Estimate to the FY 1989 Current Estimate is based on 1988 actuals. The increase in 1990 reflects the same level of effort at anticipated rates.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. TECHNICAL SERVICES........................... | 33,370 | 27,576 | 32.348 | 37.197 |

Summarv of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing.................. | 23,328 | 18,560 | 22.222 | 25.353 |
| 2. Scientific and Technical Information........ | 4,814 | 4,464 | 5,000 | 5.368 |
| 3. Shop and Support Services.................. | 5,228 | 4.552 | 5.126 | 6.476 |
| Total, Technical Services.................. | 33.370 | 27.576 | 32,348 | 37.197 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing.................. | 23.328 | 18.560 | 22.222 | 25.353 |

This activity provides support to all JSC administrative ADP functions; included within this area are institutional portions of lease and maintenance costs of hardware systems within the Central Computer Facility, as well as contractor effort for computer programming, operations, keypunch, and other support personnel. The ADP systems supported include institutional management, finance and accounting, procurement, contract status and tracking, personnel management, payroll, and utility tracking. The increase from the FY 1989 budget Estimate to the FY 1989 Current Estimate is due to the realignment of ADP equipment funding from the Management Operations function. The increase from the FY 1989 Current Estimate to the FY 1990 Estimate reflects additional civil service workforce support, as well as, full year funding of support service contracts at anticipated price and wage rates.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Scientific and Technical Information............ | 4.814 | 4,464 | 5.000 | 5,368 |

This activity provides for a public affairs educational and informational program and support to the Center in provision of various scientific and technical information services. Included in the public affairs program are: motion picture production from script to screen; film clip preparation; exhibit management and refurbishment; visitor orientation tours; lecturing; mail answering services; and other public affairs activities. The increase from the FY 1989 Budget Estimate to the FY 1989 Current Estimate is based on the information requirements associated with the successful return to flight and the increased requirements associated with the growing flight rate and changed manifest. The increase from the FY 1989 Current Estimate to the FY 1990 Budget Estimate reflects the same level of effort as FY 1989 and full year funding of support service contracts at anticipated wage rates.

| | | | | |
|---|---|---|---|---|
| 3. Shop and Support Services...................... | 5,228 | 4.552 | 5,126 | 6,476 |

These funds provide for a support contractor who provides JSC graphics and photographic services. Graphic materials are prepared for use in presentations and senior management reviews. Various kinds of films are processed and reproductions and reprints made. The increase from the 1989 Budget Estimate to the FY 1989 Current Estimate is due to refinement of the previous estimates plus realignment of safety contractors from custodial services. The increase from the 1989 Current Estimate reflects an increase in safety personnel and full year funding of support service contracts at anticipated price and wage rates.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| C. MANAGEMENT AND OPERATIONS........................ | 35.637 | 43.340 | 39,854 | 41.269 |
| 1. Administrative Communications.................. | 10,970 | 13,205 | 12,448 | 12,466 |
| 2. Printing and Reproduction..................... | 1,780 | 2,258 | 2,069 | 2,112 |
| 3. Transportation.................. .......... | 4,500 | 5,253 | 5,897 | 5,496 |
| 4. Installation Common Services...... .......... | 18,387 | 22.624 | 19,440 | 21,195 |
| Total, Management and Operations .......... | 35.637 | 43.340 | 39,854 | 41,269 |

## Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications............. | 10.970 | 13,205 | 12.448 | 12,466 |

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 FY 1989 Budget Estimate to the FY 1989 Current Estimate is due to refinement of the estimates based on FY 1988 actuals. The increase from the 1989 Current Estimate to the 1990 Budget Estimate reflects the same level of effort as 1989.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 2. Printing and Reproduction.................. | 1.780 | 2,258 | 2,069 | 2.112 |

Printing services are provided by on-site and off-site facilities. The on-site printing plant, operated by JSC personnel, produces approximately 69 million units each year. In addition to this on-site printing plant, JSC also purchases printing from private firms through Government Printing Office contracts, about 66,000,000units each year. Purchased printing is overflow requirements that cannot be handled on-site and printing which require capabilities not available at the on-site plant. The decrease from the FY 1989 Budget Estimate to the FY 1989 Current Estimate is based on reduced requirements associated with the NSTS program due to flight rate changes. The FY 1990 Budget Estimate reflects the same level of effort as FY 1989 at anticipated rates.

| | | | | |
|---|---|---|---|---|
| 3. Transportation........................... | 4.500 | 5,253 | 5.897 | 5,496 |

Transportation includes administrative aircraft maintenance and fuel costs, lease of passenger vehicles and trucks including GSA drivers and dispatchers and maintenance of vehicles. The increase from the FY 1989 Budget Estimate to the FY 1989 Current Estimate is due to a planned engine overhaul on the administrative aircraft. The increase from the 1989 Current Estimate to the 1990 Budget Estimate reflects the same level of effort as the year 1989.

| | | | | |
|---|---|---|---|---|
| 4. Installation Common Services................. | 18,387 | 22.624 | 19.440 | 21.195 |

These services support center management and staff activities, provide medical services and cover various installation support services. Center management and staff functions include legal, personnel, procurement and EEO activities. Medical services provided include occupational medicine and environmental health, consisting of the operation of the JSC on-site clinic; emergency assistance at Ellington Field; providing physicals for JSC personnel at Downey, California; medical consultation and crew test support; industrial hygiene; radiological health; and an environmental health laboratory. Installation support services include administrative supplies, materials and equipment at the Center and at WSTF; JSC share of operating costs at Ellington Field; and miscellaneous administrative support. The decrease from the 1989 Budget estimate to the 1989 Current Estimate ,reflects the deferred purchase of administrative equipment into FY 1990 and the realignment of ADP equipment funding to the Automatic Data Processing function. The increase from the 1989 Current Estimate to the 1990 Estimate reflects restoration of equipment deferrals from FY 1988 and FY 1989, support for additional civil service workforce and full year funding of support service contracts for expected rates.

# National Aeronautics & Space Administration
## Johnson Space Center

**Proj. EOFY Staffing Summary**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 46 | 48 |
| GS/GM-15 | 294 | 294 |
| GS/GM-14 | 536 | 538 |
| All other GS/GM | 2896 | 2848 |
| Wage Grade | 7 | 7 |
| TOTAL | 3680 | 3695 |

**Director, Deputy Director, Assistant Director**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 6 | 6 |
| GS/GM-15 | 2 | 2 |
| GS/GM-14 | 1 | 1 |
| All other GS/GM | 8 | 8 |
| Wage Grade | 0 | 0 |
| TOTAL | 17 | 17 |

**Office of Inspector General JSC**

**Human Resources Office**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM-15 | 1 | 1 |
| GS/GM-14 | 4 | 4 |
| All other GS/GM | 60 | 60 |
| Wage Grade | 0 | 0 |
| TOTAL | 66 | 66 |

**Equal Opportunity Programs Office**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM-15 | 0 | 0 |
| GS/GM-14 | 1 | 1 |
| All other GS/GM | 6 | 6 |
| Wage Grade | 0 | 0 |
| TOTAL | 7 | 7 |

**Legal Office**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM-15 | 1 | 1 |
| GS/GM-14 | 4 | 6 |
| | [illegible] | 7 |
| Wage Grade | 0 | 0 |
| TOTAL | 15 | 15 |

**Public Affairs Office**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM-15 | 1 | 1 |
| GS/GM-14 | 2 | 2 |
| All other GS/GM | 27 | 27 |
| Wage Grade | 0 | 0 |
| TOTAL | 31 | 31 |

**New Initiatives Office**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM-15 | 3 | 3 |
| GS/GM 14 | 15 | 15 |
| All other GS/GM | 70 | 74 |
| Wage Grade | 0 | 0 |
| TOTAL | 90 | 94 |

**White Sands Test Facility**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM-15 | 1 | 1 |
| GS/GM-14 | 8 | 8 |
| All other GS/GM | 48 | 42 |
| Wage Grade | 0 | 0 |
| TOTAL | 58 | 52 |

**Director Engineering**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 5 | 5 |
| GS/GM-15 | 56 | 56 |
| GS/GM-14 | 115 | 115 |
| All other GS/GM | 513 | 525 |
| Wage Grade | 0 | 0 |
| TOTAL | 689 | 701 |

**Space Station Projects Office**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 3 | 3 |
| GS/GM-15 | 16 | 16 |
| GS/GM 14 | 42 | 42 |
| All other GS/GM | 61 | 69 |
| Wage Grade | 0 | 0 |
| TOTAL | 122 | 130 |

**Orbiter and GFE Projects Office**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 15 | 20 | 20 |
| GS/GM 14 | 46 | 46 |
| All other GS/GM | 61 | 63 |
| Wage Grade | 0 | 0 |
| TOTAL | 129 | 131 |

**National Space Transportation Systems Office**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 15 | 28 | 28 |
| GS/GM 14 | 58 | 58 |
| All other GS/GM | 104 | 108 |
| Wage Grade | 0 | 0 |
| TOTAL | 190 | 194 |

**Director Safety, Reliability, And Quality Assurance**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM-15 | 17 | 17 |
| GS/GM-14 | 13 | 13 |
| All other GS/GM | 151 | 156 |
| Wage Grade | 0 | 0 |
| TOTAL | 183 | 188 |

**Director Flight Crew Operations**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 3 | 3 |
| GS/GM-15 | 28 | 28 |
| GS/GM-14 | 22 | 22 |
| All other GS/GM | 121 | 133 |
| Wage Grade | 0 | 0 |
| TOTAL | 174 | 186 |

**Director Mission Operations**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 7 | 7 |
| GS/GM-15 | 36 | 36 |
| GS/GM-14 | 62 | 62 |
| All other GS/GM | 406 | 437 |
| Wage Grade | 0 | 0 |
| TOTAL | 511 | 542 |

**Director Mission Support**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 3 | 3 |
| GS/GM-15 | 30 | 30 |
| GS/GM-14 | 49 | 49 |
| All other GS/GM | 252 | 262 |
| Wage Grade | 0 | 0 |
| TOTAL | 334 | 344 |

**Director Space and Life Sciences**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 4 | 4 |
| GS/GM-15 | 36 | 36 |
| GS/GM-14 | 43 | 42 |
| All other GS/GM | 171 | 180 |
| Wage Grade | 0 | 0 |
| TOTAL | 247 | 254 |

**Director Administration and Program Support**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 3 | 3 |
| GS/GM 15 | 16 | 16 |
| GS/GM 14 | 37 | 37 |
| All other GS/GM | 341 | 361 |
| Wage Grade | 0 | 0 |
| TOTAL | 397 | 407 |

**Director Center Operations**

| | FY-89 | FY-90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM-15 | 8 | 8 |
| GS/GM-14 | 15 | 16 |
| All other GS/GM | 306 | 310 |
| Wage Grade | 7 | 7 |
| TOTAL | 338 | 342 |

KENNEDY
SPACE CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1990 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, 1988, was $1,763,918,000.

### CENTER ROLES AND MISSIONS

The Launch Operations Center was established at Cape Canaveral, Florida, in July 1962 to serve as the primary NASA center for the test, checkout, and launch of space vehicles. In late 1963, it was named the John F. Kennedy Space Center and in 1964 the Center was relocated to Merritt Island. This site was chosen because of its unique geographical characteristics, climate, local growth capability, accessibility, and availability. The Center has since become the major free world launch site with a unique civil service staff of unparalleled expertise in the test, checkout and launch of space vehicles and in the design of associated ground support equipment. The technical facilities developed at KSC represent a recognized national resource. The principal roles of the Center are:

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

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

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

FY 1990 CONGRESSIONAL BUDGET
DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM

| KENNEDY SPACE CENTER | 1988 ACTUAL | 1989 BUDGET ESTIMATE | 1989 CURRENT ESTIMATE | 1990 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION.......................... | 156 | 159 | 177 | 248 |
| SPACE FLIGHT PROGRAMS.................. | 1,510 | 1,577 | 1,669 | 1,624 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 190 | 152 | 237 | 222 |
| SPACE SHUTTLE...................... | 1,320 | 1,425 | 1,432 | 1,402 |
| SPACE SCIENCE AND APPLICATIONS.......... | 75 | 72 | 76 | 76 |
| PHYSICS AND ASTRONOMY............... | 53 | 54 | 56 | 55 |
| LIFE SCIENCES...................... | 22 | 18 | 20 | 21 |
| PLANETARY EXPLORATION............... | 0 | 0 | 0 | 0 |
| SPACE APPLICATIONS.................. | 0 | 0 | 0 | 0 |
| AERONAUTICS AND SPACE TECHNOLOGY........ | 0 | 0 | 0 | 0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 0 | 0 | 0 | 0 |
| SPACE RESEARCH AND TECHNOLOGY....... | 0 | 0 | 0 | 0 |
| TRANSATMOSPHERIC RESEARCH & TECH.... | 0 | 0 | 0 | 0 |
| COMMERCIAL PROGRAMS.................... | 11 | 17 | 9 | 9 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE. | 0 | 0 | 0 | 0 |
| TRACKING AND DATA PROGRAMS............. | 0 | 0 | 0 | 0 |
| SUBTOTAL DIRECT.................. | 1,752 | 1,825 | 1,931 | 1,957 |
| CENTER MANAGEMENT AND OPERATIONS........ | 415 | 499 | 400 | 400 |
| SUBTOTAL (FULL-TIME PERMANENTS).... | 2,167 | 2,324 | 2,331 | 2,357 |
| OTHER CONTROLLED FTE'S................. (PMI's/CO-OPS/OTFTP's) | 66 | 64 | 78 | 78 |
| GRAND TOTAL (FULL-TIME EQUIVALENTS) | 2,233 | 2,388 | 2,409 | 2,435 |

PROGRAM DESCRIPTION

Permanent Civil Service Workyears

**RESEARCH AND DEVELOPMENT**

| | |
|---|---|
| SPACE STATION................................................................ | *248* |

The KSC Space Station Project Office assures that the Space Station elements received from the Work Package Centers receive the required assembly, checkout, servicing, and packaging for integration into the Shuttle Orbiter. Specifically, KSC will manage the launch site processing, provide launch site facilities and ground support equipment as required, provide payload integration and interface test equipment, provide an operational influence on design, and provide flight element transportation for the Program. Additional responsibilities delegated to KSC by Headquarters Level II include the Program ground support equipment commonality management function, Program flight element transportation planning, logistics operational capability development, launch site SR&QA assessment, and to act as a Program logistics support analysis agent.

| | |
|---|---|
| **SPACE FLIGHT PROGRAMS**........................................................ | **1,619** |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT.......................... ... | 222 |

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 deployment of Space Shuttle transported payloads to high energy orbits not attainable by the Space Shuttle alone.

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

The Center's role in the Spacelab program is similar to that 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 compatible with the Spacelab, with each other, and with safety requirements.

KSC will provide facilities and support to the various customers during processing of their payloads. KSC, in concert with other NASA organizations must analyze potential payload users' requirements and activities. Based on experience gained during the Espendahle Launch Vehicle program and thus fer in the

Shuttle program, KSC will monitor payload activity from conception; participate in design reviews to ensure compatibility with KSC facilities; and provide support coordination during the payload checkout and launch at KSC.

| | Permanent Civil Service Workvears |
|---|---|
| SPACE SHUTTLE............................................................. | 1,402 |

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

The first Space Shuttle landing at KSC occurred 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 upgrading the orbiter maintenance and refurbishment facility to a full-up orbiter processing bay, and modifications to existing systems, including the Launch Processing System. In addition, KSC ground support equipment and associated subsystems which have been in place since the mid-1970's must be upgraded/replaced due to obsolescense and to take advantage of advancing state of the art. These include replacement of the Launch Processing System and the replacement of existing copper wire intercom system with a digital intercom system, 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.

| | Permanent Civil Service Workyears |
|---|---|
| **SPACE SCIENCE AND APPLICATIONS** ........................................... | 76 |
| PHYSICS AND ASTRONOMY.......... ... .... .................. .... | 55 |

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................................................................... | 21 |

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

| | |
|---|---|
| COMMERCIAL PROGRAMS........................................................ | 9 |

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

The Technology Utilization program identifies, acquires and disseminates the results of NASA research and development in useful forms and through a variety of technology transfer mechanisms to strengthen the national ecomony 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 Workvears |
|---|---|
| CENTER MANAGEMENT AND OPERATIONS SUPPORT.................. .................... | 400 |

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

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

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

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

SUMMARY **OF RESOURCES REQUIREMENTS**

FUNDING PLAN **BY FUNCTION**

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| I Personnel and Related Costs........................ | 106,319 | 115,907 | 117,780 | 120,602 |
| II. Travel........................................... | 2,999 | 5,338 | 4,315 | 4,522 |
| III. Operation of Installation....................... | 132,538 | 149,230 | 141,335 | 154,139 |
| A. Facilities Services......................... | (77,372) | (87,017) | (81,915) | (89,962) |
| B. Technical Services.......................... | (16,740) | (17,891) | (15,803) | (17,943) |
| C. Management and Operations................... | (38.426) | 144,322) | (43.617) | (46.234) |
| Total, Fund Requirements................... | 241.856 | 270.475 | 263.430 | 279,263 |

## RESOURCES REQUIREMENTS BY FUNCTION

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| I. PERSONNEL AND RELATED COSTS...................... | 106,319 | 115,907 | 117,780 | 120,602 |
| **Summary of Fund Requirements** | | | | |
| A. Compensation and Benefits..................... | | | | |
| 1. Compensation | | | | |
| a. Full-time permanent................... | 85,342 | 91,775 | 92,934 | 95,a67 |
| b. Other than full-time permanent......... | 1,625 | 1,844 | 1,a13 | 1,838 |
| c. Reimbursable detailees................. | 91 | 122 | 101 | 119 |
| d. Overtime and other compensation........ | 3,343 | 3,585 | 4,341 | 3,476 |
| Subtotal, Compensation............... | 90,401 | 97,326 | 99,189 | 101,300 |
| 2. Benefits................................. | 13,113 | 16,229 | 14,624 | 15,789 |
| Subtotal, Compensation and Benefits....... | 103,514 | 113,555 | 113,a13 | 117,089 |
| B. Supporting Costs | | | | |
| 1. Transfer of personnel...................... | 1,550 | 506 | 2,121 | 1,633 |
| 2. Personnel training......................... | 1,255 | 1,846 | 1,846 | 1,880 |
| Subtotal, Supporting Costs................ | 2,805 | 2,352 | 3,967 | 3,513 |
| Total, Personnel and Related Costs...... | 106,319 | 115,907 | 117,780 | 120,602 |

## Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| A. Compensation and Benefits........................ | 103.514 | 113,555 | 113,813 | 117,089 |
| 1. Compensation................................ | 90,401 | 97,326 | 99,189 | 101,300 |
| a. Full-time Permanent..................... | 85,342 | 91,775 | 92,934 | 95,867 |

The increase in the 1989 Current Estimate from the 1989 Budget Estimate is due a refinememt of estimates for benefits, the effect of the 1989 pay raise and an increase of 7 FTE in the workforce. The 1990 Budget Estimate provides cost for the full year funding of the 1989 actions and additional civil service workforce.

### Basis of Cost for Civil Service Workyears

In 1990, the cost of permanent workyears will be $95,867,000. The change is calculated as follows:

| | | |
|---|---|---|
| Cost of full-time workyears in 1989........................................................ | | 92,934 |
| Cost changes in 1990........................................................ | | 5,340 |
| Within Grade and Career Advances: | | |
| Full year effect of 1989 actions.................................... | 824 | |
| Partial year effect of 1990 actions.................................. | 3,581 | |
| Additional FTE........................................................ | 1,189 | |
| Changes in reimbursements........................................... | -254 | |
| Turnover effect........................................................ | | -2,407 |
| Full year 1989 effect.................................................. | -1,918 | |
| Part year 1990 effect.................................................. | -489 | |
| Cost of FTP workyears in 1990........................................................ | | 95.867 |

|  | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
|  |  | (Thousands of Dollars) |  |  |
| b. Other than full-time permanent positions |  |  |  |  |
| (1) cost.................................... | 1,625 | 1,844 | 1,813 | 1,838 |
| (2) Workyears................................ | 89 | 94 | 109 | 109 |

The distribution of 1990 workyears is as follows:

Distribution of Other than Full-Time Permanent Workvears

| Program | Workvears |
|---|---|
| Other temporary programs.......................................................... | 78 |
| Youth Opportunity Programs........................................................ | 31 |
| Total.............................................................................. | 109 |

The change in the 1989 Budget Estimate to the 1989 Current estimate reflects a workyear increase in other temporary programs which included the Co-ops, PMIP, Intermittents, and all Youth Opportunity programs. The decrease in funding results from lower skilled employees being hired than planned, no summer program for regular temporaries is planned, and costs vary slightly with grades of employees. The 1990 estimate remains at the same level of effort for these programs with a slight increase in cost due to the full year effect of the 1989 pay raise.

|  | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| c. Reimbursable detailees...................... | 91 | 122 | 101 | 119 |

The reimburable military detailees at Kennedy Space Center are in the Security Office. The decrease in the 1989 Current Estimate from the 1989 Budget Estimate is due to a lower ranked officer assigned than was expected. The 1990 estimate reflects current requirements at expected cost levels.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| d. Overtime and other compensation | 3,339 | 3,585 | 4,341 | 3,476 |

This item includes overtime, holiday pay, night differential, premium pay and incentive awards. The increase from the 1989 Budget Estimate to 1989 the Current Estimate is due to increased overtime caused by the return of the shuttle to flight status. The 1990 estimate reflects less overtime required due to additional FTE's.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Benefits | 13,113 | 16,229 | 14,624 | 15,789 |

The following are the amounts of contribution by category

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| Retirement Fund and Thrift Plan.................... | 7,301 | 9,801 | 8,165 | 9,185 |
| Employee Life Insurance.......................... | 186 | 230 | 200 | 205 |
| Employee Health Insurance........................ | 3,092 | 2,606 | 3,276 | 3,327 |
| Workmen's Compensation........................... | 347 | 382 | 350 | 350 |
| FICA............................................. | 1,108 | 1,780 | 1,006 | 1,053 |
| Medicare......................................... | 993 | 1,315 | 1,536 | 1,576 |
| Other Benefits................................... | 86 | 115 | 91 | 93 |
| Total............................................ | 13,113 | 16,229 | 14.624 | 15.789 |

The decrease in the 1989 Current Estimate from the 1989 Budget Estimate is due to a re-estimate of the Civil Service Retirement, Life Insurance, and FICA caused by a different mix of employees planned for hire. The 1990 estimate provides for the full year effect of the 1989 pay raise and an increase in FTE's.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Supporting Costs | 2,805 | 2,352 | 3,967 | 3,513 |
| 1. Transfer of personnel..................... | 1,550 | 506 | 2,121 | 1,633 |

Transfer of personnel includes actual expenses involved in the movement and storage of employee's household goods. The increase in the 1989 Current Estimate reflects a change in the mix of new hires which include more engineers who would be eligible for these benefits. The 1990 decrease reflects fewer new hires who would require these moving costs.

| | | | | |
|---|---|---|---|---|
| 2. Personnel training........................ | 1,255 | 1,846 | 1,846 | 1,880 |

The increase in the 1990 Budget Estimate from the 1989 Current Estimate is due to KSC's training needs related to a large number of new employees.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| **11.** TRAVEL........................................ | 2.999 | 5.338 | 4,315 | 4.522 |

Summarv of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel........................... | 1,811 | 4,403 | 3,051 | 3.333 |
| B. Scientific and Technical Development Travel.................................. | 147 | 94 | 17 | 19 |
| C. Management and Operations Travel........... | 1.041 | 841 | 1.247 | 1,170 |
| Total, Travel............................ | 2.999 | 5.338 | 4,315 | 4.522 |

Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| **A.** Program Travel........................... | 1.811 | 4,403 | 3,051 | 3.333 |

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

The decrease of the 1989 Budget Estimate to the 1989 Current Estimate is due to the reduction of return-to-flight requirements, reduction of the Shuttle Flight Kate and budget reductions in this current fiscal year. The 1990 Budget Estimate increase provides additional launch and landing support for the Shuttle flight rate, Space Station Program Requirement Reviews, Test Checkout Monitoring Systems (TCMS) Reviews, and
Design Reviews on Space Station Processing Facility and associated equipment.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Scientific and Technical Development Travel....... | 147 | 94 | 17 | 19 |

Scientific and Technical Development Travel permits employees to participate in meetings and technical seminars with other representatives of the aerospace community. This participation allows personnel to benefit from exposure to technological advances outside KSC, as well as to present both accomplishments and problems to associates. Many of the meetings are working panels convened to solve certain problems for the benefit of the government. The decrease from the 1989 Budget Estimate to the 1989 Current Estimate reflects budget constraints to support programmatic requirements.

The increase in the 1990 Budget Estimate reflects continued support to Scientific and Technological Studies at approximately the 1989 levels.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| C. Management and Operations Travel.................. | 1.041 | 841 | 1.247 | 1.170 |

Management and Operations Travel is used for the direction and coordination of general management matters. It includes travel concerning such areas as personnel, financial management, and procurement activities; travel of the Center's top management to NASA Headquarters, and other NASA Centers; and local transportation. Local travel includes personal travel in and around the official station of the employer, including tolls, parking fees and taxis. Non-NASA travel includes transportation of persons, per diem and other incidental expenses for all non-NASA employees, such as unpaid advisory committee members and preemployment interviews for NASA SES positions. The increase from the 1989 Budget Estimate to the 1989 Current Estimate is based on 1988 actual and reflects administrative requirements for technical management reviews and studies. The decrease in the 1990 Budget Estimate reflects a reduced level to support programmatic requirements due to budget restraints.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 111. **OPERATION OF INSTALLATION**...................... | 132,538 | 149,230 | 141.335 | 154,139 |

Summarv of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Facilities Services........................ | 77,372 | 87,017 | 81,915 | 89,962 |
| B. Technical Services......................... | 16,740 | 17,891 | 15,803 | 17,943 |
| C. Management and Operations................... | 38,426 | 44,322 | 43,617 | 46,234 |
| Total, Operation of Installation............ | 132,538 | 149.230 | 141,335 | 154,139 |

Explanation of Fund Requirement

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

The decreases in the Operation of Installation from the 1989 Budget Estimate to the 1989 Current Estimate is due primarily to overall reductions through deferral of ADP and other equipment, and maintenance and related projects due to budget constraints. The increase from the 1989 Current estimate to the 1990 Budget Estimate results from the full year funding of support service contracts at anticipated wage rates, increased STS activity and reinstatement of some deferred items from 1988 and 1989.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. FACILITIES SERVICES........................ | 77.372 | 87,017 | 81,915 | 89.962 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property................. | 0 | 6 | 0 | 0 |
| 2. Maintenance and Related Services........ | 19,474 | 21,932 | 81,915 | 21,590 |
| 3. Custodial Services..................... | 30,178 | 36,891 | 35,089 | 36,926 |
| 4. Utility Services....................... | 27.720 | 28.188 | 28,062 | 31.446 |
| Total, Facilities Services............. | 77.372 | 87.017 | 81,915 | 89,962 |

Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property................. | 0 | 6 | 0 | 0 |
| 2. Maintenance and Related Services........ | 19.474 | 21.932 | 18.764 | 21.590 |

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

The decrease from the 1989 Budget Estimate to the 1989 Current Estimate is due to delay and deferral of maintenance projects and equipment upgrades due to budget reductions. The increase in 1990 provides full year funding of support service contracts at expected contractor wage rates, restoration of some projects deferred from FY 1989, but provides less services than were initially planned.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 3. Custodial Services. .. .......... | 30.178 | 36.891 | 35,089 | 36,926 |

This category includes janitorial services, fire protection, and security. Funding provides janitorial services to highly specialized clean room areas and orbiter support equipment; fire protection services such as conducting drills, fire inspections of facilities and equipment, standby support during operational tests, and fighting fires. Security protection of personnel and property involves: support of hazardous tests and operations; badging of all on-site personnel and official visitors; safeguarding flight hardware and other items of high intrinsic value; protection of classified information; and maintaining area surveillance and traffic control. Other activities in this category consist of pest control services, laundry services, and supplies and equipment used by the support contractor performing the function. The decrease from the 1989 Budget Estimate to the 1989 Current Estimate reflects less security requirements than planned and less support for the LC 39 OPS/support building which will not be operable until late 1989 or early 1990. The increase in 1990 results from the full year funding of support service contracts at expected price and wage levels and funding for LC 39 complex support.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 4. Utility Services.......................... | 27,720 | 28,188 | 28,062 | 31,446 |

The major utility is electrical energy purchased from Florida Power and Light Company through an Air Force contrnct. Fuel oil is purchased from a local supplier. Water services are purchased from the City of

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

The increase from the 1989 Budget Estimate to the 1989 Current Estimate reflects the same level of effort at increased rates. The increase from the 1989 Current Estimate to the 1990 Budget Estimate is for anticipated support contractor wage rates, projected purchased utility rates and projected utility consumption for new facilities and increased STS flight rate.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. TECHNICAL SERVICES........................... | 16.740 | 17.891 | 15,803 | 17.943 |

Summary of Fund Reauirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing................. | 9.721 | 12.031 | 10.463 | 11,364 |
| 2. Scientific and Technical Information...... | 1,231 | 1.459 | 1,460 | 1,509 |
| 3. Shop and Support Services................. | 5.762 | 4,401 | 3,880 | 5.070 |
| Total, Technical Services................. | 16.714 | 17.891 | 15,803 | 17.943 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing................ | 9,721 | 12,031 | 10.463 | 11,364 |

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

The decrease from the 1989 Budget Estimate to the 1989 Current Estimate is due to the reallocation of institutional computer services activity, and reduction and deferral of equipment purchases due to budget constraints. The increase from the 1989 Current Estimate to the 1990 Budget Estimate results from the full year funding of anticipated support service contractor wage rates; additional support for increased development of policies, procedures, and audits to assure the adequacy of security safeguards of ADP applications; and support for additional Civil Serivce workforce.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 2. Scientific and Technical Information.. | 1,231 | 1,459 | 1,460 | 1,509 |

This funding provides for operation of a technical library at KSC and for technical and administrative documentation services, including support to the public affairs educational and information program. The base operations contractor operates the library facilities, which provide technical and management books and periodicals plus the military, federal, and professional society specifications and standards. The contractor also operates an STS and Spacelab documents repository which catalogs, classifies, and indexes documents and provides document reference and distribution services. Public Affairs support provides for the gathering and dissemination of information about the agency's program to the mass communications media, the general public, and the educational community at the elementary and secondary levels. The 1990 increase reflects a full year funding of support service contracts at expected contractor wage rates.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 3. Shop and Support Services................ | 5.762 | 4,401 | 3.880 | 5070 |

These funds provide for Eastern Space and Missile Center photographic services for NASA's Public Affairs Office and any other institutional support. These funds also provide for the institutional part of the mishap reporting system. The support contractor also provides the necessary management of a comprehensive safety program. This includes the establishment and development of both short and long-range work plans, emergency plans and schedules in support of KSC base operations. The support contractor provides graphic services, technical writing, illustration support, ordering, storing, issuing forms/publications, and providing support for presentations. The support contractor will provide Operational Maintenance Documentation (OMD's) for pre-STS activities. Also, the support contractor will maintain, lease and purchase the associated supplies and equipment for this function.

The decrease from the 1989 Budget Estimate to the 1989 Current Estimate is due to the leveling off of base operations maintenance documentation for power, HVAC, etc. for ground processing and launch support which had been anticipated to grow. The increase in the 1990 estimate reflects a full year funding of support service contracts at expected contractor wage rates and partial restoration of deferred documentation.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| C. MANAGEMENT AND OPERATIONS.................. | 38,426 | 44,322 | 43.617 | 46,234 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications........... | 6,850 | 6,719 | 8,366 | 8.630 |
| 2. Printing and Reproduction.............. | 7.102 | 8,216 | 7.435 | 7,705 |
| 3. Transportation......................... | 5.163 | 5.627 | 6.326 | 6.462 |
| 4. Installation Common Services............ | 19,337 | 23,760 | 21.490 | 23.054 |
| Total, Management and Operations,....... | 38,452 | 44,322 | 43,617 | 45,851 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |

## Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications.......... | 6,850 | 6,719 | 8,366 | 8,630 |

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

The increase from the 1989 Budget Estimate to the 1989 Current Estimate is for projected increases in FTS rates and increased requirements associated with NSTS recovery and a larger on-site workforce. The increase from the 1989 Current Estimate to the 1990 Budget Estimate reflects anticipated rate changes.

| | | | | |
|---|---|---|---|---|
| 2. Printing and Reproduction.............. | 7,102 | 8,216 | 7,435 | 7,705 |

This category includes printing, reproduction and micrographics services which are provided by the support contractor, the Government Printing Office (GPO) and minor commercial firms contracted by GPO. This work includes constantly updating Operation Maintenance instructions (OMI's) for return-to-flight; preparing viewgraphs, halftones, and offset plates; trim, bind, collate, drill, cut, and staple finished products; reduce documentation to micrographic products; producing the house organ, the telephone directory, and Public Affairs brochures and launch support material; and providing lease and maintenance for office copiers at KSC, ESMC and VAFR. Also, the contractor provides the supplies and equipment associated with this function.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |

The decrease from the 1989 Budget Estimate to the 1989 Current Estimate is due to favorable contractor rates and deferral of equipment upgrades due to budget constraints. The increase in 1990 is due to anticipated support contractor wage rates.

| | | | | |
|---|---|---|---|---|
| 3. Transportation ......................... | 5,163 | 5.627 | 6.326 | 6.462 |

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

The increase from the 1989 Budget Estimate to the 1989 Current Estimate reflects increased contractor manpower to support STS and contingency landing site activity in the heavy equipment operations area. The increase from the 1989 Current Estimate to the 1990 Budget Estimate is for anticipated support contractor and vehicle maintenance rates.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 4. Installation Common Services ........... | 19.337 | 23.760 | 21.490 | 23,054 |

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

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

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

Also, a support contractor is responsible for environmental monitoring efforts which include the generation of data and documentation of impact assessments, analyses, and environmental impact statements; field surveillance €or impacts due to launch and recovery activities, industrial operations, and specialized functions in support of space activities, including efforts to maintain and update ecological baseline data; data base management work, including development, operation, and maintenance of a Geographic Information System; and laboratory operations and equipment maintenance in support of the above activities.

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

The decrease from the 1989 Budget Estimate to the 1989 Current Estimate reflects the inventory spares account being severely reduced due to budget constraints. The State of Florida repealed the sales tax on subcontracted services after three months in 1988. The requirement for funding to pay that tax is no longer required and is part of our reduction. The increase from the 1989 Current Estimate to the 1990 Budget Estimate results from the full year funding of support service contracts at expected contractor wage rates.

# NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
## JOHN F. KENNEDY SPACE CENTER

### STAFFING SUMMARY

| | CY89 | FY90 |
|---|---|---|
| SES | 31 | 31 |
| GM/GS-15 | 128 | 128 |
| GM/GS-14 | 299 | 301 |
| OTBER GM/GS | 1886 | 1904 |
| WG | 5 | 5 |
| TOTAL | 2349 | 2369 |

### CENTER DIRECTOR

| | CY89 | FY90 |
|---|---|---|
| SES | 3 | 3 |
| GM/GS-15 | 1 | 1 |
| GM/GS-14 | 1 | 1 |
| OTHER GM/GS | 3 | 3 |
| TOTAL | 8 | 8 |

### EXECUTIVE MANAGEMENT OFFICE

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 3 | 3 |
| GM/GS-14 | 10 | 10 |
| OTHER GM/GS | 35 | 35 |
| WG | 5 | 5 |
| TOTAL | 54 | 54 |

### PUBLIC AFFAIRS OFFICE

| | CY89 | FY90 |
|---|---|---|
| SES | | |
| GM/GS-15 | | |
| GM/GS-14 | 3 | |
| OTBER GM/GS | 21 | 21 |
| TOTAL | 26 | 26 |

### CHIEF COUNCIL

| | FY89 | FY9 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 1 | 1 |
| GM/GS-14 | 2 | 2 |
| OTHER GM/GS | 4 | 4 |
| TOTAL | 8 | 8 |

### EQUAL OPPORTUNITY PROGRAM OFFICE

| | FY89 | FY9 |
|---|---|---|
| SES | - | - |
| GM/GS-15 | - | - |
| GM/GS-14 | 1 | 1 |
| OTHER GM/GS | 4 | 4 |
| TOTAL | 5 | 5 |

### PERSONNEL OFFICE

| | FY89 | FY90 |
|---|---|---|
| SES | – | – |
| GM/GS-15 | 1 | 1 |
| GM/GS-14 | 4 | 4 |
| OTHER GM/GS | 35 | 35 |
| TOTAL | 40 | 40 |

### PROTECTIVE SERVICES OFFICE

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 1 | 1 |
| GM/GS-14 | 2 | 2 |
| OTBER GM/GS | 20 | 20 |
| TOTAL | 24 | 24 |

### COMPTROLLER

| | FY89 | FY9 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 3 | 3 |
| GM/GS-14 | 7 | 7 |
| OTBER GM/GS | 99 | 99 |
| TOTAL | [illegible] | 110 |

### BIOMEDICAL OPERATIONS & RESEARCH OFFICE

| | FY89 | FY9 |
|---|---|---|
| SES | 1 | |
| GM/GS-15 | 3 | 3 |
| GM/GS-14 | 4 | 4 |
| OTBER GM/GS | 20 | 20 |
| TOTAL | 28 | 8 |

### ADVANCED PROJECTS, TECHNOLOGY & COMMERCIALIZATION OFFICE

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM GS-15 | 5 | 5 |
| GM 65-14 | 8 | 8 |
| OTHER GM/GS | 12 | 12 |
| TOTAL | 16 | 26 |

### SPACE STATION PROJECT OFFICE

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 7 | 7 |
| GM/GS-14 | 18 | 18 |
| OTBER GM/GS | 13 | 13 |
| TOTAL | 39 | 39 |

### DIRECTOR OF STS MANAGEMENT & OPERATIONS

| | CY89 | CY90 |
|---|---|---|
| SES | 2 | 2 |
| GM/GS-15 | 8 | 8 |
| GM/GS-14 | 12 | 12 |
| OTHER GM/GS | 39 | 40 |
| TOTAL | 61 | 61 |

### DIRECTOR OF SAFETY RELIABILITY & QUALITY ASSURANCE

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 2 | 2 |
| GM/GS-14 | 10 | 10 |
| OTHER GM/GS | 19 | 19 |
| TOTAL | 32 | 32 |

### DIRECTOR OF ENGINEERING DEVELOPMENT

| | FY89 | FY90 |
|---|---|---|
| SES | 2 | 2 |
| GM/GS-15 | 8 | 8 |
| GM/GS-14 | 13 | 13 |
| OTHER GM/GS | 23 | 23 |
| TOTAL | 46 | 46 |

### DIRECTOR OF CENTER SUPPORT OPERATIONS

| | FY89 | FY90 |
|---|---|---|
| SES | 2 | 2 |
| GM GS-15 | | |
| GM/GS-14 | 11 | 11 |
| | 21 | 21 |
| OTHER GM/GS | 203 | 105 |
| TOTAL | 131 | 239 |

### DIRECTOR OF PAYLOAD MANAGEMENT & OPERATIONS

| | FY89 | FY90 |
|---|---|---|
| SES | 2 | 2 |
| | | 2 |
| GM/GS-15 | 2 | 5 |
| OTBER GM/GS | 5 | 9 |
| TOTAL | 18 | 18 |

### DIRECTOR, SHUTTLE OPERATIONS

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 1 | 1 |
| GM/GS-14 | 15 | 15 |
| OTBER GM/GS | 85 | 86 |
| TOTAL | 108 | 109 |

### DIRECTOR, SHUTTLE LOGISTICS PROJECT MANAGEMENT

| | CY89 | CY90 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 1 | 1 |
| GM/GS-14 | 8 | 8 |
| OTBER GM/GS | 53 | 54 |
| TOTAL | 69 | 70 |

### DIRECTOR, SAFETY & RELIABILITY

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 3 | 3 |
| GM/GS-14 | 4 | 4 |
| OTHER GM/GS | 16 | 18 |
| TOTAL | 84 | 86 |

### DIRECTOR, QUALITY ASSURANCE

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 2 | 2 |
| GM/GS-14 | 4 | 4 |
| OTHER GM/GS | 110 | 214 |
| TOTAL | 211 | 221 |

### DIRECTOR, FACILITIES ENGINEERING

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 3 | 3 |
| GM/GS-14 | 9 | 9 |
| OTBER GM/GS | 61 | 61 |
| TOTAL | 74 | 74 |

### DIRECTOR PAYLOAE PROJECTS MANAGEMENT

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM GS-15 | 5 | 5 |
| GM/GS-14 | 19 | 19 |
| OTHER GM/GS | 23 | 23 |
| TOTAL | 48 | 48 |

### DIRECTOR, VEHICLE ENGINEERING

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 14 | 14 |
| GM/GS-14 | 36 | 36 |
| OTHER GM/GS | 306 | 310 |
| TOTAL | 351 | 361 |

### DIRECTOR, GROUND ENGINEERING

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 8 | 8 |
| GM/GS-14 | 17 | 18 |
| OTHER GM/GS | 127 | 130 |
| TOTAL | 153 | 151 |

### DIRECTOR, MECHANICAL ENGINEERING

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM/GS-15 | 4 | 4 |
| GM/GS-14 | 14 | 14 |
| OTHER GM/GS | 78 | 78 |
| TOTAL | 91 | 91 |

### DIRECTOR, ELECTRONIC ENGINEERING

| | FY89 | FY90 |
|---|---|---|
| | 1 | 1 |
| GM/GS-15 | 6 | 6 |
| | 18 | 19 |
| OTHER GM/GS | 108 | 110 |
| TOTAL | 133 | 136 |

### DIRECTOR, STS PAYLOAD OPERATIONS

| | CY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| | 8 | 8 |
| GM/GS-15 | 28 | 28 |
| OTHER GM/GS | 116 | 178 |
| TOTAL | 213 | 215 |

### DIRECTOR, EXPENDABLE VEHICLES

| | FY89 | FY90 |
|---|---|---|
| SES | - | - |
| GM/GS-15 | 4 | 4 |
| GM/GS-14 | 6 | 6 |
| OTHER GM/GS | 24 | 20 |
| TOTAL | 34 | 30 |

MARSHALL
SPACE FLIGHT CENTER

**RESEARCH AND PROGRAM MANAGEMENT**

**FISCAL YEAR 1990 ESTIMATES**

## GEORGE C. MARSHALL SPACE FLIGHT CENTER

### DESCRIPTION

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

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

The Michoud Assembly Facility, located 15 miles east of downtown New Orleans, Louisiana, is where the external tanks for the Space Shuttle are being manufactured and where activities for other Federal agencies are conducted. The Michoud Facility occupies 832 acres and provides 3,723,770 gross square feet of space, including the main assembly plant. The facility is located on the Gulf Intracoastal Waterway and has deep water access via the Mississippi River.

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

A number of individual facilities at MSFC and its component installations are unique within NASA, the Nation and the free world. The combined capability of the science and engineering laboratories, special development facilities, and test facilities provide a unique national resource for designing, developing, and testing large, complex space systems. The total capital investment of the Marshall Space Flight Center and its installations in Louisiana, including fixed assets in progress and contractor-held facilities at various locations was $955,504,000 as of September 30, 1988.

## 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 Freedom, 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 and upper stages. The Center also has a principal role for the design and development of manned vehicle systems; for Spacelab and payload mission management and payload definition and development; for design and development of large, complex, and specialized automated spacecraft; for management of materials processing in space activities; for solar and magnetospheric physics; and for astrophysics. MSFC has a primary role within NASA for the development and processing of space science and applications experiments. In addition, MSFC conducts a vigorous research and technology program and is involved in the study and definition of future programs, including significant roles contributing to the development of large, complex space structures, space propulsion systems, materials research, materials processing in space, power systems, guidance and control, fundamental electronics, advanced optical systems, and payload systems analysis and integration.

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

PRINCIPAL ROLES

Propulsion Systems - design, develop and procure propulsion-oriented systems and subsystems. Current focus is on Space Transportation Systems, including Space Shuttle main engine, solid rocket booster, advanced solid rocket motor, external tank, Orbital Maneuvering Vehicle, Inertial Upper Stage in cooperation with the Air Force, procurement of upper stages for NASA missions including monitoring commercially developed and produced upper stages such as the Payload Assist Module by McDonnell Douglas and the transfer orbit stage by Orbital Services Corporation. Through ground testing of SSME's in the Technology Test Bed, MSFC is advancing the propulsion technology for improved SSME's and future rocket engine development. Advanced program efforts are focused on analysis and definition of propulsion/transportation systems to meet national needs for the next 25 years. MSFC is currently leading NASA- wide efforts to define and plan for potential development of an unmanned cargo version of the Space Shuttle (Shuttle-C). In concert with other Centers and USAF, MSFC is continuing to lead in examing potential needs for new upper stages and concepts/plans to meet these needs. The Center also has a key role in joint NASA-DOD activities to identify promising systems and to implement technologies and advanced development to ensure a vigorous national posture in space transportation, specifically an Advanced Launch System (ALS). This includes propulsion/transportation systems for a next generation Space Shuttle, unmanned launch vehicles, heavy-lift launch vehicles, liquid rocket boosters, LOX/HC and LOX/$H_2$ engines, orbit transfer vehicles, and propulsion technologies for future high performance systems.

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

- Spacelab - focus is on program management, systems engineering, development of related payload carriers, procurement, flight and ground operations sustaining engineering.

- Advanced Development - technology advances focused on advanced missions.

Space Transportation Svstem (STS) Sustaining Engineering - provide sustaining engineering for STS propulsion system hardware and software to assure maintenance of the original design requirements throughout the life of the STS program, decrease the unit cost of manufacturing through design improvements, ensure flight safety through a rigorous ground test program for the Solid Rocket Motor and SSME and upgrade operational performance capabilities through product improvement redesign.

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

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

-- Hubble Space Telescope (HST) - The current focus is on completion of activities leading to the launch of the Hubble Space Telescope in 1989.

-- Advanced X-Ray Astronomy Facility (AXAF) - spacecraft development and utilization

-- Automated Servicing/Resupply/Retrieval Kits - definition and development of specialized mission kits to provide remote spacecraft servicing, resupply and retrieval capabilities supported by the Orbital Maneuvering Vehicle from the Shuttle and Space Station.

Tethered Satellite Svstem (TSS) - joint U.S./Italian endeavor involving development and scientific use of a system allowing operations from the Shuttle via a long tether.

Space Station Freedom - design, development, manufacturing, integration and checkout of the habitation and laboratory modules, the pressurized and unpressurized logistics elements; the resources nodes pressurized structure and cupolas; and the Environmental Control/Life Support System (ECLSS), the audio/video system, the thermal control system, and the manned systems. The development and operation of the Payload Operations Integration Center (POIC); sustaining engineering and operational support during the Space Station Freedom operations period.

Combined Release and radiation Effects Satellite (CRRES) - redesign, retest, and preparation of the CRRES spacecraft launch.

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

Microgravity Science and Applications - development of space processing discipline base, enlistment of user interest in potential applications, and development and management of space processing experiments and facilities.

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

**SUPPORTING ROLES**

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

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

## SUMMARY OF RESOURCES REQUIREMENTS

### Funding Plan By Function

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. Personnel and Related Costs | 163,235 | 171,331 | 172,963 | 182,623 |
| II. Travel | 6,538 | 8,196 | 6,779 | 7,287 |
| 111. Operation of Installation | 67,683 | 69,577 | 70,131 | 75,799 |
| A. Facilities Services | (26,866) | (28,285) | (27,330) | (30,723) |
| B. Technical Services | (10,621) | (13,094) | (10,853) | (12,076) |
| C. Management and Operations | (30.196) | (28.1981 | (31,948) | 133.000) |
| Total, fund requirements | 237,456 | 249,104 | 249,873 | 265,709 |

FY 1990 CONGRESSIONAL BUDGET
DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM

| MARSHALL SPACE FLIGHT CENTER | 1988 ACTUAL | 1989 BUDGET ESTIMATE | 1989 CURRENT ESTIMATE | 1990 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION.......................... | 377 | 430 | 430 | 517 |
| SPACE FLIGHT PROGRAMS................... | 1,550 | 1,725 | 1,623 | 1,594 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 501 | 628 | 548 | 534 |
| SPACE SHUTTLE...................... | 1,049 | 1,097 | 1,075 | 1,060 |
| SPACE SCIENCE AND APPLICATIONS..... | 694 | 645 | 704 | 734 |
| PHYSICS AND ASTRONOMY ............... | 576 | 538 | 591 | 631 |
| LIFE SCIENCES...................... | 0 | 0 | 0 | 0 |
| PLANETARY EXPLORATION............... | 0 | 0 | 0 | 0 |
| SPACE APPLICATIONS.................. | 118 | 107 | 113 | 103 |
| AERONAUTICS AND SPACE TECHNOLOGY........ | 201 | 125 | 204 | 246 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 0 | 0 | 0 | 0 |
| SPACE RESEARCH AND TECHNOLOGY....... | 201 | 125 | 204 | 246 |
| TRANSATMOSPHERIC RESEARCH & TECH.... | 0 | 0 | 0 | 0 |
| COMMERCIAL PROGRAMS.................... | 34 | 32 | 36 | 32 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE. | 0 | 0 | 0 | 0 |
| TRACKING AND DATA PROGRAMS........... | 14 | 14 | 14 | 14 |
| SUBTOTAL DIRECT................ | 2,870 | 2,971 | 3,011 | 3,137 |
| CENTER MANAGEMENT AND OPERATIONS........ | 481 | 490 | 470 | 470 |
| SUBTOTAL (FULL-TIME PERMANENTS).... | 3,351 | 3,461 | 3,481 | 3,607 |
| OTHER CONTROLLED FTE'S.................. (PMI's/CO-OPS/OTFTP's) | 81 | 90 | 90 | 90 |
| GRAND TOTAL (FULL-TIME EQUIVALENTS) | 3,432 | 3,551 | 3,571 | 3,697 |

## PROGRAM DESCRIPTION

Permanent Civil Service Workyears

### RESEARCH AND DEVELOPMENT

SPACE STATION........................................................................ 517

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

In 1990, the design, development, test, evaluation and production of components and subsystems will be continued by the prime contractor. MSFC will continue the technical assessment and evaluation of these activities including emphasis on SR&QA. A close working relationship will be maintained with other centers and NASA Headquarters to assure accomplishment of the technical, cost and schedule objectives of the Program. System engineering and integration, test and verification, and simulation efforts will be continued at MSFC. The Preliminary Design Review (PDR-MTC) which is the second formal Program review during Phase C/D, is scheduled for late 1990.

### SPACE FLIGHT PROGRAMS

SPACE TRANSPORTATION CAPABILITY DEVELOPMENT...................................... 534

Spacelab

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

Inertial Upper Stages (IUS)

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

Transfer Orbit Stage (TOS)

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

Payload Assist Module (PAM)

Activities include managing PAM-A inventory and performing upper stage and propulsion technical studies and investigations, including feasibility studies and materials investigations.

Solid Propulsion Integrity Program (SPIP)

Activities and work performed are focused on directly improving the engineering technology base for solid rocket motors (SRM's) with the specific objective to improve the overall success rate of SRM's. Efforts in the areas of nozzles, bondlines, propellants, combustion dynamics, and verification testing are ongoing. These efforts include work to: (1) improve analytical capabilities; (2) validate models use for design; (3) further characterize and define the behavior of materials currently used for design, (4) improve understanding of the processes involved in manufacturing SRM's and their components, fabrication and the influences of process and material variables on the final product; (5) develop criteria and techniques to enhance current capabilities and practices to nondestructively evaluate the acceptability of SRM elements; and (6) define and characterize some alternate design and construction approaches in selected areas.

Tethered Satellite System (TSS)

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

Orbital Maneuvering Vehicle (OMV)

Activities include continuation of system engineering and integration efforts, receipt of initial long lead procurement items, fabrication of STA subsystems, ground software PDR, and continued detailed design effort leading to a CDR in early FY-91.

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 FY 1990 advanced study activities include: (1) Shuttle C; (2) advanced transportation including reusable evolutionary upper stages, launch vehicle systems, new engines, and advanced recovery systems; (3) liquid rocket booster; (4) platforms and facilities in low-Earth and geosynchronous orbit such as the Tethered Satellite Systems and the geostationary platform; (5) orbital services such as satellite servicing applications and in-orbit assembly, maintenance and repair; and (6) flight demonstration studies.

Advanced Launch System Propulsion

NASA and the Air Force are conducting studies of engines and vehicles applicable to the Advanced Launch System (ALS). The ALS has the overall goal of reducing the cost of placing payloads in orbit by an order of magnitude. This goal will require a substantial reduction of life cycle cost with significant emphasis on recurring costs compared to current launch vehicles. The ALS propulsion activities at MSFC include Definitions Studies and Advanced Development. Based on the ALS goal, definition studies have baselined engine concepts and established the importance of a low cost engine, i.e., low acquisition cost, low operational cost, high reliability, and low life cycle cost for two new liquid rocket engine systems, the Space Transportation Booster Engine (STBE) and the Space transportation Main Engine (STME). These systems will be further defined in the Space Transportation Engine Program (STEP) Phase B effort which began in FY 1989. The emphasis toward low cost requires component/subsystem designs that utilize low cost fabrication techniques. The Advanced Development Program will provide full scale major components/subsystem design, fabrication and test to verify low cost design approaches. This activity includes turbopumps, thrust chambers, injectors, nozzles, gas generators, engine controllers, and engine valve/actuators. The results of this advanced development effort will provide data to be used in the STEP Phase B program.

| | Permanent Civil Service Workyears |
|---|---|
| SPACE FLIGHT. CONTROL, AND DATA COMMUNICATIONS | |
| SPACE SHUTTLE...... .... .... .......... ... .......... | 1,060 |

Activities include those necessary for the planned increase in flight rate including the proper emphasis on SRM&QA. This includes the analysis of the flight hardware performance (including the redesigned SRM joint/seal, SRB SSME, and ET) as the Shuttle flights continue. This effort also provides main engines for a four Space Shuttle orbiter fleet and continues a logistics support capability to provide spares hardware. Activity will continue in the development of an alternate turbopump for the Shuttle main engine, as will certification testing of the engine design changes which will be incorporated in the SSME flight engine for margin improvements. Development activity for the Advanced Solid Rocket Motor will continue in FY-90.

Included in this activity is the standard operational support services for the Space Shuttle in the operations phase. Major activity in 1990 will be associated with the increased rate of Shuttle flights. Other activities will include the production, overhaul, and acquisition of hardware for Shuttle flights. The flight hardware program element provides for the procurement of external tanks, solid rocket motors and propellants, booster hardware and replenishment spare components and overhaul for the main engine. Typical functions will be production engineering, manufacturing, sustaining engineering, anomaly resolution, logistics, configuration mangement, systems level analysis, test and integration tasks, ground operations, and contract management.

**SPACE SCIENCE AND APPLICATIONS**



Hubble Space Telescope (HST)

The objective of the project is to place in orbit via the Space Shuttle a high-quality optical 2.4-meter telescope system for use by the astronomical community in conjunction with NASA. MSFC is the lead center for the management of the project and has overall implementation responsibility under the Office of Space Science and Applications (OSSA). The HST project includes the design, development, delivery, launch, orbital verification, mission/science operations activities, data analysis and in-orbit servicing. The total HST project responsibility, including management, operations, and maintenance and refurbishment, will be phased over to GSFC approximately one-year after the launch, now scheduled for late 1989.

Gamma Ray Observatory

The objective of the Gamma Ray Observatory (GRO) is to measure gamma radiation from the universe, and to explore the fundamental physical processes involved. MSFC has responsibility for the design, development and operation of the Burst and Transient Source Experiment (BATSE) which is one of the four experiments developed for the GRO mission. BATSE hardware was delivered in July 1988 for integration and at the GRO integration contractor facility test activities will continue in FY 1990.

Advanced X-Ray astrophysics Facility (AXAF)

**AXAF** will be a Shuttle-launched X-ray telescope system for studies of stellar structure and evolution, large scale galactic phenomena, and the nature of active galaxies. It will operate in a 28.5 degree, 300-nautical mile orbit. The observatory will weigh approximately 30,000 pounds and will be about

45 feet long and 14 feet in diameter. A 15-year operational lifetime is planned through use of orbital servicing at the space station or from the orbiter. MSFC is assigned management responsibility for the entire AXAF program, through development and 15 years of operation. This includes flight systems development, ground systems development, science operations, mission operations, and servicing, including development of replacement science instruments.

Payload Mission Management

In FY 1990, MSFC will be responsible for managing and planning activities of the Astro, Atlas, International Microgravity Laboratory (IML), Spacelab J, United States Microgravity Laboratory (USML), Materials Science Laboratory (MSL), and other dedicated and partial payload missions as assigned. MSFC is also responsible for the definition and development of selected payloads, facilities, and instruments to be flown on these missions.

Mission management responsibility begins with the definition of the payload complement and ends with the dissemination and analysis of the experiment data and materials resulting from the flight. During FY 1990, MSFC will continue to manage the assigned mission planning and definition activities, as well as development of the required instruments and supporting hardware and software.

Interfaces will continue to be maintained in 1990 with the cognizant NASA program offices, principal investigators, and other appropriate organizations to assure accomplishment of the scientific objectives of the assigned missions. MSFC will continue to participate in and manage the analysis of the requirements, objectives, and constraints of the STS systems and payload complements in order to develop requirements for all levels of integration to ensure physical, functional, and operational compatibility for all assigned missions.

Supporting Research and Technology

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

Permanent Civil
Service Workvears

SPACE APPLICATIONS.......................... ................................ 103

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 FY 1990, MSFC will continue to embody research and development activities in such areas as: crystal growth, containerless processing, fluid and chemical processing, and solidification of metals and alloys. Other ongoing activities include engineering and scientific analyses, advanced studies, definition, design, development, and operations of materials processing payloads.

Combined Release and Radiation Effects Satellite (CRRES)

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

Atmospheric Supporting Research

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

Permanent Civil
Service Workvears

**AERONAUTICS AND SPACE TECHNOLOGY**

SPACE RESEARCH AND TECHNOLOGY........................................................ 246
The space research and technology activities are in propulsion controls and guidance, robotics, autonomous systems, sensor technology, control of flexible structures, in-space assembly, construction and autonomous

rendezvous and docking, and flight experiments including the Aeroassist Flight Experiments. The primary effort in 1990 will be on developing and extending the technoiogy base in support of current and future space transportation systems and large space systems.

COMMERCIAL PROGRAMS AND TECHNOLOGY UTILIZATION ........................................ 32

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

The Technology Utilization Office develops, implements, and administers programs for Marshall Space Flight Center, involving applications projects, space benefits reporting, identification and evaluation of new technology derived from MSFC development programs, both in-house and contractor-performed, and dissemination to the Nation's industrial, governmental agencies, and educational communities for the benefit of the Nation's economy.

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

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

CENTER MANAGEMENT AND OPERATIONS SUPPORT.......................................... 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, Administraiive Operations, Legal, Patent Counsel, Equal Opportunity, Public Affairs.

Management Support - Those who provide management and support services to all levels of Center management, both program and functional. Specific functions include 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

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| **A. PERSONNEL AND RELATED COSTS**................ | 163.235 | 171.331 | 172,963 | 182,623 |

### Basis of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. compensation and Benefits | | | | |
| 1. Compensation | | | | |
| a. Full-time permanent..................... | 136.508 | 141.635 | 142.566 | 150.548 |
| b. Other than full-time permanent........... | 1.692 | 1.960 | 1.806 | 1.806 |
| c. Overtime and other compensation.......... | 2.079 | 2.231 | 2.372 | 2.582 |
| Subtotal. Compensation.................. | 140.279 | 145.826 | 146.744 | 154.936 |
| 2. Benefit..................................... | 20.930 | 22.891 | 23.732 | 25.074 |
| Subtotal. Compensation and Benefits..... | 161.209 | 168.717 | 170.476 | 180.010 |
| B. Supporting Costs | | | | |
| 1. Transfer of personnal...................... | 497 | 912 | 785 | 834 |
| 2. Personnel training......................... | 1.529 | 1,702 | 1.702 | 1.779 |
| Subtotal. Supporting Costs.............. | 2.026 | 2.614 | 2.487 | 2.613 |
| Total. Personnel and Related Costs........... | 163.235 | 171.331 | 172.963 | 182.623 |

## Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. Compensation and Benefits.......................... | 161,209 | 168,717 | 170,476 | 180,010 |
| 1. Compensation.................................. | 140,279 | 145,826 | 146,744 | 154,936 |
| a. Full-time permanent......................... | 136,508 | 141,635 | 142,566 | 150,548 |

The increase from the 1989 Budget Estimate to the 1989 Current Estimate is based on 1988 actuals and the payraise. The increase from the 1989 Current Estimate and the 1990 Budget Estimate is due to the increased permanent FTE's and the full year effect of the FY 1989 payraise.

### Basis of Cost for Permanent Workyears

In 1990 the cost of permanent workyears will be $149,701,000.

| | | |
|---|---|---|
| Cost of full-time workyears in 1989................................... | | 142,566 |
| Cost changes in 1990.................................................... | | 9,587 |
| Within Grade and Career advances: | | |
| Full-year effect of 1989 actions.......................... | 1,663 | |
| Partial year effect of 1990 actions....................... | 2,200 | |
| Additional FTE............................................ | 5,724 | |
| Changes in reimbursements................................. | 0 | |
| Turnover effect........................................ | | -1.605 |
| Full-year 1989 effect.................................... | -955 | |
| Part year 1990 effect.................................... | -650 | |
| Cost of FTP workyears in 1990......................... | | 150,548 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| b. Other than full-time permanent | | | | |
| (1) cost........................................ | 1,692 | 1,960 | 1,806 | 1,806 |
| (2) Manyears.................................... | 126 | 136 | 132 | 132 |

The decrease in manyears from the 1989 Budget Estimate to the 1989 Current Estimate is due to a reduction in the Co-op program in 1988, but is planned to increase to 79 in the 1989 timeframe.

The 1989 Current Estimate and the 1990 Budget Estimate reflect the same level of effort.

Distribution of Other Than Full Time Permanent Workvears

| Program | Workvears |
|---|---|
| Cooperative education programs.................................................... | 79 |
| Other temporary programs.......................................................... | 11 |
| Youth opportunity programs........................................................ | 42 |
| Total............................................................................. | 132 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| c. Overtime and Other Compensation.............. | 2,079 | 2,231 | 2,372 | 2,582 |

The 1989 Budget Estimate differs from the 1989 current Estimate due to the 1989 payraise. The 1989 Current Estimate and the 1990 Budget Estimate reflects the increased shuttle flight rate and the full year effect of the 1989 payraise.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Benefits.................................... | 20.930 | 22.891 | 23,732 | 25,074 |

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

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| Category of Cost | | | | |
| Retirement Fund and Thrift Plan | 10,808 | 11,057 | 11,195 | 11,356 |
| Employee life insurance | 287 | 417 | 292 | 305 |
| Employee health insurance | 5,219 | 5,832 | 6,661 | 7,448 |
| FICA | 1,549 | 2,180 | 2,258 | 2,431 |
| Unemployment Compensation | 6 | 10 | 10 | 10 |
| Workmen's Compensation | 1,536 | 1,662 | 1,491 | 1,624 |
| Medicare | 1,525 | 1,733 | 1,825 | 1,900 |
| Total | 20,930 | 22,891 | 23,732 | 25,074 |

The increase of the 1989 current estimate from the 1989 budget estimate is due to the 1989 payraise, additional workforce and increased health benefits. The increase in the 1989 Current Estimate and the 1990 Budget Estimate is due to the full year effect of increased health benefits rates, the 1989 payraise, and increased civil service workforce.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| B. Supporting Costs | 2,026 | 2,614 | 2,487 | 3,613 |
| 1. Transfer of personnel | 497 | 912 | 735 | 834 |

This estimate provides for personnel relocation costs, such as the expenses of selling and buying a home and the movement of household goods. The decrease from the 1989 budget estimate to the 1989 current estimate is based on 1988 actual experience and anticipated hiring plans. The major reason for the cost increase from the 1989 Current Estimate to the 1990 Budget Estimate is due to an increase in the number of hires eligible for Permanent Change of Station reimbursement and increased relocation costs.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Personnel training | 1,529 | 1,702 | 1,702 | 1,779 |

The purpose of the MSFC training program is to continue the development of skills and knowledge of civil service employees in order to more efficiently support MSFC's roles and missions in the space program. The benefits to be derived by NASA from the training and educational programs conducted at MSFC include: enhancement of scientific and engineering leadership in the scientific community; maintenance of a high degree of professional competency with the administrative and clerical work force; development of needed skills and knowledge required in MSFC mission activities; and extending MSFC work force capability and increasing productivity. The increase from the 1989 Current Estimate to the 1990 Budget Estimate is due to required training for new hires in 1989 and 1990 and on-going training to support the Center's computer capabilities and other technical requirements.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 11. TRAVEL.................................... | 6,538 | 8.196 | 6.779 | 7,287 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel........................... | 5,616 | 7,299 | 5,856 | 6,299 |
| B. Scientific and Technical Development Travel.................................. | 258 | 197 | 274 | 287 |
| C. Management and Operations Travel........... | 664 | 700 | 649 | 701 |
| TOTAL TRAVEL........................... | 6.538 | 8.196 | 6,779 | 7.287 |

Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel | 5.616 | 7.299 | 5.856 | 6.299 |

Program travel is directly related to the accomplishment of the Center's mission, and accounts for almost eighty-four percent of total travel. Travel requirements include those for ongoing programs such as the Shuttle, Spacelab, Space Station, OMV, Upper Stages, Space Telescope, Spacelab Payloads, Space Science and Applications payloads and basic supporting research and technology, as well as support to the planning and definition of potential new programs. The decrease in the 1989 budget estimate to the 1989 current estimate is due to a reduction in funding availability and a re-priorization of requirements. FY 1989 travel will be consistent with FY 1988 levels. The anticipated increase in 1990 travel costs is due to increased requirements in support of Space Shuttle payloads, Space Telescope, and Space Station activities, in addition to projected growth in the cost per trip.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Scientific and Technical Development Travel........ | 258 | 197 | 274 | 287 |

Scientific and technical related travel permits employees to participate in meetings and technical seminars with representatives of the aerospace community. This participation allows them to maintain and to grow in technical excellence, and they benefit from exposure to technological advances outside MSFC, as well as to present both accomplishments and concerns to their associates. These meetings are principally working panels convened to solve problems for the benefit of the Government. Travel costs in 1989 and 1990 will permit the same level of travel as in 1988.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| C. Management and Operations Travel................... | 664 | 700 | 649 | 701 |

Management and Operations travel is required for the direction and coordination of general management matters. It includes travel by managers in such areas as personnel, financial management, and procurement activities and travel of the Center's top management to NASA Headquarters and other NASA Centers. This category of travel includes lease of aircraft, local travel, passenger vehicle rental and non-NASA travel. The lease of aircraft provided transportation during 1988 until NASA 3 completed its 20,000 hour check. 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 1989 and 1990 travel costs provide for the same level of travel as in 1988.

| | | 1989 | | 1990 |
|---|---|---|---|---|
| | 1988 Actual | Budget Estimate | Current Estimate | Budget Estimate |
| | | (Thousands of Dollars) | | |
| 111. **OPERATION OF INSTALLATION**...................... | 67.683 | 69,577 | 70,131 | 75.799 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| A. Facilities Services.......................... | 26,866 | 28,285 | 27,330 | 30,723 |
| B. Technical Services........................... | 10,621 | 13,094 | 10,853 | 12,076 |
| C. Management and Operations.................... | 30,196 | 28,198 | 31,948 | 33,000 |
| Total, Operation of Installation............. | 67.683 | 69,577 | 70.131 | 75,799 |

Explanation of Fund Requirements

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

The increase in the 1989 current estimate over the 1989 budget estimate is due to restoration of funding for supplies, materials and equipment deferred from 1988. The increased FY 1990 Budget Estimate provides for anticipated utility rate increases at the planned level of usage, anticipated mission service contractor rate increases at the planned level of usage, anticipated price levels for other required goods and services. including support to the additional civil service work force.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. FACILITIES SERVICES............................. | 26.866 | 28.285 | 27.330 | 30.723 |

The Marshall Space Flight Center occupies 1,841 acres under a Department of the Army non-revocable lease in a complex of science and engineering laboratories and special development and test facilities. The complex encompasses approximately 3.8 million gross square feet of building space on Redstone Arsenal. This physical plant houses an average daily on-Center population of approximately 5,824 personnel.

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property...................... | 105 | 0 | 200 | 209 |
| 2. Maintenance and Related Services.............. | 7,828 | 7.338 | 6,674 | 9.045 |
| 3. Custodial Services........................... | 5,420 | 5.537 | 5.790 | 5.957 |
| 4. Utility Services............................. | 13,513 | 15,410 | 14,666 | 15,512 |
| Total, Facilities Services.................. | 26,866 | 28,285 | 27.330 | 30,723 |

Expanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property...................... | 105 | 0 | 200 | 209 |

Provides for lease of off-site space for the Space Station, Advanced X-Ray Astrophysics Facility, and Advanced Solid Rocket Motor Source Evaluation Boards. The increase from the 1989 budget estimate to the 1989 current estimate is based on 1988 actuals. The 1990 estimate provides for the same level of requirements as 1989.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Maintenance and Related Services............. | 7.828 | 7.338 | 6,674 | 9,045 |

This activity involves maintenance and operation of a total of 234 facilities (buildings, structures, and trailers). The decrease in the 1989 current estimate from the 1989 budget estimate is deferral of maintenance and repair projects due to budget reductions. The increase in 1990 is due to restoration of delayed critical maintenance and repair projects and support of additional permanent employees.

| | | | | |
|---|---|---|---|---|
| 3. Custodial Services.......................... | 5,420 | 5.537 | 5,790 | 5,957 |

Custodial services include janitorial services, security services, fire protection, trash removal, sanitary landfill operations, and related supplies and materials. Janitorial services are provided to about 3.5 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 1989 Current increase over the 1989 Budget estimate is due to restoration of funding for equipment and materials deferred from 1988. The 1990 increase reflects essentially the same level of activity as the 1989 Current Estimate at anticipated price levels.

| | | | | |
|---|---|---|---|---|
| 4. Utility Services... ............. | 13.513 | 15,410 | 14,666 | 15.512 |

This function provides for the cost of electricity, steam, natural gas, water, and sewage disposal service provided by Redstone Arsenal Support Activity (RASA) on a reimbursable basis. It also provides for the propane and burner fuel to generate steam for heating and cooling. The decrease from the 1989 Budget Estimate to the 1989 Current Estimate is based on 1988 actual experience and rates associated with the RASA agreements. The increase in the 1990 estimate reflects increased utility rates and increased consumption due to the reactivation of Test Stand 4670 and associated advanced LOX/Hydrocarbon engine system and component tests and increased center activity associated with the Shuttle launches.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. TECHNICAL SERVICES............................ | 10.621 | 13,094 | 10,853 | 12.076 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing.................. | 6.589 | 7.662 | 6.652 | 7.440 |
| 2. Scientific and Technical Information......... | 1.692 | 1.778 | 1.785 | 1.785 |
| 3. Shop Support Services....................... | 2.340 | 3,654 | 2,416 | 2,851 |
| Total, Technical Services.................. | 10.621 | 13,094 | 10,853 | 12,076 |

Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing.................. | 6,589 | 7.662 | 6.652 | 7,440 |

Funds provide centralized systems analysis, systems and applications, operations, and related computational services to meet the management and administrative computing requirements. This category also includes maintenance of ADP equipment such as central site computers and associated equipment. Activities supported include IBM 3083, systems software, and data base management system and administrative/institutional application software development.

The decrease from the 1989 Budget Estimate to the 1989 Current Estimate is due essentially to delay in purchase of equipment due to budget constraints. The increase from the 1989 Current Estimate to the 1990 Budget Estimate provides for anticipated mission service contractor rate increases, funding for purchase of equipment delayed from prior years, and skill mix changes required by the contractor to support more sophisticated software applications.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Scientific and Technical Information............ | 1,692 | 1,778 | 1.785 | 1,785 |

This activity provides for the cost sharing operation of the Redstone Scientific Information Center (RSIC) library on Redstone Arsenal and other scientific and technical information services. Scientific information and library services are provided to MSFC employees and associated NASA contractor personnel through RSIC operations. The RSIC contains a central collection of books and journals, periodicals, documents on microfilm, and technical papers. Operation of the RSIC by the Army is under direction of a joint MSFC/Army Redstone scientific information board, with shared costs. These funds also provide for MSFC's share of the operation of the MSFC Visitor Information Center located at the Alabama Space and Rocket Center. The increase in the 1989 Current Estimate and the 1990 Budget Estimate provides a consistent level of effort based on N 1988 actual cost.

| | | | | |
|---|---|---|---|---|
| 3. Shop and Support Service.......................... | 2,340 | 3,654 | 2.416 | 2.851 |

These funds provide the Center with support in the areas of graphics, photographic services, and related supplies, materials, and equipment. The decrease from the 1989 Budget Estimate to the 1989 Current Estimate is due to the deferral of equipment and supplies and skill mix changes within the Consolidated Institutional Contract. The increase in the 1990 Budget Estimate is based on additional mission service contractor manyears to support the growing requirement associated with program workload.

| | | | | |
|---|---|---|---|---|
| C. MANAGEMENT AND OPERATIONS......................... | 30,196 | 28.198 | 31.948 | 33.000 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications.................. | 17,586 | 14,469 | 15,819 | 15,819 |
| 2. Printing and Reproduction...................... | 651 | 808 | 831 | 835 |
| 3. Transportation................................. | 3,399 | 3,963 | 3,676 | 4,201 |
| 4. Installation Common Services................... | 8,560 | 8.958 | 11,622 | 12.145 |
| Total, Management and Operations................ | 30.196 | 28,198 | 31,948 | 33,000 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications.................. | 17.586 | 14,469 | 15,819 | 15.819 |

Communications support for MSFC consists of local administrative telephone service, local area data networks, local base/mobile/portable radio services to include radio paging, the MSFC Emergency Warming System, and the MSFC fire Surveillance System. The MSFC Private Automated Branch Exchange (PABX) furnishes local telephone service as provided by Boeing Computer Support Services. Federal Telephone Service (FTS) is provided by GSA, long distance tolls by South Central Bell (SCB), and American Telephone and Telegraph Communications (AT&T COM). AUTODIN network, furnished by the Air Force, is a secure digital message system that provides institutional support in sending classified and non-classified messages in a classified mode. The AUTODIN network is also used to interface with world-wide DOD elements in ordering supplies and materials from the Defense Logistics Agency. The increase from the 1989 Budget Estimate to the 1989 Current Estimate reflects adjusted price levels for long distance tolls (FTS) and other required communication associated equipment. The FY 1990 Budget provides for the same level of service as 1989.

| | | | | |
|---|---|---|---|---|
| 2. Printing and Reproduction ..................... | 651 | 808 | 831 | 835 |

A portion of MSFC's printing and reproduction requirements is met by a contractor operated on-site reproduction plant. MSFC also purchases reproduction services from the Government Printing Office, Redstone Arsenal Support Activity, and private firms. Off-site printing is an overflow requirement that cannot be handled within the on-site workload or capability. The 1989 Current Estimate and 1990 Budget Estimates reflect essentially the continuation of the level of funding planned in the 1989 Budget estimate at revised rates.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 3. Transportation................................ | 3.399 | 3.963 | 3.676 | 4,201 |

Transportation includes operation and maintenance of vehicles and aircraft, transportation of related supplies and materials, and purchases of transportation equipment. Included is the maintenance of general purpose vehicles, material handling equipment, special purpose trailers and vehicles, equipment such as cranes, tractors, generators and welders; and intermediate and major inspections. Freight charges for shipment of materials and equipment by both surface and air transportation are also included. The decrease in the 1989 Current Estimate from the 1989 Budget Estimate is due to a deferral of aging vechicle replacement. The increase in the 1990 Budget Estimate is for the replacement of general purpose motor vehicles that exceed GSA replacement standards and for anticipated rate increases.

| | | | | |
|---|---|---|---|---|
| 4. Installation Common Services................... | 8.560 | 8,958 | 11,622 | 12,145 |

This activity provides administrative support to Center management and staff activities, medical services, and various other installation support services. Installation support services include maintenance and repair of office equipment, equipment rental, acquisition of supplies and materials and other miscellaneous services such as: (1) receiving supplies, materials, and equipment; (2) distributing supplies, materials, equipment, and program-critical hardware; (3) preparing supplies, materials, and equipment for shipment, and (4) warehousing of raw materials.

Center management and staff functions include patent counsel services, tort claims, and equal opportunity activities. Medical services provide occupational medicine and environmental health services for the maintenance and improvement of employee health at MSFC, with emphasis on prevention, diagnosis, treatment, and care of illnesses and injuries. 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 repair, and postage; and acquisition of supplies and materials. The increase from the 1989 Budget Estimate to the 1989 Current Estimate is to restore funding for supplies, materials, and equipment deferred from prior year due to budget constraints. The increase from the 1989 Current Estimate to the 1990 Budget Estimate is essentially for supplies, materials, and equipment to support the additional civil service workforce and for office space rehabilitation.

3-1443-8-44

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

**OFFICE OF DIRECTOR**

| | FY89 | FY90 |
|---|---|---|
| SES | 6 | 6 |
| GS-16 | | |
| GS-15 | | |
| GS-14 | | |
| ALL OTHER GS | 6 | 6 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 12 | 12 |

**MSFC SUMMARY**

| | FY89 | FY90 |
|---|---|---|
| SES | 50 | 50 |
| GS-16 | 1 | 1 |
| GS-15 | 310 | 320 |
| GS-14 | 560 | 570 |
| ALL OTHER GS | 2600 | 2700 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 3520 | 3640 |

**ASSOCIATE DIRECTOR FOR SCIENCE**

| | FY89 | FY90 |
|---|---|---|
| SES | * | * |
| GS-16 | | |
| GS-15 | | |
| GS-14 | 1 | 1 |
| ALL OTHER GS | 1 | 1 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 3 | 3 |

**EXECUTIVE STAFF**

| | FY89 | FY90 |
|---|---|---|
| SES | | |
| GS-16 | | |
| GS-15 | 1 | 1 |
| GS-14 | 1 | 1 |
| ALL OTHER GS | 11 | 11 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 13 | 13 |

**SAFETY, REL, MAINT, & QUAL ASSUR OFFICE**

| | FY89 | FY90 |
|---|---|---|
| SES | 3 | 3 |
| GS-16 | | |
| GS-15 | 9 | 9 |
| GS-14 | 21 | 21 |
| ALL OTHER GS | 132 | 132 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 165 | 165 |

**PUBLIC AFFAIRS OFFICE**

| | FY89 | FY90 |
|---|---|---|
| SES | | |
| GS-16 | | |
| GS-15 | 1 | 1 |
| GS-14 | 4 | 4 |
| ALL OTHER GS | 16 | 16 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 21 | 21 |

**CHIEF COUNSEL**

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GS-16 | | |
| GS-15 | 3 | 3 |
| GS-14 | 2 | 2 |
| ALL OTHER GS | 9 | 9 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 15 | 15 |

**CENTER COMPTROLLER**

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GS-16 | | |
| GS-15 | 3 | 3 |
| GS-14 | 8 | 8 |
| ALL OTHER GS | 99 | 99 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 112 | 112 |

**ADMINISTRATIVE OPERATIONS OFFICE**

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GS-16 | | |
| GS-15 | 3 | 3 |
| GS-14 | 10 | 10 |
| ALL OTHER GS | 168 | 168 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 182 | 182 |

**EQUAL OPPORTUNITY OFFICE**

| | FY89 | FY90 |
|---|---|---|
| 01.11 | | |
| GS-15 | | |
| 01.14 | 1 | 1 |
| | 4 | 6 |
| TOTAL PERMANENT | 1 | |
| TOTAL PERMANENT | 7 | 7 |

**SHUTTLE PROJECTS OFFICE**

| | FY89 | FY90 |
|---|---|---|
| SES | 5 | 5 |
| GS-16 | | |
| GS-15 | 25 | 25 |
| GS-14 | 36 | 36 |
| ALL OTHER GS | 110 | 110 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 186 | 186 |

**SPECIAL PROJECTS OFFICE**

| | FY89 | FY90 |
|---|---|---|
| SES | 2 | 2 |
| GS-16 | | |
| GS-15 | 9 | 9 |
| GS-14 | 8 | 8 |
| ALL OTHER GS | 14 | 14 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 33 | 33 |

**HUBBLE SPACE TELESCOPE PROJECT OFFICE**

| | FY89 | FY90 |
|---|---|---|
| SES | 3 | 3 |
| GS-16 | | |
| GS-15 | 6 | 6 |
| GS-14 | 19 | 19 |
| ALL OTHER GS | 27 | 27 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 55 | 55 |

**PAYLOAD PROJECTS OFFICE**

| | FY89 | FY90 |
|---|---|---|
| SES | 4 | 4 |
| GS-16 | | |
| GS-15 | 12 | 12 |
| GS-14 | 32 | 32 |
| ALL OTHER GS | 55 | 55 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 103 | 103 |

**SPACE STATION PROJECTS OFFICE**

| | FY89 | FY90 |
|---|---|---|
| SES | | |
| GS-16 | | |
| GS-15 | 1 | 1 |
| 01.14 | 23 | 23 |
| ALL OTHER GS | 38 | 38 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 72 | 72 |

**HEAVY LIFT LAUNCH VEHICLE DEFINITION OFFICE**

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GS-16 | | |
| GS-15 | 1 | 1 |
| GS-14 | 1 | 1 |
| ALL OTHER GS | 4 | 4 |
| WAGE ~~O-U-M~~ | | |
| TOTAL PERMANENT | 7 | 7 |

**PROGRAM DEVELOPMENT**

| | FY89 | FY90 |
|---|---|---|
| SES | 3 | 3 |
| GS-16 | | |
| GS-15 | 21 | 21 |
| GS-14 | 35 | 35 |
| ALL OTHER GS | 93 | 93 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 152 | 152 |

**SCIENCE AND ENGINEERING**

| | FY89 | FY90 |
|---|---|---|
| SES | 14 | 14 |
| GS-16 | 1 | 1 |
| GS-15 | 95 | 105 |
| GS-14 | 321 | 331 |
| ALL OTHER GS | 1568 | 1668 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 1999 | 2119 |

**INSTITUTIONAL & PROGRAM SUPPORT**

| | FY89 | FY90 |
|---|---|---|
| SES | 3 | 3 |
| GS-16 | | |
| GS-15 | 14 | 14 |
| GS-14 | 32 | 32 |
| ALL OTHER GS | 314 | 314 |
| WAGE GRADE | | |
| TOTAL PERMANENT | 363 | 363 |

NOTE: ALL MANPOWER SHOWN IN EOY

C002
10-24-88

**STENNIS SPACECENTER**

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1990 ESTIMATES

JOHN C. STENNIS SPACE CENTER

DESCRIPTION

The John C. Stennis Space Center is located in southwest Mississippi, approximately 50 miles northeast of New Orleans, Louisiana. Total land area is 138,807 acres of which 13,480 acres make up the actual installation owned by NASA. The remaining 125,327 acres are held as a buffer zone. In the buffer zone, 7,162 acres are owned by NASA and 118,165 acres are under restrictive easements. The installation has deep water access via the Pearl River and the Intercoastal Waterway. Capital investment for the John C. Stennis Space Center, as of September 30, 1988, was $351,236,000.

CENTER ROLES AND MISSIONS

The John C. Stennis Space Center (SSC) formerly the National Space Technology Laboratories (NSTL), is NASA's prime static test facility for large liquid propellant rocket engines and propulsion systems. The redesignation of NSTL to the SSC in August 1988 recognized the role of the installation in space and environmental technology programs.

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

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

Advanced Launch Systems: - Will provide, maintain and manage the facilities, laboratories and related capabilities essential to the development of large propulsion systems.

Advanced Solid Rocket Motor: - Will provide support of ASRM production and test facilities including operational institutional and security support.

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

## SUMMARY OF RESOURCES REQUIREMENTS

### Funding Plan by Function

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| I. Personnel and Related Costs | 6,717 | 8,041 | 8,687 | 9.298 |
| II. Travel | 346 | 457 | 477 | 506 |
| III. Operation of Installation | 13,470 | 14,850 | 15,133 | 16,079 |
| A. Facilities Services | (5,439) | (7,319) | (5,896) | (6,451) |
| B. Technical Services | (3,492) | (2,926) | (3,704) | (3,677) |
| C. Management and Operations | (4,539) | (4,605) | (5,533) | (5,951) |
| Total, Fund Requirements | 20,533 | 23.348 | 24,297 | 25,883 |

FY 1990 CONGRESSIONAL BUDGET
DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM

| STENNIS SPACE CENTER | 1988 ACTUAL | 1989 BUDGET ESTIMATE | 1989 CURRENT ESTIMATE | 1990 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION.......................... | 3 | 4 | 7 | 7 |
| SPACE FLIGHT PROGRAMS................... | 73 | 70 | 66 | 68 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 34 | 0 | 20 | 24 |
| SPACE SHUTTLE...................... | 39 | 70 | 46 | 44 |
| SPACE SCIENCE AND APPLICATIONS .......... | 7 | 16 | 16 | 16 |
| PHYSICS AND ASTRONOMY .............. | 0 | 0 | 0 | 0 |
| LIFE SCIENCES...................... | 0 | 1 | 1 | 1 |
| PLANETARY EXPLORATION............... | 0 | 0 | 0 | 0 |
| SPACE APPLICATIONS.................. | 7 | 15 | 15 | 15 |
| AERONAUTICS AND SPACE TECHNOLOGY ....... | 0 | 0 | 0 | 0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 0 | 0 | 0 | 0 |
| SPACE RESEARCH AND TECHNOLOGY....... | 0 | 0 | 0 | 0 |
| TRANSATMOSPHERIC RESEARCH a TECH.... | 0 | 0 | 0 | 0 |
| COMMERCIAL PROGRAMS.................... | 12 | 13 | 23 | 23 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE. | 0 | 0 | 0 | 0 |
| TRACKING AND DATA PROGRAMS.............. | 0 | 0 | 0 | 0 |
| SUBTOTAL DIRECT................... | 95 | 103 | 112 | 114 |
| CENTER MANAGEMENT AND OPERATIONS........ | 45 | 56 | 54 | 60 |
| SUBTOTAL (FULL-TIME PERMANENTS).... | 140 | 159 | 166 | 174 |
| OTHER CONTROLLED FTE'S.................. (PMI's/CO-OPS/OTFTP's) | 9 | 10 | 9 | 10 |
| GRAND TOTAL (FULL-TIME EQUIVALENTS) | 149 | 169 | 175 | 184 |

PROGRAM LESCRIPTION

| | Permanent Civil Service Workyears |
|---|---|
| SPACE STATION.................... ..... ................................ | 7 |

During 1990, SSC/Science and Technology Laboratories, formerly Earth Resource Lab (ERL), will ensure the implementation of the commercial Earth and Ocean Observation Mission Study (EOOMS); refine requirements for a commercial remote sensing test facility on space station core elements; and, identify data management requirements for accommodation of commercial EOOMS onboard space station. The payload simulator is an evolutionary software product currently supporting GSFC and JSC and will be used in future end-to-end capability (EPC) at JSC. Additional support will be provided through the conversion of the existing Pascal software to ADA software currently residing on the ACLSS environmental control simulator at JSC.

| | |
|---|---|
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT..................................... | 24 |

In 1990, the John C. Stennis Space Center will continue to provide, maintain, and manage the facilities and the related capabilities required for development and acceptance testing of the Space Shuttle Main Engines and ALS, ASRM activities.

| | |
|---|---|
| SPACE FLIGHT CONTROL AND DATA COMMUNICATIONS................. ................ | 44 |

In 1990 the SSC will continue to provide, maintain and manage the facilities and the related capabilities required for Shuttle Production and Operations capability.

| | |
|---|---|
| SPACE SCIENCE AND APPLICATIONS................................................. | 16 |

In 1990, the SSC's Science and Tech Lab program will continue to

Conduct research investigations in the application of remotely sensed data using existing aircraft and satellite programs as a basic source of remotely sensed data in conjunction with surface data to develop techniques and procedures for practical applications.

Conduct applied research investigations for the application of new sensor data to priority information requirements of national concern in the areas of agricultural productivity, geological explorations, and land resources management including studies for aligning appropriate sensor technology with applicable discip1inary sequisements.

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

| | Permanent Civil Service Workyears |
|---|---|
| **COMMERCIAL PROGRAMS**....................................................... | 23 |

The opportunity of the Commercial Use of Space program is to increase private sector awareness of space opportunities and encourage increased 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 SSC Technology Utilization Program is responsible for identifying and reporting new NASA/SSC technology, and promoting the transfer of NASA technology to the public and private sector. Applications Engineering Projects are conducted with non-NASA users to adapt NASA technology for solving problems that have widespread public benefit and for improving the competitiveness of U.S. industry. The States of Louisiana and Mississippi maintain active technology transfer offices that team with the NASA Technology Utilization Office to promote the transfer of technology to users within their states. Programs of national scope are conducted with other government agencies and industry to expedite the transfer of NASA technology.

| | |
|---|---|
| **CENTER MANAGEMENT AND OPERATIONS SUPPORT**........................................... | 60 |

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

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

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

Operations Support - Those who manage or provide €or 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

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. Personnel and Related Costs | 6,717 | 8,041 | 8,687 | 9,298 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | | | | |
| 1. Compensation | | | | |
| A. Full-Time Permanent | 5,488 | 5,991 | 6,467 | 6,999 |
| B. Other than full-time permanent positions | 184 | 208 | 181 | 210 |
| C. Overtime and other compensation | 31 | 57 | 59 | 67 |
| Subtotal - Compensation | 5,703 | 6,256 | 6,707 | 7,276 |
| 2. Benefits | 918 | 1,239 | 1.535 | 1,550 |
| Subtotal - Compensation & Benefits | 6,621 | 7.495 | 8.242 | 8,826 |
| B. Supporting Costs | | | | |
| 1. Transfer of Personnel | 42 | 445 | 321 | 346 |
| 2. Personnel Training | 54 | 101 | 124 | 126 |
| Subtotal - Supporting Costs | 96 | 546 | 445 | 472 |
| Total Personnel and Related Costs | 6,717 | 8.041 | 8,687 | 9,298 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. Compensation and Benefits | 6,621 | 7,495 | 8,242 | 8,826 |
| 1. Compensation | 5,703 | 6,256 | 6,707 | 7,276 |
| A. Full Time Permanent | 5,488 | 5,991 | 6,467 | 6,999 |

The 1989 current estimate reflects additional civil service workforce and 1989 pay increase. 1990 includes additional civil service workforce and full year effect of 1989 pay raise.

## Basis of Cost for Permanent Workyears

In 1990, the cost of full-time workyears will be $6,999,000. The change is calculated as follows:

| | | |
|---|---|---|
| Cost of full-time workyears in 1989 | | 6,467 |
| Cost changes in 1990 | | 579 |
| Within Grade and Career advances: | | |
| Full year effect of 1989 actions | 3 | |
| Partial year effect of 1990 actions | 198 | |
| Additional FTE | 378 | |
| Changes in reimbursements | 0 | |
| Turnover effect | | -47 |
| Full year 1989 effect | -43 | |
| Part year 1990 effect | -4 | |
| Cost of FTP workyears in 1990 | | 6,999 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| b. Other than full-time permanent | | | | |
| 1. Cost | 184 | 208 | 181 | 210 |
| 2. Workyears | 15 | 10 | 14 | 15 |

The distribution of 1989 workyears is as follows:

Distribution of Other than Full-Time Permanent Workyears

| | Program Workyears |
|---|---|
| Developmental programs | |
| Summer employment program | 2 |
| Youth opportunity programs (Non-ceiling) | 6 |
| Other temporary programs | 7 |
| Total | 15 |

The change from the 1989 Budget Estimate to the 1989 Current Estimate is based on FY 1988 experience. The FY 1990 Budget reflects one additional temporary FTE.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| c. Overtime and other compensation | 31 | 57 | 59 | 67 |

The increase from the 1989 Budget Estimate to the 1989 Current Estimate and 1990 Budget Estimate is increases in GM performance awards due to increased workforce.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Benefits | 918 | 1.239 | 1.535 | 1,550 |

Following are the amounts of contribution by category:

| | | | | |
|---|---|---|---|---|
| Retirement Fund and Thrift Plan | 525 | aoa | 1,019 | 1,032 |
| Employee Life Insurance | 11 | 17 | 12 | 12 |
| Employee Health Insurance | 200 | 170 | 215 | 215 |
| FICA | 131 | 173 | 236 | 238 |
| Medicare | 51 | 71 | 53 | 53 |
| Other Benefits | 0 | 0 | 0 | 0 |
| Total | 918 | 1,239 | 1.535 | 1,550 |

The increase from the 1989 Budget Estimate to the 1989 Current Estimate and the 1990 Budget Estimate is the result of an increase in the number of employees.

| | | | | |
|---|---|---|---|---|
| B. Supporting Costs | 96 | 546 | 445 | 472 |
| 1. Transfer of personnel | 42 | 445 | 321 | 346 |

The estimates for 1989 and 1990 are based on projected hiring plans including anticipated relocations associated with increase in civil service workforce.

| | | | | |
|---|---|---|---|---|
| 2. Personnel training | 54 | 101 | 124 | 126 |

The personnel training program continues to develop the skills and knowledge of SSC employees in order to more effectively support SSC roles and missions, primarily through "Upward Mobility" training of women and minorities, and Equal Opportunity Seminars. Increases in the 1989 Current Estimate and the 1990 Budget Estimate are required for training of increased personnel and additional funding for NASA employee training to help maintain the current skill level.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 11. **TRAVEL** ................... ................... | 346 | 457 | 477 | 506 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel .............................. | 62 | 242 | 191 | 205 |
| B. Scientific and Technical Development Travel... | 33 | 4 | 36 | 39 |
| C. Management and Operations Travel.............. | 251 | 211 | 250 | 262 |
| Total Travel.............................. | 346 | 457 | 477 | 506 |

Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel ................................ | 62 | 242 | 191 | 205 |

Program travel requirements are directly related to the accomplishments of the Center's mission, and will primarily be in support of Space Science and Applications Programs and Advanced Launch System and Advanced Solid Rocket Motor activities. The decrease between the 1989 Budget Estimate and the 1989 Current Estimate is based on the 1988 actual expense with the addition of the Advanced Launch System and Advanced Solid Rocket Motor new programs requirements. The increase from the FY 1989 Budget Estimate to the 1990 Budget Estimate includes expected growth of existing programs.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| B. Scientific and Technical Development Travel.... | 33 | 4 | 36 | 39 |

Scientific and technical development travel will permit employees to participate in meetings and technical seminars with other representatives of the aerospace community. This participation allows them to retain their technical competency and gain awareness of technological advances outside SSC as well as to present both accomplishments and problems to their associates. Many of the meetings are working panels convened to solve certain problems for the benefit of the Government. The increase from 1989 Budget Estimate to the 1989 Current Estimate is a re-evaluation of requirements based on 1988 actual experience. 1990 is essentially the same level as 1989.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| C. Management and Operations Travel.............. | 251 | 211 | 250 | 262 |

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 Center's top management to NASA Headquarters and other NASA Centers. The increase from the 1989 Budget Estimate to the 1989 Current Estimate reflects expected transportation increases and new programs. The 1990 Budget Estimate is essentially the same level as 1989.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 111. OPERATION OF INSTALLATION...................... | 13,470 | 14,850 | 15,133 | 16,079 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| A. Facilities Services........................... | 5,439 | 7,319 | 5,896 | 6,451 |
| B. Technical Services........................... | 3,492 | 2,926 | 3,704 | 3,677 |
| C. Management and Operations.................... | 4,539 | 4,605 | 5,533 | 5,951 |
| Total - Operation of Installation............. | 13,470 | 14,850 | 15,133 | 16,079 |

Explanation of Fund Requirements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Center's institutional activities. These are divided into three major function areas: Facilities

Services, the cost of maintaining and repairing institutional facilities and equipment, and the cost of custodial services and utilities; Technical Services, the cost of educational and informational programs and technical shops supporting institutional activities; and Management and Operations, the cost of administrative communications, printing, transportation, and related services. The increase from the 1989 Budget Estimate to the 1989 Current Estimate is due to inclusion of ALS support in Management and Operations for communications and transportation. The 1990 increase reflects the anticipated rate increases in support service contracts, utilities, and other goods and services required at SSC.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. FACILITIES SERVICES............................... | 5,439 | 7.319 | 5.896 | 6.451 |

The SSC 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

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property........................ | 31 | 32 | 32 | 33 |
| 2. Maintenance and Related Services................ | 2.749 | 4,040 | 1.968 | 2,330 |
| 3. Custodial Services............................. | 839 | 836 | 1,781 | 1.862 |
| 4. Utility Services.............................. | 1,820 | 2,411 | 2,115 | 2.226 |
| Total, Facilities Services.................. | 5.439 | 7.319 | 5.896 | 6.451 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property........................ | 31 | 32 | 32 | 33 |

Provides for lease of hanger space for Science and Technology Laboratory.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Maintenance and Related Services................ | 2.749 | 4.040 | 1.968 | 2.330 |

This activity provides for the modifications, alternations and maintenance of installation facilities and movements of personnel and equipment of the Science and Technology Laboratories and purchase of O&M equipment and updated equipment to support the shop activities at SSC. The decrease from the 1989 Budget Estimate to the 1989 Current Estimate reflects the transfer of security to the custodial services function and deferrals of maintenance projects due to budget reductions. The 1990 increase reflects escalated cost for the same level of support and full year funding of support service contracts at expected contractor wage rates.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 3. Custodial Services............................ | 839 | 836 | 1.781 | 1.862 |

Provides for NASA's share of janitorial services and fire protection, services by the SSC institutional support services contractor. The increase from the 1989 Budget Estimate to the 1989 Current Estimate refects the transfer of Security services from the maintenance and related services function and the latest pricing data. The 1990 Budget Estimate reflects the same level of effort at anticipated contractor wage rates.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 4. Utility Services.............................. | 1,820 | 2.411 | 2.115 | 2.226 |

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 SSC. 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 1989 Budget Estimate to the 1989 Current Estimate is the result of lower than anticipated utility rates. The increase in the 1990 Budget Estimate reflects expected rates for utilities and anticipated support service contractor wage rates.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. TECHNICAL SERVICES............................. | 3.492 | 2.926 | 3.704 | 3.677 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing.................... | 1.311 | 1.280 | 1,578 | 1,469 |
| 2. Scientific and Technical Information.......... | 391 | 282 | 310 | 324 |
| 3. Shop Support and Services.................... | 1,790 | 1.364 | 1.816 | 1.884 |
| Total - Technical Services.................. | 3.492 | 2.926 | 3.704 | 3,677 |

Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing....................... | 1,311 | 1.280 | 1.578 | 1.469 |

Provides center institutional ADP support. The increase in the 1989 Current Estimate and the decrease in the 1990 Budget Estimate reflect appropriation realignment and changes in the share of ADP levels of effort.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Scientific and Technical Information............. | 391 | 282 | 310 | 324 |

Provides for books, periodicals, and other technical reports by the Center, and NASA's share of upgrading and operating the SSC Visitor Information Center (VIC). The increase from the 1989 Budget Estimate to the 1989 Current Estimate reflects an increase in the cost support for the Visitor Information Center. The 1990 estimate includes current requirements at expected cost levels.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 3. Shop Support and Services........................ | 1,790 | 1,364 | 1,816 | 1,884 |

Provides for NASA's share of such technical services as safety, photography and graphics. The 1989 Current Estimate reflects support service contractor activities growth to support additional civil service workforce and STS flights and testing. The increase in 1990 reflects expected contractor wage rates.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| C. MANAGEMENT AND OPERATIONS...................... | 4,539 | 4,605 | 5,533 | 5.951 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications................ | 2,911 | 2,727 | 3,573 | 3,635 |
| 2. Printing and Reproduction................... | 26 | 98 | 129 | 135 |
| 3. Transportation.............................. | 932 | 1,084 | 1,126 | 1,177 |
| 4. Installation Common Services................. | 670 | 696 | 705 | 1.004 |
| Total - Management and Operations......... | 4.539 | 4,605 | 5,533 | 5,951 |

Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications................ | 2.911 | 2.727 | 3.573 | 3,635 |

Provides for NASA's share of the local telephone service, Federal Telecommunications System (FTS), long distance, and operation and maintenance of the on-site communications equipment and switchboard and Institutional Telephone System. The increase from the 1989 Budget Estimate to the Current Estimate reflects actual rates and the addition of ALS support. The increase from the 1989 Current Estimate to the 1990 Budget Estimate reflects anticipated rates.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Printing and Reproduction.................. | 26 | 98 | 129 | 135 |

Provides for printing and reproduction services in support of the Science and Technology Laboratory and the SSC organization. The increase from the 1989 Budget Estimate to the 1989 Current Estimate reflects increased printing due to testing rate and more documentation is required. The increase from the 1989 Current Estimate to the 1990 Budget Estimate reflects expected cost escalation.

| | | | | |
|---|---|---|---|---|
| 3. Transportation.............................. | 932 | 1,084 | 1,126 | 1,177 |

This estimate includes local transportation for the SSC staff and the support contractors, as well as freight costs, government bills of lading, air freight, other general shipments and related transportation costs. The increase from the 1989 Budget Estimate to the 1989 Current Estimate is based on actual rates. The increase from the 1989 Current Estimate to the 1990 Budget Estimate reflects anticipated cost increases in vehicle rentals and additional ALS support.

| | | | | |
|---|---|---|---|---|
| 4. Installation Common Services.................. | 670 | 696 | 705 | 1,004 |

Provides supplies, materials and equipment for the Center. The increase from the 1989 Budget Estimate to the 1989 Current Estimate is due to rephasing of support service contractor obligation plans. The increase from the 1989 Current Estimate to the 1990 Budget Estimate reflects restoration of funding for delayed administrative equipment purchases records management program and inventory of supplies and materials.

# ORGANIZATION CHART

FY1990 CONGRESSIONAL BUDGET
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHN C. STENNIS SPACE CENTER

**SSC SUMMARY STAFFING**

| | | |
|---|---|---|
| GM-15 | | |
| GM-14 | 19 | 19 |
| All other G W M | 146 | 183 |
| TOTAL PERMANENT | 180 | 218 |

**OFFICE OF THE DIRECTOR**

| | FY89 | FY90 |
|---|---|---|
| SES | 3 | 3 |
| GM-15 | 0 | 0 |
| GM-14 | 1 | 1 |
| All other GSIGM | 2 | 3 |
| TOTAL PERMANENT | 6 | 7 |

**ALS PROJECT O f fICE**

| | FY89 | FY90 |
|---|---|---|
| GM-15 | 0 | 1 |
| GM-14 | 1 | 0 |
| All other GS/GM | 3 | 9 |
| TOTAL PERMANENT | 4 | 10 |

**CHIEF COUNSEL**

| | FY89 | FY90 |
|---|---|---|
| GM-15 | 1 | 1 |
| GM-14 | 0 | 0 |
| | 3 | 3 |
| TOTAL PERMANENT | 4 | 4 |

**PUBLIC AFFAIRS OFFICE**

| | FY89 | FY90 |
|---|---|---|
| GM-14 | 1 | 1 |
| All other GSIGM | 3 | 4 |
| TOTALPERMANENT | 4 | 5 |

**PERSONNEL OFFICE**

| | FY89 | FY90 |
|---|---|---|
| All other GSIGM | 5 | 5 |
| TOTAL PERMANENT | 5 | 5 |

**SAFETY/QUALITY AND HEALTH**

| | FY89 | FY90 |
|---|---|---|
| GM-14 | 1 | 1 |
| All other GS/GM | 8 | 7 |
| TOTAL PERMANENT | 7 | 8 |

**COMPTROLLER**

| | FY89 | FY90 |
|---|---|---|
| GM-15 | 1 | 1 |
| GM-14 | 2 | 3 |
| All olher GSIGM | 18 | 22 |
| TOTAL PERMANENT | 21 | 26 |

**PROCUREMENT OFFICE**

| | FY89 | FY90 |
|---|---|---|
| GM-15 | 1 | 1 |
| GM-14 | 3 | 2 |
| All other GS/GM | 13 | 15 |
| TOTAL PERMANENT | 17 | 18 |

**PROPULSION TEST OPERATIONS**

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | I |
| GM-15 | 1 | 1 |
| GM-14 | 3 | 3 |
| All other GSIGM | 23 | 31 |
| TOTAL PERMANENT | 28 | 36 |

**SCIENCE ANDTECHNOLOGY LABORATORY**

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM-15 | 4 | 4 |
| GM-14 | 3 | 4 |
| All olher GSIGM | 38 | 41 |
| TOTAL PERMANENT | 46 | 50 |

**CENTER OPERATIONS OFFICE**

| | FY89 | FY90 |
|---|---|---|
| SES | 1 | 1 |
| GM-15 | 1 | 1 |
| GM-14 | 4 | 4 |
| All other GSIGM | 32 | 43 |
| TOTAL PERMANENT | 38 | 49 |

(NS33-8—Revised 11/88)

GODDARD
SPACE FLIGHT CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1990 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 that 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, 1988, was approximately $820,020,000. The majority of the Goddard Center's personnel are located at Greenbelt, Maryland. Other personnel are located at the Wallops facility in Virginia, the Goddard Institute for Space Studies in New York City, and throughout the world, managing the operation of satellite tracking and communications network stations.

### ROLES AND MISSIONS

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

PRINCIPAL ROLES

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

SPACE SCIENCE AND APPLICATIONS - develops the basis for science and technology disciplines, 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.

SPACE STATION FREEDOM - Provides the development, integration, and delivery of: Attached Payload Accommodation Equipment, a Polar Orbiting Platform, a Flight Telerobotic Servicer, and Servicing Accommodations Equipment. GSFC is also providing and maintaining the Space Station Freedom's Assembly and Servicing System Architecture. GSFC is responsible for the operations of the Polar Platform and operations support for the Attached Payload Accommodation Equipment, Flight Telerobotic Servicer and Servicing Accommodations Equipment.

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

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

**EXPENDABLE LAUNCH VEHICLES** - management of medium and small class expendable launch vehicle programs. Includes the procurement and management of the launch services required to place a variety of spacecraft into earth or solar orbit.

**SOUNDING ROCKET DEVELOPMENT, PROCUREMENT AND OPERATIONS** - management of the NASA sounding rocket program; provides the complete spectrum of support including mission planning and operation; launch vehicles; payload design and development including recovery systems, telemetry systems, power systems, separation systems, and attitude control systems; payload testing and evaluation; analytical studies; and launch range operations/coordination.

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

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

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

**SUPPORTING ROLES**

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

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

FY 1990 CONGRESSIONAL BUDGET
DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM

| GODDARD SPACE FLIGHT CENTER | 1988 ACTUAL | 1989 BUDGET ESTIMATE | 1989 CURRENT ESTIMATE | 1990 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION...................... | 183 | 234 | 201 | 242 |
| SPACE FLIGHT PROGRAMS............... | 90 | 88 | 98 | 104 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 32 | 27 | 35 | 36 |
| SPACE SHUTTLE...................... | 58 | 61 | 63 | 68 |
| SPACE SCIENCE AND APPLICATIONS.......... | 1,881 | 1,935 | 1,898 | 1,961 |
| PHYSICS AND ASTRONOMY............... | 1143 | 1,160 | 1128 | 1158 |
| LIFE SCIENCES....................... | 1 | 1 | 1 | 1 |
| PLANETARY EXPLORATION............... | 79 | 82 | 106 | 107 |
| SPACE APPLICATIONS................. | 658 | 692 | 663 | 695 |
| AERONAUTICS AND SPACE TECHNOLOGY........ | 84 | 91 | 88 | 100 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 9 | 10 | 9 | 9 |
| SPACE RESEARCH AND TECHNOLOGY....... | 75 | 81 | 79 | 91 |
| TRANSATMOSPHERIC RESEARCH a TECH.... | 0 | 0 | 0 | 0 |
| COMMERCIAL PROGRAMS.................... | 12 | 12 | 8 | 8 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE. | 9 | 0 | 7 | 8 |
| TRACKING AND DATA PROGRAMS.............. | 581 | 590 | 582 | 616 |
| SUBTOTAL DIRECT.................... | 2,840 | 2,950 | 2,882 | 3,039 |
| CENTER MANAGEMENT AND OPERATIONS........ | 745 | 634 | 736 | 612 |
| SUBTOTAL (FULL-TIME PERMANENTS).... | 3,585 | 3,584 | 3,618 | 3,651 |
| OTHER CONTROLLED FTE'S.................. (PMI's/CO-OPS/OTFTP's) | 80 | 91 | 99 | 99 |
| GRAND TOTAL (FULL-TIME EQUIVALENTS) | 3,665 | 3,675 | 3,717 | 3,750 |

**PROGRAM DESCRIPTION**

| | Permanent Civil Service Workyears |
|---|---|
| SPACE STATION FREEDOM | 242 |

Space Station Freedom activities include management of a major work package development and the Flight Telerobotic Servicer (FTS). Development of user science requirements, automated free-flying platforms, attached payload accommodation equipment for payloads that are not in pressurized modules and development of the architecture to permit servicing, maintenance and repair of space platforms and free-flying spacecraft will be undertaken. In addition, systems engineering and integration efforts will be performed in direct support of the Space Station Freedom Program Office. Discipline studies in robotics, thermal and data systems requirements will be conducted. Working groups of scientists will continue to involve potential users in Space Station Freedom requirements definition. In FY90 the design and development of the Flight Telerobotic Servicing System will continue.

| | |
|---|---|
| SPACE FLIGHT PROGRAMS | 104 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | 44 |

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

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|---|---|
| SPACE SHUTTLE (SPACE TRANSPORTATION OPERATIONS1 | 60 |

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

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

Goddard has management responsibility for the medium-class Expendable Launch Vehicle (ELV). This vehicle is used to launch a wide variety of spacecraft into a broad spectrum of orbits, ranging from equatorial to polar inclinations. Under existing contracts, the Delta launch vehicle will be used to launch the COBE, ROSAT and the EWE spacecraft. Additional requirements for medium class launches will be procured via a competitive procurement for launch services. The resultant contract will be managed by Goddard.

Goddard also has management responsibility for the Scout-small class Expendable Launch Vehicle. Activities include management and procurement of launch services including all aspects of launch operations. A Scout launch capability is maintained by the Wallops Flight Facility.

| | Permanent Civil Service Workyears |
|---|---|
| SPACE SCIENCE AND APPLICATIONS............. .... ................ | 1961 |
| PHYSICS AND ASTRONOMY................................................... | 1158 |

Astrophysics activities at GSFC are responsible for laboratory and flight scientific research to increase human knowledge of the Earth's space environment, the stars, the sun, and other objects in space; provide advanced technical development of experiments and spacecraft components for future astrophysics missions. GSFC manages activities in the pursuit of scientific progress in all of the following discipline areas of astrophysics: gamma ray astronomy, X-ray astronomy, ultraviolet and optical astronomy, infrared and radio astronomy, particle astrophysics, solar physics, interplanetary physics, planetary magnetospheres, and astrochemistry. During 1989, the Hubble Space Telescope (HST) will be launched and will provide a space observatory and dedicated ground system to extend the sensitivity, resolving power, and spectral range significantly beyond those achievable from ground-based observations. In 1989, the Cosmic Background Explorer (COBE) will be launched by a Delta launch vehicle.

Development activities will continue on the Gamma Ray Observatory (GRO) leading to a STS launch in FY 1990, the Extreme Ultraviolet Explorer (EUVE) and various Shuttle/Spacelab Payloads and integrated rocket experiments. The analysis of data from several Physics and Astronomy missions including COBE, the High Energy Astronomy observatories (HEAO), the Dynamics Explorers (DE), and others will continue.

The International Ultraviolet Explorer (IUE) 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.

Goddard 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 (ROSAT) which is scheduled for launch in early 1990 on a Delta II. The ROSAT will perform the first all-sky survey of X-ray sources and will point to and study specific X-ray sources for extended periods of time.

Goddard manages the U.S. participation in the international cooperative program between the United States, Japan's Institute of Space and Astronautical Science (ISAS), and the European Space Agency (ESA), consisting of eight spacecraft; two (WIND & POLAR) provided by the U.S., one (GEOTAIL) provided by ISAS, and five SOHO and four CLUSTER spacecraft supplied by ESA. Mission objectives are to measure, model, and quantitatively assess the processes in the Sun-Earth interaction chain with emphasis on Solar Wind-Magnetosphere-Ionosphere interactions, Global plasma storage, flow, and transformation, solar wind origin and three-dimensional features, deposition of plasma energy into the atmosphere, solar seismology, solar coronal dynamics, and the basic physics of cosmic plasma. Activities in FY 1990 include instrument development of for the WIND and POLAR spacecraft, SOHO and CLUSTER, and for the GEOTAIL mission.

A new thrust is definition phase activity for the Orbiting Solar Laboratory (OSL); a free-flying mission that will enable quantum leaps in understanding of solar phenomena through high-resolution, coordinated observations in visible light, ultraviolet and X-ray/extreme ultraviolet spectral ranges over extended periods of time. Definition of the visible light instrument, the UV and the EUV/X-ray instruments will continue.

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

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

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

| | Permanent Civil Service Workvears |
|---|---|
| **LIFE SCIENCES** ........................................................ | **1** |

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

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| **PLANETARY EXPLORATION** ................................................. | **107** |

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

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| **SPACE APPLICATIONS** .................................................... | **695** |

The FY 1990 program activities will span GSFC's broad roles and missions mandate, including activities in the discipline areas of land, oceans, and atmospheric sciences. GSFC is engaged in three major types of activities in these areas: research and technology, flight projects, and data analysis.

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

- The global circulation of the Earth's atmosphere for better weather and climate predictions, including extensive ozone studies;

- The geopotential fields (gravity and magneticj of the Earth to provide a better understanding of the structure and evolution of the the Earth;

- The processes of the oceans such as surface winds, waves, temperature, currents, and circulation to support of the ongoing weather and climate studies and the ocean research program;

- The physical characteristics of the Earth's vegetation cover, water resources, and land use dedectable via remote sensing; and

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

A new major thrust, the Earth Observing System (EOS), will be a continuation of definition phase activities beginning in FY 1989. This effort represents a coordinated international effort for the study of earth science with a multi-disciplinary systems approach. Envisioned are four space elements (platforms - 2 U.S., 1 ESA and 1 Japan) producing earth science data sets over a 15-year period possibly commending in the mid-late 1990's.

Advanced definition of Space Station attached payloads will also be conducted.

Flight project responsibilities include:

- Development of operational weather satellite missions for the National Oceanic and Atmospheric Administration (NOAA) on a reimbursable basis, including launch of GOES I and NOAA I in 1990;

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

- Continued development activities on the Upper Atmospheric Research Satellite instruments and spacecraft, leading to a launch in late 1991;

Earth Science activities involve the formulation, analysis, and distribution of data received from satellites for which GSFC has management responsibility. Data from the Earth Radiation Budget Experiment will continue to be collected for study of geographical and seasonal variations of the Earth's radiation budget. Other activities involve the use of data from the Nimbus-7 spacecraft for the solution of problems concerning pollution, ocean resources and dynamics, and weather and climate. Similar activities will be conducted by using the data from non-NASA satellites, both domestic and foreign. This information will be of use to investigators in the disciplines of agriculture, forestry, geology, cartography, hydrology, ecology, and oceanography. Solar terrestrial research efforts will include analysis of data collected from satellites, for example, the Dynamics Explorer, the Interplanetary Monitoring Probe and the International Sun-Earth Explorers, which are providing opportunities to study the dynamic interactions of the solar wind and the Earth's magnetosphere from various points in space.

The Agency's information systems program applies advanced data systems technology in support of science data management and scientific computing. Goddard provides ongoing support to the research community through the NASA Space and Earth Sciences Computing Center (NSESCC) for supercomputing resources in support of modeling and simulation efforts, and the National Space Science Data Center (NSSDC) for archival and distribution of data acquired from spaceflight experiments and observations.

| | Permanent Civil Service Workyears |
|---|---|
| **AERONAUTICS AND SPACE TECHNOLOGY** ........................................ | 100 |
| **AERONAUTICAL RESEARCH AND TECHNOLOGY** ... ......................... | 9 |

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

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

| | Permanent Civil Service Workyears |
|---|---|
| **SPACE RESEARCH AND TECHNOLOGY** ........................................... | **91** |

Goddard's Space Research and Technology program activities are directed at providing advanced technology for future NASA missions. The broad technology development program encompasses technologies targeted at experiments and instruments, on-board spacecraft systems and subsystems, and end-to-end systems including ground segments.

During 1990, support of the on-going Civil Space Technology Program will continue with GSFC focusing its efforts in advanced data systems and science sensors technology development.

Goddard will continue emphasis in current robotics, cryogenics, thermal management and contamination control technology programs and provide strong support of OAST's space flight experiments program. Technologies that support earth systems science, global change, and the agency's Mission to Planet Earth thrust will also be investigated.

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|---|---|
| **SAFETY, RELIABILITY AND QUALITY ASSURANCE** .............................. | **8** |

Goddard has responsibility for the Agency's electronic parts standards activity, including preparing and maintaining the NASA Standard Parts List (NSPL); evaluating new parts technology for potential additions to the NSPL; and for preparing qualification criteria to be used by vendors who wish to be listed as certified suppliers for electronic parts on the NSPL. Other efforts are aimed at correlating on-orbit and laboratory induced radiation effects damage in electronic parts in order to develop ground test methods that accurately simulate the radiation damage induced on-orbit.

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| **COMMERCIAL PROGRAMS** ..................................................... | **8** |

Technology Utilization activities at Goddard are directed toward the application of space technology to public and private sector needs. Foremost among the technology applications projects in 1990 are the cerebrospinal fluid control system, the biomedical implantable devices systems, and the biomedical ingestible telemetry systems. Other activities include: (1) new technology identification, evaluation, and publication; (2) dissemination methods and techniques; (3) public section technology applications projects; and (4) outreach activities to encourage industrial participation in the program.

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

| | Permanent Civil Service Workyears |
|---|---|
| TRACKING AND DATA PROGRAMS............................................... | 616 |

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

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

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

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

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

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

With the demonstration of a successful TDRSS, a number of Spaceflight Tracking and Data Network ground stations will be closed. However, some of the current stations will be maintained to provide tracking support, mission control, orbit/attitude computing and data processing for the Space Transportation System launched payloads. Support will also continue for a number of operating satellites such as the International Ultraviolet Explorer, Solar Maximum Mission, Dynamic Explorer, and Nimbus.

In data processing, emphasis will continue to be placed on the operation of data processing facilities. Implementation of both the generic data capture facility for packet processing and the generic time division multiplexed data capture facility will be completed by the end of 1989. These implementations will replace outdated equipment and systems, and, as generic facilities, will minimize the repetitive development cost currently encountered in support of different scientific missions.

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

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

Studies for the Customer Data and Operations System (CDOS) will continue. The CDOS, when implemented, will provide payload and platform command and control, data capture and data handling for use in the Space Station era.

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

| | Permanent Civil Service Workyears |
|---|---|
| **CENTER MANAGEMENT AND OPERATIONS SUPPORT**.................................... | **612** |

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

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

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

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

## SUMMARY OF RESOURCES REQUIREMENTS

## FUNDING PLAN BY FUNCTION

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. Personnel and Related Costs.,.. | 173,405 | 179,592 | 181,017 | 186,143 |
| 11. Travel ...................... | 5,571 | 6,200 | 5,734 | 6,098 |
| III. Operation of Installation.... | 63,805 | 71,031 | 66,262 | 78,998 |
| A. Facilities Services...... | (24,558) | (28,404) | (25,557) | (34,842) |
| B. Technical Services...... | (14,825) | (14,499) | (13,188) | (15,128) |
| C. Management Operations... | (24,422) | (28,128) | (27,517) | (29,028) |
| Total, Fund Requirements | 242,781 | 256,823 | 253,013 | 271,239 |

## RESOURCES REQUIREMENTS BY FUNCTION

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. PERSONNEL AND RELATED COSTS........ | 173,405 | 179,592 | 181,017 | 186.143 |

## SUMMARY OF FUND REQUIREMENTS

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | | | | |
| 1. Compensation | | | | |
| a. Full-Time Permanent | 146,034 | 148,356 | 151,368 | 155,210 |
| b. Other than full-time permanent........... | 1,721 | 1,753 | 2,036 | 2,129 |
| c. Overtime and other compensation........ | 2,719 | 2,527 | 2,654 | 2,787 |
| Subtotal, Compensation........ | 150,474 | 152,636 | 156,058 | 160,126 |
| 2. Benefits.................. | 20,224 | 23,199 | 22,603 | 23,534 |
| Subtotal, Compensation and Benefits.......... | 170,698 | 175,835 | 178,661 | 183,660 |
| B. Supporting Costs | | | | |
| 1. Transfer of Personnel..... | 252 | 1,893 | 350 | 400 |
| 2. Personnel Training........ | 2,455 | 1,864 | 2,006 | 2,083 |
| Subtotal, Supporting Costs............... | 2,707 | 3,757 | 2,356 | 2,483 |
| Total, Personnel and Related Costs...... | 173,405 | 179,592 | 181,017 | 186,143 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. Compensation and Benefits | 170,698 | 175,835 | 178,661 | 183,660 |
| 1. Compensation......... | 150.474 | 152,636 | 156,058 | 160,126 |
| a. Full-time Permanent | 146,034 | 148,356 | 151,368 | 155,210 |

The change in compensation from the 1989 Budget Estimate to the 1989 Current Estimate is due to the increased workyears, the FY 1989 pay raise, and increased overtime. Compensation increases from the 1989 Current Estimate to the 1990 Budget Estimate result primarily from increased workyears, the full year effect of the 1989 pay raise, and the full year effect of within-grade and career advancements.

BASIS OF COST FOR PERMANENT WORKYEARS

In 1990, the cost of full-time workyears will be 155,210,000. The increase from 1989 is calculated as follows:

| | | |
|---|---|---|
| Cost of full-time permanent workyears in 1989 | | $151,368 |
| Cost Changes in 1990 | | + 7,141 |
| Within Grade and Career Advances: | | |
| Full Year Effect of 1989 Actions | + $1,724 | |
| Partial Year Effect of 1990 Actions | + 2,419 | |
| Additional FTE | + 1,439 | |
| Full Year Effect of the 1989 Payraise | + 1,562 | |
| Changes in Reimbursements | 3 | |
| Turnover Effect | | - 3,299 |
| Full Year 1989 Savings | 0 | |
| Part Year 1990 Savings | - 3,299 | |
| Cost of FTP Workyears in 1990 | | $155,210 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| b. Other than full-time permanent workyears | | | | |
| 1. cost.......... | 1,721 | 1,753 | 2,036 | 2,129 |
| 2. Workyears..... | 100 | 128 | 129 | 129 |

The distribution of 1990 workyears is as follows:

DISTRIBUTION OF OTHER THAN FULL-TIME PERMANENT WORKYEARS

| | Program Workvears |
|---|---|
| Developmental programs.................................................. | 65 |
| Other temporary......................................................... | 34 |
| Youth opportunity programs.............................................. | 30 |
| Total................................................................... | 129 |

The increase from the 1989 Budget Estimate to the 1989 Current Estimate is due to the 1989 payraise plus the 1988 actual expenses. The increase from the 1989 Current Estimate to the 1990 Budget Estimate is due to the full year effect of the 1989 payraise.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| c. Overtime and other compensation.... | 2,719 | 2,527 | 2,654 | 2,787 |

The change from the 1989 Budget Estimate to the 1989 Current Estimate is due to an increase in the estimate of overtime hours based on experience, revised pricing due to the 1989 pay raise, and the projected impact of launch activities. The increase to the 1990 Budget Estimate is due to an increase in the estimate of overtime hours due to projected project activities.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Benefits.............. | 20,224 | 23,199 | 22,603 | 23,534 |

The following are the amounts of contribution by category:

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| Retirement Fund and Thrift Plan........ | 11,729 | 13,885 | 12,731 | 13,172 |
| Employee Life Insurance...... | 269 | 303 | 268 | 276 |
| Employee Health Insurance.... | 4,535 | 3,908 | 5,813 | 6,016 |
| Workmen's Compensation....... | 270 | 280 | 266 | 421 |
| FICA........................ | 1,858 | 3,026 | 1,915 | 1,982 |
| Medicare.................... | 1,563 | 1,797 | 1,610 | 1,667 |
| Other....................... | -0- | -0- | -0- | -0- |
| Total.................... | 20,224 | 23,199 | 22,603 | 23,534 |

The decrease in benefits from the 1989 Budget Estimate to the 1989 Current Estimate is due to revised estimates for retirement costs resulting from the fewer number of employees who switched from CSRS to FERS. The increase to the 1990 Budget Estimate is due to the growth in population and increasing enrollment in the Federal Employee Retirement System.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| B. Support Costs....... | 2,707 | 3,757 | 2,356 | 2,483 |
| 1. Transfer of personnel....... | 252 | 1,893 | 350 | 400 |

The decrease from the 1989 Budget Estimate to the 1989 Current Estimate is due to revised estimates for relocation expenses based on actual experience. The number of hires eligible for reimbursement is fewer than previously anticipated. The increase to the 1990 budget is due to the increase in accessions.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Personnel Training............ | 2,455 | 1,864 | 2,006 | 2,083 |

The personnel training costs are based on current training programs and the need to reorient skills of employees into areas compatible with the direction of the current space program and GSFC's role in the program. The changes from the 1989 Budget Estimate to the 1989 Current Estimate results from an increased level of training plus increased tuition and other costs. The increased 1990 Budget Estimate as compared with the 1989 Current Estimate results from additional Civil Service FTE.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| **11.** TRAVEL......................... | 5.571 | 6,200 | 5,734 | 6.098 |

SUMMARY OF FUND REQUIREMENTS

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel.............. | 4,465 | 5,025 | 4,544 | 4,803 |
| B. Scientific and Technical Development Travel........ | 599 | 700 | 640 | 700 |
| C. Management and Operations Travel................... | 507 | 475 | 550 | 595 |
| Total, Travel............. | 5.571 | 6,200 | 5.734 | 6.098 |

EXPLANATION OF FUND REQUIREMENTS

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel.............. | 4,465 | 5,025 | 4,544 | 4,803 |

Program travel is essential to the accomplishment of the Center's mission, particularly with regard to the Space Science and Applications, Space Station, Tracking and Data Acquisition, Space Transportation System, and Aeronautics and Space Technology 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 1989 Current Estimate reflects a decrease from the 1989 Budget Estimate due to decreased travel associated with the Supernova campaigns as well as a general reevaluation of travel requirements. The increase in FY90 travel costs is due to increased requirements for the major on-going flight programs and travel for the additional civil service personnel.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Scientific and Technical Development Travel...... | 599 | 700 | 640 | 700 |

Scientific and technical development travel permits employees to participate in meetings and technical seminars with other representatives of the aerospace community. This participation allows them to benefit from exposure to technological advances outside GSFC, as well as to present both accomplishments and problems to their associates. Many of the meetings are working panels convened to solve certain problems for the benefit of the Government. The decrease from the 1989 Budget Estimate to the 1989 Current Estimate reflects the impact of revised estimates based on 1988 experience. The 1990 Estimate reflects required levels for scientific meeting trips.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| C. Management and Operations Travel................. | 507 | 475 | 550 | 595 |

Management and operations travel is used for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management, and procurement activities, travel of the Center top management to other NASA Centers and local travel in and around the Washington Metropolitan area, and to and from the Wallops Flight Facility. The increases from the 1989 Budget Estimate to the 1989 Current Estimate and from the 1989 Current Estimate to the 1990 Budget Estimate result from an increase in local transportation costs with a significant increase in travel to the Space Station program office located in Reston, Virginia.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 111. OPERATION OF INSTALLATION | 63,805 | 71,031 | 66,262 | 78,998 |

SUMMARY OF FUND REQUIREMENTS

| | | | | |
|---|---|---|---|---|
| A. Facilities Services........ | 24,558 | 28,404 | 25,557 | 34,842 |
| B. Technical Services......... | 14,825 | 14,499 | 13,188 | 15,128 |
| C. Management and Operations | 24,422 | 28,128 | 27,517 | 29,028 |
| Total, Operation of Installation. | 63,805 | 71,031 | 66,262 | 78,998 |

EXPLANATION OF FUND REQUIREMENTS

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

The decrease in the 1989 Budget Estimate to the 1989 Current Estimate is due to the deferral of some planned facility repair projects and a decrease in utility rates. The 1990 Budget Estimate provides funding to prevent further deterioration of the aging GSFC and Wallops complexes, and to enhance utility contract support at the Greenbelt complex.

| | | | | |
|---|---|---|---|---|
| A. Facilities Services......... | 24,558 | 28,404 | 25,557 | 34,842 |

The Greenbelt facility is located on a 552-acre main site, and on a 554-acre remote site area with a complex of laboratory and office-type buildings as well as test facilities. This complex encompasses 2.5 million gross square feet of building space including 34 buildings. This physical plant supports an average daily on-center population of about 9,000. Many of the test facilities are used on schedules involving more than one shift, often during off-peak hours. The Wallops Facility includes 6,175 acres and a complex of facilities which mainly consists of a research airport and launch operation facilities.

This complex encompasses 1.1 million gross square feet of building space including three major buildings. Also included are three major technical facilities. This physical plant supports an average daily on-site population of approximately 1,000.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| **SUMMARY OF FUND REQUIREMENTS** | | | | |
| 1. Rental of Real Property............... | 1,451 | 1,346 | 1,224 | 1,224 |
| 2. Maintenance and Related Services............... | 7,391 | 9,424 | 7,808 | 14,922 |
| 3. Custodial Services....... | 6,091 | 6,657 | 6,318 | 7,658 |
| 4. Utility Services......... | 9.625 | 10.977 | 10,207 | 11,038 |
| Total, Facilities Services................ | 24,558 | 28.404 | 25.557 | 34,842 |

EXPLANATION OF FUND REQUIREMENTS

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property....... | 1,451 | 1,346 | 1,224 | 1,224 |

Provides space for personnel at tracking stations and the Goddard Institute for Space Studies in New York. Funding also provides for the lease of trailers to be used on-site for the housing of Space Station TDRSS and Hubble Space Telescope employees. The decrease from the 1989 Budget Estimate to the 1989 Current Estimate is due to the elimination of the requirement for the Hubble Space Telescope warehouse because on-site storage was made available. The 1989 Current Estimate and the 1990 Budget Estimate reflect current projected rates based on 1988 experience.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Maintenance and Related Services................ | 7,391 | 9,424 | 7,808 | 14,922 |

This activity includes general building maintenance such as painting, inspection, and mechanical and electrical maintenance, as well as rehabilitation and modification projects in office buildings. This activity provides for roads and grounds maintenance. Funding is also provided for supplies, materials, and equipment costs associated with maintenance and related services. The decrease from the 1989 Budget Estimate to the 1989 Current Estimate is due to deferral of some planned facilities repair projects. The 1990 Budget Estimate results from the need to adequately fund maintenance of facilities, equipment, roads, and grounds which have been deferred from prior years, and providing contract services for plant operations and maintenance.

| | | | | |
|---|---|---|---|---|
| 3. Custodial Services......... | 6,091 | 6,657 | 6,318 | 7,658 |

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 1989 Budget Estimate to the 1989 Current Estimate reflects 1988 experience and lower support service contract wage rates than previously estimated. In 1989 and 1990, funding also provides for increases in Shuttle mission related security support, which was artificially low in FY88 due to the absence of Shuttle launches. The increase to the 1990 Budget Estimate is due to anticipated rate changes in support service contracts and increased requirements of security, fire protection, and custodial services.

| | | | | |
|---|---|---|---|---|
| 4. Utility Services........... | 9,625 | 10,977 | 10,207 | 11,038 |

The estimate provides for maintenance of the utility plant and distribution systems as well as the purchase of utility services, and supplies, materials, and equipment required for the maintenance of these systems. At the Greenbelt facility, electricity is purchased from the Potomac Electric and Power Company, natural gas from the Washington Gas Light Company, and fuel oil from a local supplies. Water and sewage service is provided by the Washington Suburban Sanitary Commission. The purchased utilities at Wallops are electricity from the Delmarva Power Co. and fuel oil from a local supplier. Rate decreases that were experienced in 1988 are reflected in the current 1989 estimate. Increased requirements for utility systems support for technical computer facilities are responsible for some of the increase shown in the 1990 estimate. Enhancements to the utilities control system at Greenbelt are also planned for 1990.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Technical Services....... | 14,825 | 14,499 | 13,188 | 15,128 |

SUMMARY OF FUND REQUIREMENTS

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing..... | 10,106 | 7,664 | 9,807 | 10,952 |
| 2. Scientific and Technical Information. | 2,643 | 3,127 | 1,965 | 2,758 |
| 3. Shop Support Services.......... | 2,076 | 3,708 | 1,416 | 1.418 |
| Total, Technical Services.......... | 14,825 | 14,499 | 13,188 | 15,128 |

EXPLANATION OF FUND REOUIREMXNTS

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 1. Automatic Data Processing........ | 10,106 | 7,664 | 9,807 | 10,952 |

This funding provides for the mainframe, micro and mini-computer hardware, system software, maintenance, and programming and operations support necessary to supply management with accurate and timely information necessary to support Center operations and missions, and respond to Congressional and other external budget, administrative, and operational requirements. All administrative and management systems are supported including institutional management, finance and accounting, procurement, personnel management, project management and management of the Research and Development program. Additional ADP purchases facilitated by the mass buy contract have been initiated at the Center, which have contributed to savings for ADP purchases. The increase from the 1989 Budget Estimate to the 1989 Current Estimate, as well as the increase from the 1989 Current Estimate to the 1990 Budget Estimate is the result of further enhancements to the administrative computer to keep pace with new systems development and on-line capabilities, and increased contractual support for systems design/development and operations support. ADP programming support will be used for the development of such systems as an on-line small purchases system, on-line time and attendance recording, on-line reprogrammings, and on-line travel.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Scientific and Technical Information......... | 2,643 | 3,127 | 1,965 | 2,758 |

FY 1989 and 1990 reflect the anticipated costs of maintaining the GSFC library, including operations support, information systems, books and subscriptions. The decrease from the 1989 Budget Estimate to the 1989 Current Estimate reflects the purchase of books, subscriptions and systems in 1988 that were originally planned for 1989. The costs are reflected in the 1988 actuals and act as an offset to the current 1989 budget. Purchase of these materials will be resumed in 1990. These funds also provide for a public affairs educational and information program, and support to the Center in the provision of various and scientific and technical information services. Costs include exhibit management and refurbishment, demonstration models, workshops and symposia, and education and information materials. The Center is making a concerted effort to energize its outreach to the community and to provide a comprehensive and participative view of the space program. Replacement and continued maintenance and upgrade of the existing exhibits in the Visitor Center, as well as an increase in distribution of literature and films, is provided for in 1989 and 1990.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 3. Shop Support Services..... | 2,076 | 3,708 | 1,416 | 1,418 |

In all years, support is given in the areas of safety, fire protection system maintenance, and related supplies and equipment. Non-technical photographic and chart and art support to all Center organizations is also included. The 1989 Current Estimate reflects the realignment to the Research and Development Budget of crane recertification activities and the refinement of non-technical photographic and graphics support requirements. The 1990 Budget Estimate increase is a result of minor changes in requirements.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| C. Management and Operations......... | 24,422 | 28,128 | 27,517 | 29,028 |

SUMMARY OF FUND REQUIREMENTS

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications..... | 7,992 | 8,968 | 9,973 | 10,052 |
| 2. Printing and Reproduction....... | 1,175 | 1,590 | 1,000 | 1,012 |
| 3. Transportation...... | 1,413 | 2,332 | 1,362 | 1,392 |
| 4. Installation Common Services.......... | 13,842 | 15,238 | 15,182 | 16,572 |
| Total, Management and Operations...... | 24,422 | 28,128 | 27,517 | 29,028 |

## EXPLANATION OF FUND REOUIREMENTS

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 1. Administrative Communications.... | 7,992 | 8,968 | 9,973 | 10,052 |

These funds support local telephone service, long distance service, FTS, and other administrative communications. The increase from the 1989 Budget Estimate to the 1989 Current Estimate is attributable increased lease to purchase costs and the expansion of the cabling system associated with the ROLM interconnect phone system. Estimates for 1989 and 1990 include full funding for the ROLM interconnect phone system, including equipment purchase, maintenance, installations and moves, engineering support, and all system lease/purchase costs.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Printing. and Reproduction...... | 1,175 | 1,590 | 1,000 | 1,012 |

This category covers the costs associated with the maintenance of administrative copiers across the Center and all administrative printing costs including all in-house operations, supplies, materials and equipment, and contracted printing. The decrease from 1988 to 1989 reflects one-time equipment purchases in 1988. A reduction in planned printing activities is responsible for the decrease from the 1989 Budget Estimate to the 1989 Current Estimate. An increase is shown in 1990 to cover the minor changes in requirements.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 3. Transportation..... | 1,413 | 2,332 | 1,362 | 1,392 |

This funding supports: the operation and maintenance of the GSFC Administrative Aircraft; the purchase, maintenance, and repair of the installation's vehicle fleet; fuel and supplies associated with the operation of the aircraft and vehicles; special vehicle rental; and packing, crating and shipping costs associated with the transportation of non-project unique materials. The decrease from the 1989 Budget Estimate to the Current Estimate is due to the reclassification of support contractors from the transportation function to the logistics area, which is funded in installation common services. The 1990 Budget Estimate provides much needed funding to upgrade the Center's transportation fleet to Government standards as well as minor changes to requirements.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 4. Installation Common Services............. | 13,842 | 15,238 | 15,182 | 16,572 |

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

The 1989 Current Estimate reflects the effect of revised estimates for support service contracts based on 1988 experience, offset by the transfer of support contractor funds from the transportation subfunction. The increase in 1990 is for improvements to the logistics support capabilities, for the benefit of in-house projects, on-site facilities, and Center institutional operations.

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

**DIRECTOR ASSOCIATE DIRECTORS**

| | 89 | 90 |
|---|---|---|
| SES | 4 | 4 |
| EXCEPTED | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 4 | 4 |
| WAGE GRADE | 0 | 0 |
| TOTAL | 8 | 8 |

**TOTAL**

| | 89 | 90 |
|---|---|---|
| SES | 52 | 52 |
| EXCEPTED | 2 | 2 |
| GS/GM 16 | 1 | 1 |
| GS/GM 15 | 366 | 384 |
| GS/GM 14 | 608 | 630 |
| OTHER GS/GM | 2552 | 2656 |
| WAGE GRADE | 119 | 0 |
| TOTAL | 3700 | 3725 |

NASA OFFICE OF INSPECTOR GENERAL GSFC FIELD OFFICE

**COMPTROLLER**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| EXCEPTED | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 2 | 3 |
| OTHER GS/GM | 15 | 15 |
| WAGE GRADE | 0 | 0 |
| TOTAL | 20 | 21 |

**DIRECTOR OF FLIGHT ASSURANCE**

| | 89 | 90 |
|---|---|---|
| SES | 2 | 2 |
| EXCEPTED | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 24 | 24 |
| GS/GM 14 | 26 | 2[illegible] |
| OTHER GS/GM | 83 | 83 |
| WAGE GRADE | 0 | 0 |
| TOTAL | 135 | 140 |

**CHIEF COUNSEL**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| EXCEPTED | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 3 | 3 |
| OTHER GS/GM | 4 | 5 |
| WAGE GRADE | 0 | 0 |
| TOTAL | 9 | 10 |

**EQUAL OPPORTUNITY PROGRAMS OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| 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 | 5 | 5 |

**OFFICE OF PUBLIC AFFAIRS**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| EXCEPTED | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 3 | 3 |
| OTHER GS/GM | 15 | 16 |
| WAGE GRADE | 0 | 0 |
| TOTAL | 19 | 20 |

**OFFICE OF HUMAN RESOURCES**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| EXCEPTED | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 3 | 3 |
| OTHER GS/GM | 67 | 69 |
| WAGE GRADE | 0 | 0 |
| TOTAL | 71 | 73 |

**DIRECTOR OF MANAGEMENT OPERATIONS**

| | 89 | 90 |
|---|---|---|
| SES | 3 | 3 |
| EXCEPTED | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 18 | 19 |
| GS/GM 14 | 37 | 39 |
| OTHER GS/GM | 521 | 549 |
| WAGE GRADE | 119 | 0 |
| TOTAL | 698 | 610 |

**DIRECTOR OF FLIGHT PROJECTS**

| | 89 | 90 |
|---|---|---|
| SES | 10 | 10 |
| EXCEPTED | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 92 | 100 |
| GS/GM 14 | 108 | 118 |
| OTHER GS/GM | 144 | 151 |
| WAGE GRADE | 0 | 0 |
| TOTAL | 355 | 380 |

**DIRECTOR OF MISSION OPERATIONS AND DATA SYSTEMS**

| | 89 | 90 |
|---|---|---|
| SES | 6 | 6 |
| EXCEPTED | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 44 | 45 |
| GS/GM 14 | 97 | 97 |
| OTHER GS/GM | 438 | 442 |
| WAGE GRADE | 0 | 0 |
| TOTAL | 585 | 590 |

**DIRECTOR OF SPACE AND EARTH SCIENCES**

| | 89 | 90 |
|---|---|---|
| SES | 13 | 13 |
| EXCEPTED | 1 | 1 |
| GS/GM 16 | 1 | 1 |
| GS/GM 15 | 115 | 116 |
| GS/GM 14 | 157 | 158 |
| OTHER GS/GM | 443 | 451 |
| WAGE GRADE | 0 | 0 |
| TOTAL | 730 | 740 |

**DIRECTOR OF ENGINEERING**

| | 89 | 90 |
|---|---|---|
| SES | 7 | 7 |
| EXCEPTED | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 56 | 63 |
| GS/GM 14 | 134 | 142 |
| OTHER GS/GM | 618 | 658 |
| WAGE GRADE | 0 | 0 |
| TOTAL | 815 | 870 |

**DIRECTOR OF SUBORBITAL PROJECTS AND OPERATIONS**

| | 89 | 90 |
|---|---|---|
| SES | 5 | 5 |
| EXCEPTED | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 12 | 12 |
| GS/GM 14 | 37 | 37 |
| OTHER GS/GM | 196 | 204 |
| WAGE GRADE | 0 | 0 |
| TOTAL | 250 | 258 |

AMES
RESEARCH CENTER

**RESEARCH AND PROGRAM MANAGEMENT**

**FISCAL YEAR 1990 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, 1988, was $815,762,000.

The Ames Dryden Flight Research Facility is 65 air miles northeast of Los Angeles. Ames Dryden is located at the north end of Edwards Air Force Base on 838 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, 1988, was $132,571,000.

### CENTER ROLES AND MISSIONS

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

In addition to these major program responsibilities, the Center provides major support for military programs. The principal and supporting roles are:

PRINCIPAL

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Airborne Research and Applications - conduct airborne research and applications experiments by operating instrumented 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.

Earth System Science - Conducts research and manages projects in the science of Earth's atmosphere, ecosystems, and other components with emphasis on how these components interact as a system.

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, and planetary science to advance our knowledge of the origin and evolution of stars, planets, and the Universe.

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

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

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

Biomedical Research - understand and ameliorate biomedical and psycho-physiological problems experienced by humans during and following long duration spaceflight, including assessment of the requirement for artificial gravity.

Advanced Life Support - Develop the foundations of physiochemical and biogenerative life support systems essential to manned solar exploration.

Exobiology - Conduct research on the origin, evolution, and distribution of life and life-related molecules on Earth and throughout the universe.

SUPPORTING

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

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

FY 1990 CONGRESSIONAL BUDGET
DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM

| AMES RESEARCH CENTER | 1988 ACTUAL | 1989 BUDGET ESTIMATE | 1989 CURRENT ESTIMATE | 1990 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION | 8 | 20 | 6 | 6 |
| SPACE FLIGHT PROGRAMS | 20 | 37 | 20 | 21 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 6 | 0 | 6 | 6 |
| SPACE SHUTTLE | 14 | 37 | 14 | 15 |
| SPACE SCIENCE AND APPLICATIONS | 338 | 341 | 344 | 356 |
| PHYSICS AND ASTRONOMY | 108 | 105 | 100 | 102 |
| LIFE SCIENCES | 144 | 131 | 161 | 171 |
| PLANETARY EXPLORATION | 35 | 49 | 35 | 35 |
| SPACE APPLICATIONS | 51 | 56 | 48 | 48 |
| AERONAUTICS AND SPACE TECHNOLOGY | 1,170 | 1,135 | 1,185 | 1,217 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 953 | 937 | 963 | 983 |
| SPACE RESEARCH AND TECHNOLOGY | 177 | 154 | 182 | 194 |
| TRANSATMOSPHERIC RESEARCH & TECH | 40 | 44 | 40 | 40 |
| COMMERCIAL PROGRAMS | 4 | 4 | 4 | 4 |
| SAFETY, RELIABILITY a QUALITY ASSURANCE. | 0 | 0 | 12 | 14 |
| TRACKING AND DATA PROGRAMS | 24 | 24 | 24 | 23 |
| SUBTOTAL DIRECT | 1,564 | 1,561 | 1,595 | 1,641 |
| CENTER MANAGEMENT AND OPERATIONS | 501 | 507 | 502 | 512 |
| SUBTOTAL (FULL-TIME PERMANENTS) | 2,065 | 2,068 | 2,097 | 2,153 |
| OTHER CONTROLLED FTE'S (PMI's/CO-OPS/OTFTP's) | 66 | 76 | 66 | 66 |
| GRAND TOTAL (FULL-TIME EQUIVALENTS) | 2,131 | 2,144 | 2,163 | 2,219 |

## DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

### PROGRAM DESCRIPTION

| | FY 1990 Permanent Civil Service Workyears |
|---|---|
| **RESEARCH AND DEVELOPMENT** | |
| SPACE STATION ........................................................................ | 6 |

In 1990, Space Station activities will focus upon developing user payload designs and outfitting requirements for incorporation into the revised baseline station configuration as well as evolutionary requirements. These Phase A and Phase B activities will support life sciences and various space science activities, such as cosmic dust collection and gas-grain simulation facilities. Efforts in human factors, i.e., designs for internal architecture and proximity operations about the station will continue. The AX-5 hard suit will be tested in the Neutral Buoyancy Test Facility and transfer of technology to JSC for joint testing will begin. Information sciences will demonstrate Artificial Intelligence technology in a Thermal System Management test bed at JSC. Further research on expert systems will continue to focus upon automation of both on board and ground control functions of the station.

| | |
|---|---|
| **SPACE FLIGHT PROGRAMS** ........................................................... | 21 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT ...................................... | 6 |

Research to develop refueling techniques for infra-red telescopic equipment aboard satellites in orbit. Super-fluid helium (sub-zero temperature) will be pumped from a refueling tank to the depleted satellite through the micro-gravity of space in an effort to extend the useful life of satellite equipment.

| | |
|---|---|
| SPACE SHUTTLE ........................................................................ | 15 |

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

| | Permanent Civil Service Workyears |
|---|---|
| SPACE SCIENCE & APPLICATIONS PROGRAMS ................................................... | 356 |
| PHYSICS AND ASTRONOMY ....................................................................... | 102 |

In 1990, civil service personnel will provide support for the airborne astronomy program via the *C-141* Kuiper Airborne Observatory (KAO) Aircraft which is operated by Ames as a flying astronomical observatory. The bulk of the observing is accomplished by various university research teams while the facility is supported through in-house research in astronomy and astrophysics and with in-house capability to operate research aircraft. The center controls a variety of other aircraft, including a U-2C, two ER-2s, a DC-8, a C-130, and a Lear Jet, some of which serve as unique National and international facilities for research in astronomy, geophysics, meteorology and Earth resources; others acquire data for remote sensing projects and provide a mechanism for integration of spaceborne, airborne, and ground-based data acquisition and processing systems. Support €or the astronomy program is also provided by a sophisticated laboratory effort in spectroscopy and dust physics.

Ames has an active program of laboratory, theoretical, and computational studies to develop the basic astrophysical modeling concepts, to obtain the necessary physical data, to interpret the infrared astronomical observations, and to support the development of improved scientific instruments for future aircraft. This program has as its objective the utilization of the unique capabilities of infrared astronomy to investigate the nature and evolution of astronomical systems, including stars, galaxies, and planets that circle other stars.

| | |
|---|---|
| LIFE SCIENCES ....................................................................... | 171 |

In 1990, civil service personnel will continue to be involved in research, hardware development, and program management related to meeting program milestones in the areas of understanding the effects of space flight on humans and other life forms, managing non-human biological experiments in space, and understanding the origin, evolution, and distribution of life-related chemicals on Earth and elsewhere in the universe.

Research in space medicine and biology will be conducted to investigate the effects of space flight on humans and other organisms. Specifically, causes and potential counter measures for neurophysiological, psychophysiological behavioral, musculoskeletal, metabolic, and cardiovascular changes observed during and immediately following space flight will continue to be studied. Ground-based space flight simulations and actual flight experiments with humans and animals will continue to be performed to provide a basis for understanding why and how biological systems are affected by space flight. Newer areas to be emphasized will be long-duration bedrest studies, and ground-based research to identify psychophysiological causes affecting human performance and behavior during extended duration missions. Computatinnally-based reconstructions and modeling of biosystems will be employed to increase understanding of their functioning on Earth and under conditions of short- and long-term weightlessness.

Because of the Challenger accident the Life Sciences Shuttle/Spacelab missions were delayed. The first scheduled mission, Spacelab Life Sciences-1 (SLS-1), will be launched in 1990. Emphasis in 1989-90 will be on testing the redesign of the Research Animal Holding Facility and all other flight hardware to ensure biological containment and other safety features. Work will continue on final integration of experiment payloads for SLS-1, International Microgravity Laboratory-1, Spacelab-J, and D-2 for flight readiness in 1990 and beyond. In addition, data will be analyzed from the joint US-USSR COSMOS mission to be flown in 1989.

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

Research into the origin, evolution, and distribution of life and life-related molecules on Earth and throughout the cosmos will include several key thrusts: origin of essential biological functions and structures, distribution of prebiological chemicals in extraterrestrial samples and environments, examination of natural or simulated extraterrestrial environments for their potential to support chemical evolution and the origin of life, and development of advanced analytical techniques to support these studies. Research and technology programs will also emphasize preparing for experimentation on solar system missions of critical importance to exobiology, including Mars Observer, Comet Rendezous Asteroid Flyby (CRAF), Cassini, etc. Additional areas of emphasis will include research programs to utilize Earth orbiting facilities (Great Observatories and Space Station) for investigations of the chemical evolution of the biogenic elements. Finally, the Microwave Observing Project will enter development phase in 1990.

The Ames controlled ecological life support system (CELSS) program supports the scientific experiments, technological investigations and potential flight experiments necessary for the development of bioregenerative life support systems. In FY 1990, the CELSS program will initiate laboratory-scale experiments in a completed closed crop growth facility, investigations of specific subsystems of a flight experiments facility intended for use on Space Station, the development of a CELSS Science Laboratory that will provide the capabilities for chemical and biological analysis necessary to support the consortium of CELSS investigators; continue investigations of various aspects of waste processing for use in space; and initiate development of several essential CELSS subsystems, including those for cellulose recovery, ammonia extraction from urine, gas separation, and nutrient composition maintenance.

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

| | Permanent Civil Service Workyears |
|---|---|
| PLANETARY EXPLORATION...... .............................................................. | 35 |

Ames carries out both basic research and project management activities in support of solar system exploration. In 1990, 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; Pioneers 10 and 11, the two spacecraft that made the initial exploratory close approaches to Jupiter and Saturn and are now the most distant man-made objects in the solar system, exploring new regions beyond the known planets; the Pioneer Venus Orbiter which is still gathering data from Venus after more than 10 years; and the Galileo Probe, which is to be launched toward Jupiter in October 1989 using the Inertial Upper Stage (IUS).

In addition, Ames scientists serve as investigators and science team members on the following planetary missions: Pioneers 10 and 11; Voyager, which will return new data from its Neptune flyby during 1990; the Pioneer Venus Orbiter; Galileo (both Jupiter Orbiter and Probe); and the Comet Rendezvous and Asteroid Flyby mission (CRAF), proposed by NASA as a new start in FY 1990.

Ames maintains an active program of laboratory, computational, and theoretical studies to develop basic atmospheric modeling concepts and obtain the necessary physical data to interpret spacecraft observations of planetary atmospheres and relate this data to the atmosphere of the Earth. The program in atmospheric modeling has been particularly active in combining radioactive transfer concepts with aerosal physics to derive comprehensive cloud models, and it has recently led to a series of general circulation models for the atmospheres of Mars and other planets.

Advanced studies of instrumentation are carried out for potential deployment on the Space Station Freedom and on future planetary missions to Saturn, Mars, Titan, and comets. Astronomical and laboratory studies contribute fundamental data on solar system chemistry and the chemical evolution of planetary atmospheres

| | Permanent Civil Service Workyears |
|---|---|
| SPACE APPLICATIONS................. ........................................... | 48 |

In 1990, a highly diversified group of scientists, engineers, and technicians will support observations of both Earth and its environment through spaceborne, airborne, and ground-based programs. This group interprets and processes both directly remotely sensed data. This group also manages projects that provide research opportunities to Ames and outside scientists using Ames' unique aircraft and other resources.

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

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

Ames also conducts a continuing program of applied research and development to enhance the use of remote and in situ sensing technology for Earth resources applications and defining, developing, and evaluating potential future satellite sensors, data acquisition and processing techniques, and associated communications technology.

| | Permanent Civil Service Workyears |
|---|---|
| **AERONAUTICS AND SPACE TECHNOLOGY PROGRAMS** | 1215 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY............................................. | 983 |

In 1990, the program in aeronautics will be characterized in terms of three elements: generic research and technology, vehicle specific technology; e.g., high performance rotorcraft and advanced short takeoff and vertical landing (ASTOVL) aircraft, and aeronautical support to other government agencies and to industry. These three elements form a coherent and interdependent program to meet the objectives of reducing rotorcraft noise and vibration and improving the operational performance and efficiency of high performance aircraft.

The generic research and technology program is principally focused in the disciplines of fluid and thermal physics, propulsion, structures, aeromechanics, flight dynamics, guidance and control, and human factors. The program provides the fundamental disciplinary advances, both theoretical and experimental, that extend the state of the art. Substantial progress is anticipated in Ames' ability to compute the theoretical behavior of flows about aerodynamic components and full configurations and to measure experimental aircraft configuration parameters. Continued efforts will be directed toward providing advances in computational capability supporting aeronautical research. Numerical aerodynamic Simulation will focus on augmenting the Nation's program in computational fluid dynamics and other areas of computational physics by developing an advanced capability that will provide modern and efficient access for users nationwide for application to computational aerodynamics, computational chemistry, and other complex analytical problems. Also, fundamental aerodynamic research will be continued using large-scale and small-scale research facilities and flight research vehicles to develop design methodologies for advanced aircraft. Flight research will continue for the development and validation of aircraft systems integration technology, including flight, propulsion, and aerodynamic controls. In controls and guidance, advanced control technology will focus on developing the methodology to design highly coupled, highly nonlinear control systems; evaluating and improving digital flight control system prediction tools, techniques, methodology and criteria; applying optimal control theory in conjunction with artificial intelligence to provide new concepts for automation; and conducting flight research on digital fly-by-wire concepts to continue to support the development of advanced flight systems technology. In 1990, the human factors program will continue basic and applied research in human performance, computational models for human machine visual perception, development of advanced pilot-vehicle interface concepts for rotorcraft, transport, and high-performance aircraft, aviation safety and other crew factors affecting the safety and efficiency of aircraft operations.

The vehicle-specific technology is focused on rotorcraft, and high-performance aircraft, including powered-lift. The vehicle technology emphasis at Ames relates to, and depends on, the basic capabilities and the aeronautical research disciplines described previously. The 1990 research program will include small-scale and large-scale wind tunnel testing, ground-based simulation, and flight research. Powered-lift aircraft performance is highly dependent on high-lift technology (both propulsive and aerodynamic lift) and advanced guidance and control systems, both of which are part of the ongoing program at Ames. High-performance aircraft research requirements include the areas of high angle-of-attack performance and control, sophisticated flight and aerodynamic controls, structural, aerodynamic, flight control and propulsive system interactions, and superaugmented aircraft.

In rotorcraft aerodynamics, research will be conducted to improve the understanding and prediction of rotor aerodynamics, rotor/fuselage interaction and tilting prop-rotor hover and forward flight performance. In guidance, work will be pursued to improve all-weather rotorcraft capability for terminal area operations. In the controls area, flying qualities design criteria will be developed to improve control system concepts for better performance and mission capabilities for rotorcraft. In addition, efforts will be continued to investigate the requirements for flying night, all weather, nap-of-the-earth missions with a single pilot. Research to provide major improvements in aircraft automation will be conducted through the use of artificial intelligence. In 1990, technology for next-generation rotorcraft will pursue further understanding and evaluation of high speed rotorcraft concepts.

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

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

| | Permanent Civil Service Workyears |
|---|---|
| SPACE RESEARCH AND TECHNOLOGY..... | 194 |

In 1990, civil service personnel will provide support to/for a space research and technology program which encompasses both basic research and project support. The basic research focuses on entry technology and materials research, with germinal effort in artificial intelligence emphasizing advanced, knowledge-based systems methodologies for expert systems applications. The project work supports Space Shuttle, the Orbiter Experiments program, and advanced work related to technology definition of a Space Station. The ARC Space R&T program includes activities of the civil space technology initiative (CSTI) in the areas of robotics, autonomous systems, science sensor technology and the aero-assisted flight experiment. ARC involvement in the Pathfinder program will include development of technologies for planetary surface exploration, high-energy aerobraking, and humans-in-space technology.

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

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

In 1990, the Space Shuttle program will be supported with ground-based facilities to study a variety of aerodynamic and thermodynamic problems. Groundbased facilities will also simulate AOTV heating environments and debris-impact on space station components. In the area of orbiting astronomical instruments, work will continue to develop infrared detectors, define systems for precision pointing and control of telescopes, and advance the technology required to cool detectors to very low temperatures. Ames is supporting Space Shuttle orbiter experiments to study advanced materials and evaluate possible cost and weight reduction for the thermal protection system for space transportation systems.

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

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

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

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

| | Permanent Civil Service Workyears |
|---|---|
| TRANSATMOSPHERIC RESEARCH AND TECHNOLOGY.. ................................................ | 40 |

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

| | |
|---|---|
| COMMERCIAL PROGRAMS......................................................................... | 4 |

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

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

| | |
|---|---|
| SAFETY, RELIABILITY AND QUALITY ASSURANCE......................... ...................... | 14 |

The objective of Reliability and Quality Assurance Engineering assures that systems designed, developed, produced, and placed into operation are capable of fulfilling their defined missions. This is achieved by requiring uniform, consistent application of R & QA policies and procedures by all organizations responsible for any aspect of a particular project/program. Quality Assurance is concerned with retaining current quality levels. In addition, software quality assurance ensures that software developed is reliable, accountable, and cost-effective.

Ames Research Center R & QA Office initiates and implements reliability, maintainability, and quality assurance policies and procedures at Ames. Support includes hardware and software projects and programs relating to any of the research conducted at Ames. R & QA support covers all stages of a program, including design, development, construction, and operations. In addition, the R & QA Office provides short courses in the various disciplines of R & QA (e.g., proper welding and soldering techniques.)

TRACKING AND DATA PROGRAMS.............................................................. 23

In 1990, Dryden will maintain and operate the NASA Western Aeronautical Test Range, which provides direct operational support for a wide variety of aeronautical and aerospace programs including support of the Space Shuttle missions. During real-time mission support operations, the various functional elements such as radar, tracking and data processing, communications, airborne video acquisition, and telemetry data processing all function in an integrated manner in the range Mission Control Centers to provide real-time control, monitoring, processing and command uplink capabilities. Post-mission processing support is also provided.

| | Permanent Civil Service Workyears |
|---|---|
| CENTER MANAGEMENT AND OPERATIONS SUPPORT ........................................... | 512 |

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

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

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

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

## SUMMARY OF RESOURCES REQUIREMENTS

### Funding Plan by Function

| | | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|---|
| | | | (Thousands of Dollars) | | |
| I. | Personnel and Related Costs.............. | 106,144 | 108,006 | 112,823 | 117,aoa |
| II. | Travel................................. | 3,704 | 4,335 | 4,197 | 4,483 |
| III. | Operation of Installation ............... | 55,366 | 67,057 | 61,465 | 64,670 |
| | A. Facilities Services .................. | (22,465) | (31,161) | (24,481) | (28,065) |
| | B. Technical Services ................... | (13,547) | (16,660) | (17,084) | (16,702) |
| | C. Management and Operations ............ | 119.354) | (19,236) | (19,743) | (19.903) |
| | Total, fund requirements ............. | 165.214 | 179,398 | 178,328 | 186,961 |

## REQUIREMENTS BY FUNCTION

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| **I. PERSONNEL AND RELATED COSTS**.................... | 106,144 | 108,006 | 112,823 | 117,808 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | | | | |
| 1. Compensation | | | | |
| a. Full-time permanent................... | 86,251 | 87,836 | 90,478 | 94,522 |
| b. Other than full-time permanent......... | 2,078 | 2,130 | 2,265 | 2,295 |
| c. Reimbursable detailees................. | 509 | 784 | 612 | 923 |
| d. Overtime and other compensation........ | 1,717 | 1,757 | 2,116 | 1,883 |
| Subtotal, Compensation................ | 90,555 | 92,507 | 95,471 | 99,623 |
| 2. Benefits .............................. | 13,494 | 13,365 | 15,290 | 15,923 |
| Subtotal, Compensation and Benefits.......... | 104,049 | 105,872 | 110,761 | 115,546 |
| B. Supporting Costs | | | | |
| 1. Transfer of personnel .................... | 464 | 437 | 364 | 504 |
| 2. Personnel training ....................... | 1,631 | 1,697 | 1,698 | 1,758 |
| Subtotal, Supporting Costs............ | 2,095 | 2,134 | 2,062 | 2,262 |
| Total, Personnel and Related Costs ....... | 106,144 | 108,006 | 112,823 | 117,808 |

Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| A. Compensation and Benefits...................... | 104.049 | 105.872 | 110.761 | 115.546 |
| 1. Compensation............................. | 90.555 | 92,507 | 95,471 | 99,623 |
| a. Full-time permanent workyears........... | 86,251 | 87,836 | 90,478 | 94,522 |

The increase from the 1989 budget estimate to the 1989 current estimate is due to the 1989 pay raise and an increase in FTE's. The increase in the 1990 budget estimate reflects the full-year effect of the 1989 pay raises and the additional manpower augmentation.

Basis of Cost for Permanent Workvears

In 1990, the cost of permanent workyears will be $94,522,000. The increase from 1989 is calculated as follows:

| | | |
|---|---|---|
| Cost of FTP workyears in 1989.......... | | 90.478 |
| Cost changes in 1990.......... | | 6.183 |
| Within grade and career advances: | | |
| Full year effect of 1989 actions.......... | 1,092 | |
| Partial year effect of 1990 actions.......... | 1,578 | |
| Additional FTE.......... | 2,510 | |
| Full year effect of the 1989 pay raise.......... | 1,003 | |
| Changes in reimbursements.......... | -0- | |
| Turnover Effect.......... | | -2,139 |
| Full year 1989 effect.......... | -792 | |
| Part year 1990 effect.......... | -1,347 | |
| Cost of FTP workyears in 1990.......... | | 94,522 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| b. Other than full-time permanent | | | | |
| 1. cost ............................... | 2,078 | 2,130 | 2,265 | 2,295 |
| 2. Workyears.......................... | 109 | 119 | 116 | 116 |

The distribution of 1990 workyears is as follows:

Distribution of Other Than Full-Time Permanent Workyears

| Program | Workyears |
|---|---|
| Development programs ........................................................ | 38 |
| Summer employment program.................................................... | 1 |
| Youth opportunity programs ................................................... | 42 |
| Other temporary............................................................... | 35 |
| Total | 116 |

The net reduction in FTE's from the 1989 budget estimate to the 1989 current estimate is due to an adjustment between permanent and other FTE's are offset by an increase in cost due to the 1989 pay raise. The 1990 estimate increase is due to the full year effect of the 1989 payraise.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| c. Reimbursable detailees................. | 509 | 784 | 612 | 923 |

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 1989 reflects the actual number of detailees. The increase in 1990 reflects an increase in the number of technical military detailees planned.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| d. Overtime and other compensation....... | 1,717 | 1,757 | 2,116 | 1,883 |

Overtime and other compensation includes overtime, holiday pay, incentive awards, Sunday premium pay, and night work differential. The use of overtime and other compensation is primarily for off-peak operation of major facilities such as the Unitary Plan Wind Tunnel System, 40 X 80 X 120 foot Wind Tunnel, and the 6 by 6 foot Supersonic Wind Tunnel, Shuttle Landings, and preparation for test flights. The increase from the 1989 budget estimate to the 1989 current estimate is due to the 1989 pay raise and overtime associated with Shuttle Landings. The decrease from the 1989 current to 1990 budget estimate reflects the full year effect of 1989 pay raises offset by a decrease in wind tunnel activities.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Benefits .......................... | 13,494 | 13,365 | 15,290 | 15.923 |

The following are the amounts of contributions by category:

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| Retirement Fund and Thrift Plan...... | 7,637 | 7,333 | 8,849 | 8,849 |
| Employee Life Insurance.............. | 164 | 179 | 178 | 178 |
| Employee Health Insurance............ | 2,700 | 2,325 | 3,615 | 3,615 |
| Workmen's Compensation............... | 675 | 670 | 670 | 593 |
| FICA................................ | 1,418 | 1,848 | 1,723 | 1,723 |
| Medicare........................... | 900 | 1,010 | 955 | 965 |
| Total....... ..... | 13,494 | 13.365 | 15,290 | 15.923 |

The increase from the 1989 budget to the 1989 current estimate reflects an increase in FTE's, a 27% increase in health benefits costs, and the 1989 pay raise. The 1990 increase reflects additional FTE's and the full year effect of the 1989 pay raise.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Supporting Costs.......................... | 2.095 | 2.134 | 2.062 | 2,262 |
| 1. Transfer of personnel.................. | 464 | 437 | 364 | 504 |

The decrease from 1989 budget estimate to 1989 current estimate reflects a decrease in the number of expected relocations. The estimate reflects additional PCS cost allowance for new FTE's in 1990.

| | | | | |
|---|---|---|---|---|
| 2. Personnel training.................... | 1,631 | 1,697 | 1,698 | 1,758 |

The purpose of the training program is to continue the development and education of civil service employees to support Ames' roles and missions more efficiently. The increase in 1990 reflects additional training dollars to cover the increase in personnel and expected tuition increases.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| **11. TRAVEL** .................................. | 3,704 | 4,335 | 4,197 | 4,483 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel........................... | 2,317 | 3,004 | 2,730 | 3,016 |
| B. Scientific and Technical Development Travel............................... | 597 | 628 | 626 | 621 |
| C. Management and Operations Travel........... | 790 | 703 | 841 | 846 |
| Total, Travel.......................... | 3,704 | 4,335 | 4,197 | 4,483 |

Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel............................ | 2,317 | 3,004 | 2,730 | 3,016 |

Program travel is required for the accomplishment of the Center's missions and accounts for 67 percent of travel costs in 1990. Travel for program purposes is required for the continual monitoring and management efforts in space research, aeronautical research and technology, flight simulation, fluid mechanics, airborne research and applications, space life sciences, space station, flight test techniques, flight measurements, guidance and flight control, and flight measurement development activities. The decrease from the 1989 budget estimate to the 1989 current estimate is due to a decrease in budget availability. The 1990 estimate reflects an increase in the number of high altitude mission deployments, additional travel costs associated with new FTE's and reinstatement of funds to meet the previously planned level of travel.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Scientific and Technical Development Travel.... | 597 | 628 | 626 | 621 |

Scientific and technical development travel permits employees to participate in meetings and technical seminars with other representatives of the scientific and aerospace community. This participation allows personnel to benefit from exposure to technological advances outside Ames as well as to present both accomplishments and problems to associates. Many such meetings are working panels convened to solve certain problems for the benefit of the Government. The minor decrease in the 1989 current estimate and the 1990 budget estimate reflects adjustments to planned requirements.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| C. Management and Operations Travel............... | 790 | 703 | 841 | 846 |

Management and operations travel provides for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management and procurement; travel of the Center's top management to NASA Headquarters, other NASA Centers, and contractor plants; and local trans portation. The increase in 1989 and 1990 reflects increased requirements placed on top management and selected support areas associated with program and institutional planning.

| | | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|---|
| | | | (Thousands of Dollars) | | |
| III. | OPERATION OF INSTALLATION | 55,366 | 67,057 | 61,308 | 64,670 |

Summary of Fund Requirements

| | | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|---|
| A. | Facilities Services | 22,465 | 31,161 | 24,481 | 28,065 |
| B. | Technical Services | 13,547 | 16,660 | 17,084 | 16,702 |
| C. | Management and Operations | 19,354 | 19,236 | 19,743 | 19,903 |
| | Total, Operation of Installation | 55,366 | 67,057 | 61,308 | 64,670 |

Explanation of Fund Requirements

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

The decrease from the 1989 budget estimate to the 1989 current estimate is primarily due to decreased electricity rates based on resumption of the diversity agreement with the Western Area Power Administration. The 1990 estimate provides for full year funding of support contractor costs and expected rate increases in the support contractor and utility areas. Utility consumption will increase with planned wind tunnel activity and small increases in support contracts are planned in the maintenance, janitorial, and medical services areas.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. FACILITIES SERVICES............................ | 22.465 | 31,161 | 24,481 | 28.065 |

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

The decrease from the 1989 budget estimate to the 1989 current estimate is due primarily to the resumption of the diversity agreement with WAPA, thereby lowering electricity rates. The 1990 estimate provides for increased utility rates and consumption associated with increased wind tunnel testing as well as an increase in support contractor rates.

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property .................. | 77 | 73 | 114 | 121 |
| 2. Maintenance and Related Services........... | 7,260 | 5,334 | 7,751 | 9,041 |
| 3. Custodial Services......................... | 5,378 | 7,128 | 5,690 | 6,372 |
| 4. Utility Services.......................... | 9,750 | 18,626 | 10,926 | 12,531 |
| Total, Facilities Services | 22.465 | 31,161 | 24,481 | 28,065 |

## Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 1. Rental of Real Property.................... | 77 | 73 | 114 | 121 |

This function primarily provides for rental of trailers for office space. The increases from the 1989 budget estimate to the 1989 current estimate is due to rental of additional trailers in support of the Shuttle program. The 1990 estimate provides for full year cost of the additional rentals.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Maintenance and Related Services........... | 7.260 | 5.334 | 7.751 | 9.041 |

Maintenance and repair includes the maintenance of grounds and repairs of heating, ventilating, and lighting equipment in institutional buildings and offices. Maintenance of grounds includes maintenance of approximately 30 acres of improved planted areas and associated pest control; maintenance of approximately 45 acres of unimproved areas such as substations, aircraft taxiways, drainage ditches, large fields and roadway shoulders within these areas; and maintaining approximately 42 acres of streets, parking lots, and V/STOL areas, and an aircraft ramp and taxiway. The increase from the 1989 budget estimate to the 1989 current estimate reflects costs consistent with the 1988 actual level of maintenance and the need to adjust funding to continue to meet critical requirements. The increase from the 1989 current estimate to the 1990 budget estimate reflects an increase in contractor support, higher contractor rates, and expected increased price levels for supplies and equipment to meet additional critical maintenance requirements.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 3. Custodial Services......................... | 5.378 | 7.128 | 5.690 | 6.372 |

Janitorial and building cleaning services are associated with approximately three million square feet of various types of space located in 231 buildings and structures, and in trailers which provide temporary office and shop space. Security services are for buildings and property, including research aircraft and computer facilities, and "round-the-clock" staffing of a duty office which monitors and coordinates fire protection, security, and safety functions at the Center. Other services include pest control, refuse collection, laundry and custodial supplies. These services are provided by support contractors. The decrease from the 1989 budget estimate to the 1989 current estimate reflects a decrease in budget availability. The increase in the 1990 budget estimate is due to support for new facilities and expected support contractor rate increases.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 4. Utility Services......................... | 9,750 | 18,626 | 10,926 | 12,531 |

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 40x80x120 foot wind tunnel, the 14-foot Transonic wind tunnel, and the flight simulators. Approximately 55 percent of the natural gas is used in research facilities; the other part is used for heating and ventilation of institutional buildings. Ames-Moffett accounts for 95 percent of the overall utility energy usage. At Dryden, electricity is purchased through Air Force contracts with regional utility companies and estimates are based on Air Force projections. Natural gas is purchased from Pacific Gas and Electric. Other commodities include fuel oil, water, and sewage services.

The decrease between the 1989 budget estimate and the 1989 current estimates is mainly attributable to resumption of the WAPA diversity agreement and reduction in planned wind tunnel testing. The increase from the 1989 current estimate to the 1990 budget estimate reflects full utilization of the wind tunnels and a scheduled WAPA rate increase.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. TECHNICAL SERVICES............................ | 13.547 | 16.660 | 17.084 | 16,702 |

Summary of Fund Reauirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing.................. | 7,968 | 8,150 | 9,818 | 9,263 |
| 2. Scientific and Technical Information........ | 3,042 | 4,169 | 3,955 | 3,973 |
| 3. Support Services.......................... | 2.537 | 4,341 | 3,311 | 3.466 |
| Total, Technical Services............... | 13.547 | 16,660 | 17.084 | 16.702 |

Explanation of Fund Reauirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing.................. | 7.968 | 8.150 | 9.818 | 9.263 |

This category includes the central administrative ADP facility equipment and operating costs. The increase from the 1989 budget estimate to the 1989 current estimate is due primarily to increased support of the on-going financial management recoding, and a mainframe upgrade all of which were required to permit a timely conversion and day-to-day management needs. The 1990 decrease reflects phasing-down of the recoding effort, partially offset by expected support contractor rate increases.

| | | | | |
|---|---|---|---|---|
| 2. Scientific and Technical Information......... | 3,042 | 4.169 | 3.955 | 3.973 |

This category provides for the purchase of books, supplies, and materials for the operation of the Ames' libraries. Also included is a support contract to perform public information services, media development, and education programs. The 1989 current estimate reflects support contractor cost consistent with the 1988 actuals while providing for a higher level of support related to Shuttle Landings. The 1990 estimate reflects a level of support consistent with 1989.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 3. Support Services | 2.537 | 4.341 | 3.311 | 3,466 |

This category includes photography and graphics, and audiovisual services primarily supporting the public affairs activity. The decrease from the 1989 budget estimate to the 1989 current estimate reflects a reduction in planned growth due to funding constraints. The 1990 estimate provides for expected support contractor rate increases plus a small increase in the level of support.

| | | | | |
|---|---|---|---|---|
| C. MANAGEMENT AND OPERATIONS | 19.354 | 19,236 | 19,743 | 19,903 |

Summary of Fund Reauirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications | 8,071 | 5,092 | 5,076 | 4,546 |
| 2. Printing and Reproduction | 1,356 | 1,945 | 1,764 | 1,749 |
| 3. Transportation | 1,067 | 1,677 | 1,292 | 1,326 |
| 4. Installation Common Services | 8.860 | 10.522 | 11,611 | 12.282 |
| Total, Management and Operations | 19.354 | 19.236 | 19,743 | 19,903 |

Explanation of Fund Reauirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications | 8.071 | 5,092 | 5,076 | 4.546 |

Communications services are provided by the General Services Administration for the Federal Telecommunications Service, and the Pacific Telephone and Telegraph Company and the General Telephone and Telegraph Company for local services at Ames-Moffett and Dryden, respectively. Other communications consist of teletype equipment and services provided by Western Union, lease of switchboard equipment, and a support contract for communications services. The decrease from the 1989 budget estimate to the 1989 current estimate reflects the cost requirements based on the 1988 actual less the major upgrade of the telecommunications facilities which were funded primarily in 1988. The decrease from the 1989 current estimate to the 1990 budget estimate reflects a return to the baseline effort following final payment on the telecommunications upgrade in FY 1989.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Printing and Reproduction.................. | 1,356 | 1,945 | 1,764 | 1,749 |

The estimate for administrative printing includes the operating costs of the printing and reproduction facility as well as supplies, materials, and equipment. All common processes of duplication, including photostating, blueprinting and microfilming are included. The decrease from the 1989 budget estimate to the 1989 current estimate reflect rates consistent with the 1988 actuals. The decrease between the 1989 current estimate and the 1990 budget estimate reflects minor adjustments to maintenance contracts.

| | | | | |
|---|---|---|---|---|
| 3. Transportation............................ | 1,067 | 1,677 | 1,292 | 1,326 |

The estimates include motor pool operation costs for NASA-owned and GSA-owned vehicles, Government bills of lading, and air freight costs. The decrease from the 1989 budget estimate to the 1989 current estimate reflects a small decrease in contractor rates along with savings from deferred vehicle purchases. The 1990 estimate provides the same level of service with expected rate increases.

| | | | | |
|---|---|---|---|---|
| 4. Installation Common Services................ | 8,860 | 10,522 | 11,611 | 12,282 |

These services include support to center management and staff activities, medical services, and installation support activities. For example, this category includes those supplies, materials and services in support of Center management functions such as personnel, procurement, and financial management. Medical services include the staffing of the health units, laboratory service fees, clinic supplies, and maintenance of clinic equipment. Installation support services provide contractor support for supply and property management, mail, pickup and delivery services, and postage. The increase from the 1989 budget estimate to the 1989 current estimate is due to increased costs of the hazardous waste monitoring and environmental compliance. The increase in 1990 provides for full year funding of support contracts as well as an increase in support contractor manpower resulting from planned conversions of Civil Service positions.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# AYES RESEARCH CENTER

ORGANIZATION AND STAFFING CHART

**STAFFING SUMMARY**

| | 89 | 90 |
|---|---|---|
| SES | 44 | 44 |
| GS/GM 16 | 1 | 1 |
| GS/GM 15 | 188 | 188 |
| GS/GM 14 | 343 | 343 |
| OTHER GS/GM | 1277 | 1245 |
| WAGE | 346 | 352 |
| TOTAL | 2080 | 2173 |

**OFFICE OF THE DIRECTOR**

| | 89 | 89 |
|---|---|---|
| SES | 4 | 4 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 12 | 12 |
| WAGE | 0 | 0 |
| TOTAL | 20 | 20 |

**EQUAL OPPORTUNITY PROGRAMS OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | | 2 |
| WAGE | | 0 |
| TOTAL | | 3 |

**OFFICE OF THE CHIEF ENGINEER**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 1 | |
| WAGE | 0 | |
| TOTAL | 2 | |

**ADV. TECHNOLOGY & SPACE STATION PUNNING OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | | |

**OFFICE OF THE COMPTROLLER**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 3 | 3 |
| OTHER GS/GM | 61 | 60 |
| WAGE | | 0 |
| TOTAL | | 67 |

**OFFICE OF THE PATENT COUNSEL**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 1 | 1 |
| WAGE | 0 | 0 |
| TOTAL | 2 | 2 |

**OFFICE OF COUNSEL**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 3 | |
| WAGE | 0 | |
| TOTAL | 5 | |

**EXTERNAL AFFAIRS OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 3 | 5 |
| OTHER GS/GM | | |
| WAGE | | |

**DIRECTOR OF ADMINISTRATION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 4 | 4 |
| WAGE | 0 | 0 |
| TOTAL | 7 | 7 |

**SECURITY OPERATIONS OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 7 | 8 |
| WAGE | 0 | 0 |
| TOTAL | 8 | 9 |

**LOGISTICS MGMT DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 18 | 19 |
| WAGE | 6 | 6 |
| TOTAL | 25 | 26 |

**HUMAN RESOURCES DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 3 | 3 |
| OTHER GS/GM | 37 | 38 |
| WAGE | 0 | 0 |
| TOTAL | 41 | 42 |

**ACQUISITION DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 7 | 7 |
| OTHER GS/GM | 78 | 83 |
| WAGE | 0 | 0 |
| TOTAL | 87 | 92 |

**TECHNICAL INFORMATION DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 26 | 27 |
| WAGE | 3 | 3 |
| TOTAL | 30 | 31 |

**DIRECTOR OF ENGINEERING AND TECHNICAL SERVICES**

| | 89 | 90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 1 | 1 |
| WAGE | 0 | 0 |
| TOTAL | 5 | 5 |

**FACILITIES PLANNING OFFICE**

| | 89 | 90 |
|---|---|---|
| GS/GM 15 | | |
| GS/GM 14 | | |
| OTHER GS/GM | 3 | |
| WAGE | | |
| TOTAL | 5 | 5 |

**INFORMATION AND COMMUNICATIONS SYSTEMS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 7 | 7 |
| OTHER GS/GM | 50 | 50 |
| WAGE | 0 | 0 |
| TOTAL | 59 | 59 |

**SYSTEMS ENGINEERING DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 7 | 7 |
| GS/GM 14 | 16 | 16 |
| OTHER GS/GM | 92 | 102 |
| WAGE | 0 | 0 |
| TOTAL | 116 | 126 |

**TECHNICAL SERVICES DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 2 | 2 |
| OTHER GS/GM | 22 | 20 |
| WAGE | 126 | 128 |
| TOTAL | 151 | 151 |

**DIRECTOR OF AEROSPACE SYSTEMS**

| | 89 | 90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 3 | 3 |
| OTHER GS/GM | 3 | 3 |
| WAGE | 0 | 0 |
| TOTAL | 8 | 8 |

**ADVANCED PLANS AND PROGRAMS OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 6 | 6 |
| OTHER GS/GM | 3 | 3 |
| WAGE | 0 | 0 |
| TOTAL | 10 | 10 |

**FULL-SCALE AERODYNAMICS RESEARCH DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 6 | 6 |
| GS/GM 14 | 11 | 11 |
| OTHER GS/GM | 51 | 52 |
| WAGE | 20 | 22 |
| TOTAL | 89 | 90 |

**ROTORCRAFT AND POWERED-LIFT FLIGHT PROJECT DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 6 | 6 |
| GS/GM 14 | 11 | 11 |
| OTHER GS/GM | 25 | 25 |
| WAGE | 0 | 0 |
| TOTAL | 43 | 43 |

**AEROSPACE HUMAN FACTORS RESEARCH DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 10 | 10 |
| GS/GM 14 | 14 | 14 |
| OTHER GS/GM | 22 | 32 |
| WAGE | 0 | 0 |
| TOTAL | 48 | 58 |

**FLIGHT SYSTEMS AND SIMULATION RESEARCH DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 1 | 1 |
| GS/GM 15 | 16 | 16 |
| GS/GM 14 | 23 | 23 |
| OTHER GS/GM | 57 | 57 |
| WAGE | 0 | 0 |
| TOTAL | 98 | 98 |

**DIRECTOR OF FLIGHT OPERATIONS AND RESEARCH**

| | 89 | 90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 8 | 8 |
| WAGE | 0 | 0 |
| TOTAL | 12 | 12 |

**CHIEF ENGINEER'S OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 0 | 0 |
| WAGE | 0 | 0 |
| TOTAL | 1 | 1 |

**DRYDEN RESEARCH OPERATIONS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 7 | 7 |
| GS/GM 14 | 5 | 5 |
| OTHER GS/GM | 61 | 59 |
| WAGE | 105 | 107 |
| TOTAL | 179 | 179 |

**SCIENCE AND APPLICATIONS AIRCRAFT DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 12 | 12 |
| OTHER GS/GM | 25 | 25 |
| WAGE | 0 | 0 |
| TOTAL | 41 | 41 |

**DRYDEN AERONAUTICAL PROJECT OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 8 | 8 |
| OTHER GS/GM | 5 | 5 |
| WAGE | 0 | 0 |
| TOTAL | 17 | 17 |

**AMES RESEARCH AIRCRAFT OPERATIONS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 4 | 4 |
| GS/GM 14 | 3 | 3 |
| OTHER GS/GM | 16 | 16 |
| WAGE | 42 | 42 |
| TOTAL | 66 | 66 |

**RESEARCH ENGINEERING DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 17 | 17 |
| GS/GM 14 | 31 | 31 |
| OTHER GS/GM | 106 | 112 |
| WAGE | 0 | 0 |
| TOTAL | 157 | 161 |

**DIRECTOR OF AEROPHYSICS**

| | 89 | 90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 4 | 4 |
| WAGE | 0 | 0 |
| TOTAL | 8 | 8 |

**INFORMATION SCIENCES DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 6 | 6 |
| GS/GM 14 | 9 | 9 |
| OTHER GS/GM | 19 | 34 |
| WAGE | 0 | 0 |
| TOTAL | 35 | 50 |

**NUMERICAL AERODYNAMIC SIMULATION SYSTEMS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 4 | 4 |
| GS/GM 14 | 8 | 8 |
| OTHER GS/GM | 25 | 38 |
| WAGE | 0 | 0 |
| TOTAL | 38 | 46 |

**AERODYNAMICS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 6 | 6 |
| GS/GM 14 | 16 | 16 |
| OTHER GS/GM | 61 | 52 |
| WAGE | 26 | 26 |
| TOTAL | 100 | 101 |

**COMPUTER SYSTEMS & RESEARCH DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 3 | 3 |
| OTHER GS/GM | 31 | 31 |
| WAGE | 0 | 0 |
| TOTAL | 38 | 38 |

**FLUID DYNAMICS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 16 | 16 |
| GS/GM 14 | 28 | 28 |
| OTHER GS/GM | 33 | 33 |
| WAGE | 1 | 1 |
| TOTAL | 80 | 80 |

**THERMOSCIENCES DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 8 | 8 |
| GS/GM 14 | 20 | 20 |
| OTHER GS/GM | 33 | 46 |
| WAGE | 17 | 17 |
| TOTAL | 79 | 92 |

**DIRECTOR OF SPACE RESEARCH**

| | 89 | 90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 2 | 2 |
| OTHER GS/GM | 6 | 6 |
| WAGE | 0 | 0 |
| TOTAL | 12 | 12 |

**PROJECT CONTROL DEVELOPMENT OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 4 | 4 |
| WAGE | 0 | 0 |
| TOTAL | 4 | 4 |

**INFRARED ASTRONOMY PROJECTS OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 13 | 13 |
| OTHER GS/GM | 18 | 18 |
| WAGE | 0 | 0 |
| TOTAL | 34 | 34 |

**SPACE SCIENCE DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 20 | 20 |
| GS/GM 14 | 12 | 12 |
| OTHER GS/GM | 25 | 25 |
| WAGE | 0 | 0 |
| TOTAL | 58 | 58 |

**SPACE EXPLORATION PROJECTS OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 15 | 15 |
| OTHER GS/GM | 20 | 20 |
| WAGE | 0 | 0 |
| TOTAL | 37 | 37 |

**SPACE LIFE SCIENCES PAYLOADS OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 8 | 8 |
| OTHER GS/GM | 24 | 27 |
| WAGE | 0 | 0 |
| TOTAL | 35 | 38 |

**W E SCIENCE DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 6 | 6 |
| GS/GM 14 | 13 | 13 |
| OTHER GS/GM | 12 | 19 |
| WAGE | 0 | 0 |
| TOTAL | 32 | 39 |

**EARTH SYSTEMS SCIENCE DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 9 | 9 |
| GS/GM 14 | 11 | 11 |
| OTHER GS/GM | 27 | 27 |
| WAGE | 0 | 0 |
| TOTAL | 48 | 48 |

**OFFICE OF SAFETY, RELIABILITY AND QUALITY ASSURANCE**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 5 | 5 |
| OTHER GS/GM | 16 | 26 |
| WAGE | 0 | 0 |
| TOTAL | 24 | 34 |

LANGLEY
RESEARCH CENTER

**RESEARCH AND PROGRAM MANAGEMENT**

**FISCAL YEAR 1990 ESTIMATE**

**LANGLEY RESEARCH CENTER**

**DESCRIPTION**

The Langley Research Center (LaRC), located at Hampton, Virginia, was established in 1917. It is situated between Norfolk and Williamsburg, Virginia, in the Tidewater area of Hampton Roads. The Center utilizes 807 acres of Government-owned land, divided into two areas by the runway facilities of Langley Air Force Base. Runways, some utilities, and certain other facilities are used jointly by NASA and the Air Force. Under a permit from the Department of Interior, Langley has access to 3,276 acres. The total capital investment of the Langley Research Center, including fixed assets in progress and contractor-held facilities at various locations, as of September 30, 1988, was $786,058,000.

**CENTER ROLES AND MISSIONS**

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

**PRINCIPAL**

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

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

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

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

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

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

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

Guidance and Control Technology - conduct guidance, navigation, and control research to improve existing aircraft and spacecraft control and guidance systems and enable future aerospace vehicles and systems.

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

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

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

Information Systems Technology - develop technology for highly reliable, fault-tolerant software and data systems for flight crucial aerospace vehicle applications.

Flight Management - conduct research to develop technology for efficient, safe crew/vehicle interfaces and improved vehicle operations.

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

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

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

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

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

SUPPORTING

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

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

Launch Vehicle Procurement - management and operation of the existing Scout launch vehicle system.

FY 1990 CONGRESSIONAL BUDGET
DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM

| LANGLEY RESEARCH CENTER | 1988 ACTUAL | 1989 BUDGET ESTIMATE | 1989 CURRENT ESTIMATE | 1990 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION.................. | 39 | 44 | 32 | 32 |
| SPACE FLIGHT PROGRAMS.................. | 43 | 27 | 53 | 52 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 33 | lo | 36 | 34 |
| SPACE SHUTTLE..................... | 10 | 17 | 17 | 18 |
| SPACE SCIENCE AND APPLICATIONS ......... | 226 | 180 | 180 | 180 |
| PHYSICS AND ASTRONOMY............... | 0 | 0 | 0 | 0 |
| LIFE SCIENCES...................... | 4 | 4 | 5 | 5 |
| PLANETARY EXPLORATION............... | 0 | 0 | 0 | 0 |
| SPACE APPLICATIONS.................. | 222 | 176 | 175 | 175 |
| AERONAUTICS AND SPACE TECHNOLOGY | 1,774 | 1,906 | 1,836 | 1,880 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 1,130 | 1,216 | 1,157 | 1,172 |
| SPACE RESEARCH-AND TECHNOLOGY .... | 502 | 563 | 527 | 555 |
| TRANSATMOSPHERIC RESEARCH & TECH . | 142 | 127 | 152 | 153 |
| COMMERCIAL PROGRAMS.................... | 12 | 12 | 16 | 16 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE. | 6 | 0 | 7 | 7 |
| TRACKING AND DATA PROGRAMS.............. | 0 | 0 | 0 | 0 |
| SUBTOTAL DIRECT.................... | 2,100 | 2,169 | 2,124 | 2,167 |
| CENTER MANAGEMENT AND OPERATIONS........ | 711 | 643 | 711 | 721 |
| SUBTOTAL (FULL-TIME PERMANENTS).... | 2,811 | 2,812 | 2,835 | 2,888 |
| OTHER CONTROLLED FTE'S ................. (PMI's/CO-OPS/OTFTP's) | 98 | 99 | 98 | 98 |
| GRAND TOTAL (FULL-TIME EQUIVALENTS) | 2,909 | 2,911 | 2,933 | 2,986 |

## PROGRAM DESCRIPTION

Permanent Civil
Service Workyears

### RESEARCH AND DEVELOPMENT

SPACE STATION ........................................................................ 32

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

SPACE FLIGHT PROGRAMS ................................................................ 52

SPACE TRANSPORTATION CAPABILITY DEVELOPMENT ........................................ 34

Langley has the lead Center focus for the Advanced Manned Launch System studies which provide the Agency long-range planning for a second generation Space Shuttle anticipated after the year 2000. A pre-definition phase contractual study is scheduled to continue in FY 1990. Langley in-house studies of concepts, technology levels, and mission requirements are coordinated with complimentary studies at Johnson Space Center, Marshall Space Flight Center, and Kennedy Space Center.

SPACE SHUTTLE ........................................................................ 18

The expendable launch vehicle program at Langley provides centralized procurement of the Scout launch vehicle. In 1990, civil service personnel will support a program which includes the procurement of launch vehicle hardware, launch services, engineering, and maintenance. Launches under this program will be conducted from sites located at the Western Space and Missile Center in California and Wallops Flight Facility in Virginia.

| | Permanent Civil Service Workyears |
|---|---|
| SPACE SCIENCE AND APPLICATIONS .................................................... | 180 |
| LIFE SCIENCES .................................................................... | 5 |

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

| | |
|---|---|
| SPACE APPLICATIONS ............................................................. | 175 |

The space applications program at Langley provides a national research capability for understanding the environment and for developing related atmospheric sensing systems and techniques. The Center's technical expertise is widely recognized in the areas of remote sensing of the Earth's atmospheric trace species and of theoretical and empirical atmospheric modeling. In the area of upper atmospheric research, Langley civil service personnel will continue to study the Earth's atmosphere to assess changes caused by man and to determine whether or not there is any associated change in the chemical composition of the stratosphere that would change the transmission of solar ultra violet radiation to the Earth's surface. Langley scientists have used satellite and airborne remote sensors to probe the Antarctic ozone hole in the 1987 international campaign and focused their capabilities on the Arctic mission in 1989. Efforts will continue in defining and developing Shuttle and satellite experiments that will provide measurements of atmospheric constituents and other characteristics. Langley researchers have prepared and submitted proposals for six new experiments for the Earth Observing System polar orbiting platform which is a key element in the Mission to Planet Earth.

A significant improvement in the understanding of man's impact on the atmosphere and climate will be obtained from the combination of Langley developed statistical/theoretical models and the comprehensive global data set provided by spaceborne sensors such as Limb Infrared Monitor of the Stratosphere, Stratospheric Aerosol Measurements 11, and Stratospheric Aerosol and Gas Experiments, Measurements of Air Pollution from Satellites, and Earth Radiation Budget Experiments. Langley has underway the design, fabrication, and test of the Halogen Occultation Experiment to fly on the Upper Atmospheric Research

Satellite to measure trace stratospheric constituent, the Laser Atmospheric Sounder Experiment to fly on the NASA ER-2 aircraft to profile trace gases and aerosols in the lower atmosphere, and the Lidar In-Space Technology Experiment to demonstrate active laser remote sensing from the shuttle. The Center's sensor development program encompasses the broadest possible range of advanced remote sensing techniques, including gas filter radiometry and interferometry, lidar, and active and passive microwave techniques.

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

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

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

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

| | Permanent Civil Service Workyears |
|---|---|
| AERONAUTICS AND SPACE TECHNOLOGY | 1.887 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY .................................. ............ | 1,172 |

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

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

Research areas include airfoil and wing design, flowfield 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 Navier-Stokes equations. Wind tunnel and flight tests will be continued on general aviation aircraft configurations with the potential for improved stall behavior or immunity and spin avoidance. Basic research on the conception and development of methods for reducing turbulent skin-friction drag and both passive and active laminar flow retention will be pursued. A goal of viscous drag reduction activities is to validate the various concepts to the level required for aircraft manufacturers to consider their use in future production aircraft. Application of advanced transonic theories to the design of improved 3-D wings will be continued and evaluated by wind tunnel tests. The development of design methodology for high-performance aircraft at high angles of attack in the areas of aerodynamics, controls, and handling qualities will be accelerated. Technology options for realization of practical hypersonic and transatmospheric flight are being studied.

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

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

Emerging technological advances in computer systems are being used to significantly increase engineering computational capability and reduce the cost of engineering computations. The Langley research program in computer science is directed at systems for distributed computer networks, methods for concurrent systems design, software engineering, fault-tolerant software techniques for improved system reliability, and software development management. In addition, studies to develop methods for validation and verification of knowledge-based software/systems have been initiated. Investigations of advanced computer hardware applications will be continued with finite-element structural analysis.

Controls and guidance work at Langley includes research programs to advance technology development in aircraft guidance and navigation, aircraft control systems, cockpit systems integration and interfacing techniques, and performance validation and verification methods for fully integrated, highly reliable flight control systems. Also, major efforts in aircraft flight management, operating procedures technology and controls technology for advanced transport aircraft are being conducted. The work includes requirement analyses, design studies, ground simulations, and experimental flight research in Langley's Boeing 737 research aircraft. The Langley expertise in the controls and guidance area is being applied to a range of problems, including intersystems communications networks for enhanced interfacing and integration of functions within an aircraft, flight path definitions, and advanced technology for pilot-system interfaces for both aircraft and spacecraft. Investigations 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 include the definition of technology for enhanced functional integration to increase aircraft systems reliability and reduce operating cost, and the investigation of concepts and technology which will result in greatly improved aircraft displays and input/output capabilities. Other technology applications are found in research on advanced flight control systems, design procedures, handling and flying qualities criteria for advanced aircraft, and modeling and assessment of pilot performance and workload using advanced human performance measurement tools. Research efforts in developing and applying artificial intelligence technology to aircraft cockpits are underway. The avionics integration research laboratory continues to be used for both NASA and industry research on fault-tolerant systems and software. The impact of lightning on inducing errors in digital aircraft systems will continue to be assessed and data disseminated. A major joint FAA/NASA research effort is underway to develop the technology required to model, detect, and either avoid or safely fly through low-altitude wind shear environments.

Langley has traditionally received requests from other agencies and industry for test support of their aircraft, missiles, and systems development programs. The Aerostructures Directorate of the U.S. Army Aviation Research and Technology Activity, and the Avionics Technology Directorate, both under Aviation

Systems Command, are located at Langley. These directorates, the primary investigators of Army rotorcraft structures and avionics, work on independent research and development projects and on projects of mutual interest with a staff integrated into the NASA organization. Langley facilities are used extensively for these research activities. There are also a large number of joint programs with the Air Force Systems Command, the Naval Air Systems Command, other DOD components, and the Federal Aviation Administration.

| | Permanent Civil Service Workyears |
|---|---|
| SPACE RESEARCH AND TECHNOLOGY .................................................... | 555 |

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

The objective in the materials area is to establish and demonstrate the required technology for application of advanced materials to 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 and radiation stability of composites and thermal control coatings. An integral part of the research activity is the definition of new experimental testing and research facility requirements which will assure that the reliability and durability of future space structures can be adequately predicted and assessed.

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

Extensive research in electronic component technology, spacecraft guidance and control, automation and robotics, and information systems technology is being conducted at Langley. Sensor research includes continuously tunable infrared laser techniques and high-power/high-pressure tunable gas lasers for the measurement of low concentration atmospheric constituents and transport phenomena (e.g., winds). Research related to onboard data management system concepts will be continued in 1990. 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 wavelength division multiplexed fiber optic technology is underway at Langley. The objective of this research is to provide the component technology base for advanced local area networks used in the Space Station or other complex aerospace systems. The evaluation of solid-state data storage technology for Space Station applications has been initiated. The overall objective is to identify candidate technologies, evaluate their potential, and perform research necessary to demonstrate viability in a projected Space Station environment. Langley is evaluating advanced optical data processing techniques which take advantage of the parallelism of optics to perform complex mathematical operations such as a matrix arithmetic at high speed for potential application to complex aerospace systems. Automation/robotic technology efforts will focus on conducting systems level research on teleoperated and robotic systems, developing and demonstrating automated construction concepts, and application of artificial intelligence technology. Other space technology efforts are focused on spacecraft guidance and control, software development, verification and validation techniques. A multi-center, multi-disciplinary technology program is underway to investigate, demonstrate, and validate the control-structures interaction of large flexible space structures through analysis, ground, and flight research experiments.

The Langley space vehicle and spacecraft technology program develops experimental and theoretical data bases to support: Space Shuttle enhancements, reduction and interpretation of Shuttle flight data, development of the aeroassist flight experiment, future space transportation vehicles for the 1990's and beyond that employ advanced technologies other than those used for the Space Shuttle, lunar and planetary exploration concepts, and large space systems. The objectives are met through the development and application of experimental and theoretical techniques employing Langley computers and wind tunnel facilities, and through comparative analyses with available flight data. Disciplines include aerodynamic and aerothermodynamic performance, configuration optimization, hypersonic computational fluid flow techniques which include the continuum and rarefied regimes, experimental fluid dynamic research primarily in the Langley hypersonic facilities complex, flight control systems assessment, mission analysis, trajectory performance analyses, and conceptual design studies.

The Langley program in space energy conversion is focused on radiant energy conversion concepts which convert solar and laser radiation efficiently into electricity or other useful forms of energy. The objective of the energy conversion effort is to perform basic research on solar-pumped lasers for conversion of solar energy directly into electromagnetic radiation, laser power, and development of potential power generation, transmission, storage, and control for future space missions.

| | Permanent Civil Service Workyears |
|---|---|
| TRANSATMOSPHERIC RESEARCH AND TECHNOLOGY .................................... | 153 |

The activities at Langley include: development of fundamental processes and engineering feasibility of supersonic combustion of both ramjets and other advanced airbreathing propulsion systems; characterization of advanced materials for high-temperature applications and the development of large, hot, reusable structures for aerospace vehicles; efforts in high-speed aerodynamics, configurations, and advanced computational methods for a variety of vehicle applications; and studies to define and understand the integration of advanced technologies into a future class of horizontal takeoff and landing aerospace plane vehicles for operation to orbit and/or hypersonic cruise within the atmosphere.

| | |
|---|---|
| COMMERCIAL PROGRAMS.............................................................. | 16 |

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

The NASA technology utilization program will contribute to the enhancement of economic growth and support state and local governments solution to public problems through the transfer of new technology, from aeronautical and space research and development efforts, to the nonaerospace segments of the economy.

Civil service personnel will provide support to define methods to expedite the application of new technology by compressing the time between the generation of technology and its application, and encourage the use of aerospace technology in nonaerospace segments of the economy.

| | Permanent Civil Service Workyears |
|---|---|
| SAFETY, RELIABILITY. MAINTENANCE AND QUALITY ASSURANCE............................ | 7 |

The Safety, Reliability, Maintainability and Quality Assurance program is to provide independent assessment activities which reduce program risk. At LaRC, a premier multidiscipline research and development laboratory has been completed (FY 1989). This facility will house research which will provide detailed understanding of fundamental physical phenomena important to quantitative measurement science focused on nondestructive material characterization in support of LaRC, NASA, and the broader aerospace community through technology transfer.

| | |
|---|---|
| CENTER MANAGEMENT AND OPERATIONS.................................................. | 721 |

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

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

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

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

## SUMMARY OF RESOURCES REQUIREMENTS

### FUNDING PLAN BY FUNCTION

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. Personnel and Related Costs...... | 127,236 | 129,281 | 134,939 | 140,120 |
| 11. Travel.......................... | 3,683 | 4,198 | 3,856 | 4,143 |
| III. Operation of Installation........ | 47,021 | 51,776 | 50,354 | 57,232 |
| A. Facilities Services.......... | (20,294) | (22,300) | (19,345) | (21,877) |
| B. Technical Services........... | (9,419) | (9,817) | (10,355) | (12,382) |
| C. Management and Operations.... | 117.3081 | (19.6591 | (20.6541 | (22,973) |
| Total, Fund Requirements..... | 177.940 | 185.255 | 189.149 | 201,495 |

RESOURCES REQUIREMENTS BY FUNCTION

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| I. PERSONNEL AND RELATED COSTS ....... | 127.236 | 129.281 | 134.939 | 140.120 |

Summary of Fund Requirements

A. Compensation and Benefits

1. Compensation

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| a. Full-time permanent.... | 107,073 | 107,950 | 111,611 | 115,797 |
| b. Other than full-time permanent............ | 1,731 | 1,882 | 1,952 | 1,973 |
| c. Reimbursable detailees............ | 23 | 0 | 0 | 0 |
| d. Overtime and other compensation......... | 1,268 | 1,386 | 1.420 | 1.540 |
| Subtotal, Compensation....... | 110,095 | 111,218 | 114,983 | 119,310 |
| 2. Benefits................... | 15.688 | 16,586 | 18,365 | 19.075 |
| Subtotal, Compensation and Benefits....... | 125.783 | 127.804 | 133.348 | 138.385 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Supporting Costs | | | | |
| 1. Transfer of personnel | 220 | 220 | 335 | 435 |
| 2. Personnel training......... | 1,233 | 1,257 | 1,256 | 1,300 |
| Subtotal, Supporting Costs.. ........... | 1,453 | 1,477 | 1,591 | 1,735 |
| Total, Personnel and Related Costs.................. | 127,236 | 129,281 | 134,939 | 140,120 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| A. Compensation and Benefits...... | 125,783 | 127,804 | 133,348 | 138,385 |
| 1. Compensation .............. | 110,095 | 111,218 | 114,983 | 119,310 |
| a. Full time permanent | 107 073 | 107 350 | 111 611 | 115 797 |

The increase from the 1989 revised budget estimate to the 1989 current estimate is due to the January 1989 pay raise and implementation of the Agency's manpower augmentation which reflects additional FTE's. The increase from the 1989 current estimate to the 1990 budget estimate reflects the full-year effect of the 1989 pay raises and the additional manpower augmentation.

## Basis of Cost for Permanent Workvears

In 1990. the cost of permanent workyears will be $115.797. The increase from 1989 is calculated as follows:

| | | |
|---|---|---|
| Cost of FTP workyears in 1989.................................. | | 111.611 |
| Cost increases in 1990.......................................... | | 5.738 |
| Within grade and career development advances: | | |
| Full year effect of 1989 actions.................... | 1,041 | |
| Partial year effect of 1990 actions.................. | 1.129 | |
| Additional FTE...................................... | 2.327 | |
| Full year cost of the 1989 pay raise................. | 1.241 | |
| Changes in reimbursements........................... | | |
| Turnover effect.................................................. | | -1,552 |
| Full year effects.................................... | .l.009 | |
| Partial year effects................................ | 543 | |
| Cost of full-time permanent workyears in 1990................... | | 115.797 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| b. Other than full-time permanent | | | | |
| 1. cost.............. | 1,731 | 1,882 | 1,952 | 1,973 |
| 2. Workyears......... | 128 | 133 | 133 | 133 |

The distribution of 1990 workyears is as follows:

Distribution of Other Than Full-Time Permanent Workvears

| Program | Workvears |
|---|---|
| Development programs........................................................ | 85 |
| Youth Opportunity programs.................................................. | 34 |
| Other temporary programs.................................................... | 14 |
| Total......................................................................... | 133 |

The increase from the 1989 budget estimate to the 1989 current estimate reflects the 1989 pay raise. The 1990 budget estimate reflects the full year effect of the 1989 pay raise.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| c. Overtime and other compensation........ | 1,268 | 1,386 | 1,420 | 1,540 |

The major cost in this area is overtime. Also included are Sunday and night-work differentials, holiday pay, incentive awards, and bonus awards. The use of overtime and other compensation is limited to emergency repairs and work that cannot be accomplished during normal duty hours. This includes the monitoring of on-site contracts during off-duty hours and wind tunnel work required at night to take advantage of off-peak electrical rates. The increase in the 1989 current estimate reflects the 1989 pay raise. The increase in the 1990 budget estimate reflects the full year effect of the 1989 pay raise.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Benefits................. | 15,688 | 16,586 | 18,365 | 19,075 |

The following are the amounts of contribution by category:

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| Retirement Fund and Thrift Plan.................. | 8,613 | 10,076 | 9,888 | 10,365 |
| Federal Group Life Ins......... | 218 | 225 | 224 | 226 |
| Employee health insurance...... | 3,913 | 3,078 | 5,005 | 5,210 |
| Workmen's compensation......... | 710 | 580 | 560 | 550 |
| FICA ......................... | 944 | 1,284 | 1,338 | 1,361 |
| Medicare...................... | 1,281 | 1,328 | 1,335 | 1,348 |
| Other Benefits................. | 9 | 15 | 15 | 15 |
| Total....................... | 15,688 | 16,586 | 18,365 | 19,075 |

The increase from the 1989 revised estimate to the 1989 current estimate reflects an increase of additional FTE's, an increase in health benefits, and the 1989 pay raise. The 1990 increase reflects the full year effect of 1989 pay raise and an increase in FTE employment.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| B. Supporting Cost................ | 1,453 | 1,477 | 1,591 | 1,735 |
| 1. Transfer of personnel...... | 220 | 220 | 335 | 435 |

Transfer of personnel includes actual expenses involved in the movement and temporary storage of employee's household goods, subsistence and temporary expenses, real estate costs, and miscellaneous moving expenses. The increase from the 1989 budget estimate to the 1989 current estimate reflects an increase due to additional FTE's. The 1990 estimate reflects increased FTE's transferring at the anticipated cost levels.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 2. Personnel training | 1 233 | 1 257 | 1 256 | 1 300 |

The purpose of training is to continue the development and education of civil service employees to support Langley's roles and missions more efficiently.

The increase from the 1989 current estimate to the 1990 budget estimate reflects an increase in tuition costs, and development of and provisions for the state-of-the-art training programs to keep pace with current technology.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| **11.** TRAVEL........................... | 3,683 | 4.198 | 3,856 | 4.143 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel............... | 2,173 | 2,801 | 2,263 | 2,550 |
| B. Scientific and Technical Development Travel......... | 1,053 | 1,007 | 1,100 | 1,110 |
| C. Management and Operations Travel.................... | 457 | 390 | 493 | 493 |
| Total, Travel............. | 3.683 | 4.198 | 3.856 | 4,143 |

Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel................ | 2.173 | 2,801 | 2.263 | 2,550 |

Program travel is directly related to the accomplishment of the Center's mission. Travel for program purposes reflects the continuing effort in space research, aircraft technology, flight simulation, fluid mechanics, airborne science and applications, space applications, Space Station, and Shuttle support. The decrease from the 1989 budget estimate to the 1989 current reflects a decrease in the planned number of trips due to budget constraints. The 1990 estimate reflects anticipated price increases.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Scientific and Technical Development Travel.......... | 1.053 | 1.007 | 1.100 | 1.100 |

Scientific and technical development travel permits employees to participate in meetings and technical seminars with other representatives of the aero-space community. Participation allows staff to benefit from exposure to technological advances outside Langley, as well as to present both accomplishments and problems to their associates. Many of the meetings are working panels convened to solve certain problems for the benefit of the Government. The increase from the 1989 revised estimate to the 1989 current estimate is due to the technological advances resulting from current and new initiatives such as the Civil Space Technology Initiative, the High-speed Civil Transport Studies, the Crew Return Capability Vehicle, Pathfinder, and Shuttle support activities.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| C. Management and Operations Travel...................... | 457 | 390 | 493 | 493 |

Management and operations travel is used for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management, and procurement activities; travel of the Center's top management to NASA Headquarters and other NASA Centers; peer group reviews; and local transportation. The 1989 current estimate and the 1990 budget estimate reflects a continuation of the 1988 level of effort at anticipated rate increases.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 111. OPERATION OF INSTALLATION ......... | 47,021 | 51,776 | 50.354 | 57,232 |

Summary of Fund Reauirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Facilities Services........... | 20,294 | 22,300 | 19,345 | 21,877 |
| B. Technical Services............ | 9,419 | 9,817 | 10,355 | 12,382 |
| C. Management and Operations..... | 17.308 | 19,659 | 20,654 | 22,973 |
| Total, Operation of Installation............. | 47.021 | 51.776 | 50,354 | 57.232 |

Explanation of Fund Reauirements

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

The decrease from the 1989 budget estimate to the 1989 current estimate reflects utility rate savings and changes in the funding pattern among support contractors, offset by increases in administrative automatic data processing and other technical services. In 1990, utility costs are expected to increase as the Virginia State Corporation Commission approved rate adjustments. Support for facility maintenance and custodial services have been adjusted for rate increases. Increases in Management and Operations in 1990 reflects increases in support contractors.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| A. FACILITIES SERVICES............ | 20.294 | 22.300 | 19.345 | 22.877 |

The Langley complex encompasses approximately 3 million square feet of buildings and structures. Included are 17 major technical facilities. This physical plant houses an average daily on-Center population of about 4,400 personnel. Many of the test facilities are utilized on more than one shift or during off-peak hours.

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property................ | 6 | 9 | 10 | 10 |
| 2. Maintenance and Related Services................. | 4,160 | 4,193 | 4,097 | 4,292 |
| 3. Custodial Services......... | 3,645 | 4,193 | 2,994 | 4,049 |
| 4. Utilitv Services.......... | 12.483 | 13.905 | 12,244 | 13.526 |
| Total, Facilities Services............. | 20.294 | 22.300 | 19.345 | 22,877 |

Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Rental of Real Property.... | 6 | 9 | 10 | 10 |

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

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Maintenance and Related Services................ | 4.160 | 4,193 | 4.097 | 4.292 |

This estimate provides funds for maintenance and repair of institutional buildings and other facilities, and roads and grounds maintenance. The decrease from the 1989 revised estimate to the 1989 current estimate reflect minor adjustments in maintenance levels in some facilities due to budget constraints. The 1990 estimate reflects the same level of maintenance support as in FY 1989 with expected rate increase.

| | | | | |
|---|---|---|---|---|
| 3. Custodial Services......... | 3.645 | 4,193 | 2.994 | 4.049 |

This activity provides for janitorial and security services. Also included are funds for fire protection services provided by the City of Hampton. The decrease from the 1989 budget estimate to the 1989 current estimate is the result of revision to the support contractor funding plan and reduction in the level of services due to budget reductions. The increase in the 1990 budget estimate reflects a full year's funding at expected rates for support contracts and required additional program requirements for security and fire protection services.

| | | | | |
|---|---|---|---|---|
| 4. Utility Services........... | 12.483 | 13.905 | 12,244 | 13.526 |

Included in this item is the purchase of electric service from Virginia Power Company, fuel oil from a local supplier, and water and sewage charges. Also included are funds for heat and steam services from the Air Force for East Area facilities and the purchase of steam from the City of Hampton, Air Force, and NASA cooperative refuse burner for facilities located in the West Area of Langley and contractor support for the steam generating and high pressure air plant. The net decrease from the 1989 revised estimate to the 1989 current estimate reflects lower than expected increases in the cost of electricity, a small increase in consumption, and reduced refuse burner costs. The 1990 budget estimate reflects expected electricity rate increases approved by the Virginia State Corporation Commission along with full year funding of support contractors.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. TECHNICAL SERVICES............. | 9.419 | 9.817 | 10.355 | 12.382 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing................. | 4,443 | 4,971 | 5,162 | 6,187 |
| 2. Scientific and Technical Information.............. | 4.976 | 4.846 | 5.193 | 6.195 |
| Total, Technical Services........... | 9.419 | 9.817 | 10,355 | 12.382 |

Explanation of Fund Reauirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing................ | 4,443 | 4.971 | 5,162 | 6.187 |

This estimate provides for Langley's business data complex which provides the Center's accounting and management information data. Included are equipment lease, purchase, and maintenance; paper and other expendable supplies; and a contract for programming and operations. The increase from the 1989 budget estimate to the 1989 current estimate reflects supports contractor workyear and rate increases. The 1990 budget estimate continues the 1989 level of operations in addition to the expected rate increases and replacement of peripheral equipment.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Scientific and Technical Information.............. | 4.976 | 4.846 | 5193 | 6,195 |

This estimate provides support contracts and related materials for the operation of the technical library and the Visitor Information Center. Funding for all the Center's public affairs activities, technical documentation, safety services, graphics, and photographic services are included. Additionally, coordination of tours and special events, construction and transportation of exhibits, and other educational and informational programs are included. The increase from the 1989 budget estimate to the 1989 current estimate reflects support for additional technical library, graphic, and photographic requirements. The increase in 1990 reflects that level of operations at expected rates with full year funding on all contracts.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| C. MANAGEMENT AND OPERATIONS...... | 17,308 | 19,659 | 20,654 | 22,973 |
| | umm | | | |
| 1. Administrative Communications.......... | 5.835 | 7.535 | 8.222 | 8,684 |
| 2. Printing and Reproduction........... | 1,630 | 1,666 | 1,722 | 1,808 |
| 3 Transportation | 1 892 | 2 296 | 2 074 | 2,313 |
| 4. Installation Common Services............... | 7,951 | 8,162 | 8,636 | 10,168 |
| Total, Management and Operations........... | 17,308 | 19,659 | 20,654 | 22,973 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications.............. | 5,835 | 7,535 | 8,222 | 8,684 |

Includes funds for local telephone and exchange costs, Federal Telecommunications Systems (FTS) services and datafax and telegraph service. Increases in the FY 1989 current estimate and the 1990 estimate reflect a rephased funding plan for a multi-year telecommunications systems upgrade

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Printing. and Reproduction...... | 1.630 | 1.666 | 1.722 | 1.808 |

Provides for a support contractor and supplies for reproduction services. The increase from the 1989 revised estimate to the 1989 current estimate reflects contractor rate increases. The 1990 estimate reflects the same level of service as 1989, adjusted for anticipated rate increases.

| | | | | |
|---|---|---|---|---|
| 3. Transportation................. | 1,892 | 2,296 | 2.074 | 2.313 |

Includes the operation, maintenance, and purchase of motor vehicles; shipping, transportation, and freight charges. Also included are charges for local transportation, pickup and delivery of freight, and operation and maintenance of the administrative aircraft. This effort includes aircraft fuel, equipment, and expendable supplies. The decrease from the 1989 budget estimate to the 1989 current estimate reflects adjustments in the plan to upgrade NASA's administrative aircraft. The 1990 increase reflects vehicle replacements and anticipated rate increases for support contracts.

| | | | | |
|---|---|---|---|---|
| 4. Installation Common Services.................... | 7,951 | 8.162 | 8.636 | 10.168 |

Provides for medical services, mail delivery, stock issue and warehousing, and other general administrative support. Also included are support to minority program management, rental and maintenance of office copy machines and equipment, and other administrative services and supplies. The increase from the 1989 budget estimate to the 1989 current estimate reflects an increase in support contract workyears, additional office equipment maintenance costs, and support for additional office rehabilitation requirements. The 1990 estimate reflects the full year cost of 1989 requirements and other adjustments in the planned level of services.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# LANGLEY RESEARCH CENTER

ORGANIZATION W O STAFFING CHART

### STAFFING SUMMARY

| | 89 | 90 |
|---|---|---|
| SES | 35 | 35 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 185 | 185 |
| GS/GM 14 | 353 | 353 |
| OTHER GS/GM | 2201 | 2305 |
| WAGE | 57 | 57 |
| TOTAL | 2831 | 2935 |

### OFFICE OF THE DIRECTOR

| | 89 | 90 |
|---|---|---|
| SES | 3 | 3 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 6 | 6 |
| OTHER GS/GM | 17 | 17 |
| WAGE | 0 | 0 |
| TOTAL | 28 | 28 |

### OFFICE OF DIRECTOR FOR ELECTRONICS

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 5 | 5 |
| WAGE | 0 | 0 |
| TOTAL | 7 | 7 |

### ANALYSIS AND COMPUTAT'N DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 4 | 4 |
| GS/GM 14 | 12 | 12 |
| OTHER GS/GM | 86 | 86 |
| WAGE | 0 | 0 |
| TOTAL | 103 | 103 |

### INSTRUMENT RESEARCH DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 5 | 5 |
| GS/GM 14 | 15 | 15 |
| OTHER GS/GM | 116 | 116 |
| WAGE | 0 | 0 |
| TOTAL | 137 | 137 |

### FLIGHT ELECTRONICS

| | | |
|---|---|---|
| GS/GM 16 | | |
| GS/GM 15 | | |
| GS/GM 14 | 14 | 14 |
| OTHERGYGM | 67 | 67 |
| WAGE | 0 | 0 |
| TOTAL | 90 | 90 |

### PROJECTS DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 8 | 8 |
| GS/GM 14 | 18 | 18 |
| OTHER GS/GM | 23 | 23 |
| WAGE | 0 | 0 |
| TOTAL | 50 | 50 |

### OFFICE OF DIRECTOR FOR STRUCTURES

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHERGYGM | 2 | 2 |
| WAGE | 0 | 0 |
| TOTAL | 4 | |

### STRUCTURAL MECHANICS DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 9 | 9 |
| GS/GM 14 | 12 | 12 |
| OTHER GS/GM | 39 | 39 |
| WAGE | 0 | 0 |
| TOTAL | 61 | 61 |

### STRUCTURAL DYNAMICS DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 9 | 9 |
| GS/GM 14 | 12 | 12 |
| OTHER GS/GM | 46 | 46 |
| WAGE | 0 | 0 |
| TOTAL | 68 | 68 |

### INTERDISCIPLINARY RESEARCH OFFICE

| | | |
|---|---|---|
| WGM16 | | |
| GYGM15 | | |
| GS/GM 14 | 3 | 3 |
| OTHERGYGM | 5 | |
| WAGE | 0 | 0 |
| TOTAL | 10 | 10 |

### MATERIALS DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 9 | 9 |
| GS/GM 14 | 15 | 15 |
| OTHER GS/GM | 42 | 42 |
| WAGE | 0 | 0 |
| TOTAL | 67 | 67 |

### ACOUSTICS DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 9 | 9 |
| OTHERGYGM | 31 | |
| GS/GM 14 | 5 | 5 |
| OTHER G | 44 | 36 |
| WAGE | 0 | 0 |
| TOTAL | | 46 |

### OFFICE OF DIRECTOR FOR AERONAUTICS

| | 89 | 90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHERGYGM | 3 | 3 |
| WAGE | 0 | 0 |
| TOTAL | 6 | 6 |

### HYPERSONIC TECHNOLOGY OFFICE

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 2 | 2 |
| OTHER GS/GM | 9 | 9 |
| WAGE | 0 | 0 |
| TOTAL | 14 | 14 |

### ADVANCED VEHICLES DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 4 | 4 |
| GS/GM 14 | 9 | 9 |
| OTHER GS/GM | 19 | 19 |
| WAGE | 0 | 0 |
| TOTAL | 33 | 33 |

### TRANSONIC AERODYNAMICS DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 10 | 10 |
| GS/GM 14 | 17 | 17 |
| OTHERGYGM | 73 | 88 |
| WAGE | 0 | 0 |
| TOTAL | 101 | 116 |

### LOW-SPEED AERODYNAMICS DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 9 | 9 |
| GS/GM 14 | 12 | 12 |
| OTHER GS/GM | 71 | 86 |
| WAGE | 4 | 4 |
| TOTAL | 97 | 112 |

### HIGH-SPEED AERODYNAMICS DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 11 | 11 |
| GS/GM 14 | 14 | 14 |
| OTHER GS/GM | 50 | 65 |
| WAGE | 0 | 0 |
| TOTAL | 76 | 91 |

### OFFICE OF DIRECTOR FOR MANAGEMENT OPERATIONS

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 4 | 4 |
| GS/GM 14 | 3 | 3 |
| OTHER GS/GM | 10 | 10 |
| WAGE | 0 | 0 |
| TOTAL | 18 | 18 |

### FINANCIAL MGMT. DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 3 | 3 |
| OTHER GS/GM | 44 | 44 |
| WAGE | 0 | 0 |
| TOTAL | 48 | 48 |

### MANAGEMENT SUPPORT DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 50 | 50 |
| WAGE | 0 | 0 |
| TOTAL | 52 | 52 |

### PERSONNEL DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 4 | 4 |
| OTHER GS/GM | 37 | 37 |
| WAGE | 0 | 0 |
| TOTAL | 42 | 42 |

### ACQUISITION DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 6 | 6 |
| OTHER GS/GM | 78 | 78 |
| WAGE | 0 | 0 |
| TOTAL | 85 | 85 |

### PROGRAMS & RESOURCES DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 2 | 2 |
| OTHER GS/GM | 18 | 18 |
| WAGE | 0 | 0 |
| TOTAL | 21 | 21 |

### RESEARCH INFO. & APPLICATIONS DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 3 | 3 |
| OTHER GS/GM | 69 | 69 |
| WAGE | 10 | 10 |
| TOTAL | 83 | 83 |

### OFFICE OF DIRECTOR FOR SELO

| | 89 | 90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GYM14 | 0 | 0 |
| OTHERGYGM | 3 | 3 |
| WAGE | 0 | 0 |
| TOTM | 6 | 6 |

### SYSTEM SAFETY, QUALITY AND RELIABILITY OFFICE

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 2 | 2 |
| OTHERGYGM | 23 | 23 |
| WAGE | 0 | 0 |
| TOTN | 26 | 26 |

### FABRICATION DIVISION

| | 89 | 39 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 2 | 2 |
| OTHER GS/GM | 281 | 281 |
| WAGE | 20 | 20 |
| TOTAL | 305 | 305 |

### FACILITIES PROGRAM DEVELOPMENT OFFICE

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 7 | 7 |
| WAGE | 0 | 0 |
| TOTAL | 10 | 10 |

### FACILITIES ENGINEERING DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 6 | 6 |
| GS/GM 14 | 17 | 17 |
| OTHER GS/GM | 109 | 109 |
| WAGE | 0 | 0 |
| TOTAL | 133 | 133 |

### OPERATIONS SUPPORT DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 4 | 4 |
| OTHER GS/GM | 388 | 388 |
| WAGE | 23 | 23 |
| TOTAL | 416 | 416 |

### OFFICE OF DIRECTOR FOR SPACE

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 3 | 3 |
| WAGE | 0 | 0 |
| TOTAL | 6 | 6 |

### SPACE STATION OFFICE

| | 89 | 90 |
|---|---|---|
| SES | 3 | 3 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 6 | 6 |
| GS/GM 14 | 9 | 9 |
| OTHERGYGM | 13 | 13 |
| WAGE | 0 | 0 |
| TOTAL | 31 | 31 |

### ATMOSPHERIC SCIENCES DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 21 | 21 |
| GS/GM 14 | 26 | 26 |
| OTHERGYGM | 43 | 43 |
| WAGE | 0 | 0 |
| TOTAL | 91 | 91 |

### SPACE SYSTEMS DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 12 | 12 |
| GS/GM 14 | 26 | 26 |
| OTHERGYGM | 55 | 85 |
| WAGE | 0 | 0 |
| TOTAL | 94 | 124 |

### OFFICE OF DIRECTOR FOR FLIGHT SYSTEMS

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 4 | 4 |
| OTHER GS/GM | 13 | 13 |
| WAGE | | |
| TOTAL | 21 | 21 |

### INFORMATION SYSTEM DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 18 | 18 |
| OTHER GS/GM | 15 | 15 |
| WAGE | 0 | 0 |
| TOTAL | 37 | 37 |

### GUIDANCE & CONTROL DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 6 | 6 |
| GS/GM 14 | 24 | 24 |
| OTHER GS/GM | 44 | 58 |
| WAGE | 0 | 0 |
| TOTAL | 75 | 89 |

### FLIGHT MANAGEMENT DIVISION

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 6 | 6 |
| OTHERWGM | 65 | 80 |
| WAGE | | |
| TOTAL | 75 | 90 |

LEWIS
RESEARCH CENTER

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1990 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 Ordinance works. There are 6,454 acres owned by NASA and approximately 47 acres in easements. Following a standby period from 1975 to 1987, several major test facilities have been reactiviated. Four major test programs are in process for NASA programs and in support of other government agencies.

The total capital investment of LeRC and Plum Brook Station, including fixed assets in progress and contractor-held facilities at various locations, as of September 30, 1988, was $544,797,000.

## 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, aircraft icing phenomena; aeronautical propulsion and power technologies including engine materials and structures, propulsion system integration, advanced propellers, instrumentation and controls technology; and the associated research facilities and experimental techniques.

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

Space Station Freedom - manage the design and development of the Space Station Freedom 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 - manage procurement and operation of intermediate and large class vehicles for the mixed fleet program.

Space Propulsion Systems Technology - develop and maintain the technology base for advanced high and low thrust primary and auxiliary propulsion systems, including associated structures, materials and analytical technologies.

Space Energy Processes and Systems Technology - develop and maintain 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 in materials processing, combustion and fluid physics, and conduct flight experiments which contribute to technology developments for space power, propulsion, fluid and thermal management systems.

Commercialization of Space - promote and facilitate the commercialization of space by increasing the awareness of U.S. industry to space opportunities and encouraging increased industry investment and participation in high technology space-based research, applications, and development.

Technology Utilization - plan, organize and facilitate the transfer of NASA-developed technology to the non-aerospace community.

SUPPORTING

Energy Processes and Systems Technology - manage research and technology projects for terrestrial propulsion and energy conservation systems.

FY 1990 CONGRESSIONAL BUDGET
DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM

| LEWIS RESEARCH CENTER | 1988 ACTUAL | 1989 BUDGET ESTIMATE | 1989 CURRENT ESTIMATE | 1990 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION........................ | 309 | 350 | 315 | 375 |
| SPACE FLIGHT PROGRAMS.................. | 61 | 48 | 61 | 61 |
| SPACE TRANSPORTATION CAPABILITY DEV | 19 | 0 | 19 | 19 |
| SPACE SHUTTLE..................... | 42 | 48 | 42 | 42 |
| SPACE SCIENCE AND APPLICATIONS....... | 269 | 216 | 272 | 203 |
| PHYSICS AND ASTRONOMY............... | 0 | 0 | 0 | 0 |
| LIFE SCIENCES...................... | 0 | 0 | 0 | 0 |
| PLANETARY EXPLORATION............... | 0 | 0 | 0 | 0 |
| SPACE APPLICATIONS.................. | 269 | 216 | 272 | 203 |
| AERONAUTICS AND SPACE TECHNOLOGY....... | 1,444 | 1,486 | 1,459 | 1,537 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 888 | 905 | 895 | 942 |
| SPACE RESEARCH AND TECHNOLOGY....... | 434 | 446 | 442 | 473 |
| TRANSATMOSPHERIC RESEARCH & TECH.... | 122 | 135 | 122 | 122 |
| COMMERCIAL PROGRAMS.................... | 12 | 14 | 12 | 12 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE. | 2 | 0 | 2 | 2 |
| TRACKING AND DATA PROGRAMS.............. | 0 | 0 | 0 | 0 |
| SUBTOTAL DIRECT................... | 2,097 | 2,114 | 2,121 | 2,190 |
| CENTER MANAGEMENT AND OPERATIONS........ | 543 | 532 | 543 | 553 |
| SUBTOTAL (FULL-TIME PERMANENTS).... | 2,640 | 2,646 | 2,664 | 2,743 |
| OTHER CONTROLLED FTE'S.................. (PMI's/CO-OPS/OTFTP's) | 51 | 48 | 51 | 51 |
| GRAND TOTAL (FULL-TIME EQUIVALENTS) | 2,691 | 2,694 | 2,715 | 2,794 |

## PROGRAM DESCRIPTION

**RESEARCH AND DEVELOPMENT** — Permanent Civil Service Workvears

| | Permanent Civil Service Workvears |
|---|---|
| **SPACE STATION** .......................... .................... | 375 |

In 1990, civil service personnel will continue to manage the detail design and development activities, and prepare for the Level II controlled preliminary design review scheduled for late 1990 in support of the p-ower generation and storage, and the distribution and control of the electrical power for Space Station Freedom. Civil service personnel will continue the activities associated with the power system integrated test bed in the Power Systems Facility, photovoltaic systems solar array and NiH2 battery tests, and solar dynamic preliminary design hooks and scars and power generation proof-of-concept test.

| | |
|---|---|
| **SPACE FLIGHT PROGRAMS** ............................................ | 61 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT...................... | 19 |

During 1990, the center will continue to support planning and analysis activities for the Office of Exploration. LeRC is the integration agent in the areas of power and propulsion. During 1990, it is expected that these activities will begin to focus on a particular exploration mission in support of an agency initiative to explore Mars and/or the Martian moons or to establish a permanent lunar base.

| | |
|---|---|
| SPACE SHUTTLE.................................................. | 42 |

Lewis is reponsible for implementation of the Mixed Fleet Program as it relates to procurement of launch services for intermediate (Atlas/Centaur and Titan 111) and large (Titan IV) class vehicles and the delivery to specified orbit of all spacecraft launched by these vehicles for NASA. The project plans to have contracts in place for the launch of AC-68 FLTSATCOM in September 1989, CRRES and GOES I, J and K missions, beginning in 1990, all on Atlas/Centaurs. In addition, plans are being made to launch the MARS Observer mission on a Titan III/TOS in 1992.

In 1990, civil service personnel will continue to support planning, assessment, and study activities managed by the Office of Exploration. These activities support the definition of alternatives for major future national missions to explore the solar system beyond low Earth orbit.

| | Permanent Civil Service Workyears |
|---|---|
| SPACE SCIENCE AND APPLICATIONS.................................. | 203 |
| SPACE APPLICATIONS............................................. | 203 |

The Space Applications activity at Lewis consists of space communications research, microgravity science and applications research, design, development and operation of space flight experiments in materials, combustion, fluid physics, and instrumentation. In 1990, civil service personnel will continue to support studies of various advanced satellite communications systems concepts directed at providing additional frequency bands and improved communications service.

Lewis will also continue to evolve its work in advanced design, development and operation of perimental flight hardware and scientific flight experiments in basic science and technology associated with materials combustion and fluid dynamics phenomemon in reduced gravity. Development of research facilities for the Space Station Freedom is also included.

| | |
|---|---|
| AERONAUTICS AND SPACE TECHNOLOGY................................. | 1.537 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY............................ | 942 |

The aeronautics research and technology program at Lewis is planned to provide innovative propulsion concepts. The primary goal is to develop aeropropulsion technology which contributes significantly to the continuing preeminence of the U.S. civil and military aircraft industry. The approach is to provide the technology base for developing advanced aeronautical propulsion systems which will lead to higher speed; longer range; improvements in fuel efficiency, operating cost, reliability and durability; and/or which will operate with acceptable environmental impact. The Lewis' aeropropulsion program includes key generic discipline research, interdisciplinary research, and efforts focused on specific propulsion systems/vehicle applications. The Propulsion Directorate of the U.S. Army Aviation Research and Technology Activity under the Aviation Systems Command is co-located with Lewis Research Center. Both program offices share a mutual interest in independent research and technology development.

The generic discipline research includes internal computational fluid mechanics (ICFM), instrumentation and controls, materials, and computational structural mechanics. The objective of this research is to develop an understanding of the physical phenomena involved in these disciplines so that accurate analytical tools can be developed to predict and to improve propulsion system performance. The scope of the ICFM research includes computational methods, modeling and verification, and applications. The focus of the instrumentation and controls technology is the development of nonintrnsive research instrumentation and engine sensors/controls for the "smart" adaptive propulsion systems of the future. The advanced materials research is focused on super-alloys, intermetallics, coatings, ceramics and advanced composites for high temperature propulsion system applications. Computational structural mechanics involves the development and verification of advanced analytical methods for high temperature structures, structural dynamics, fracture mechanics, and the development of life prediction methodology.

The interdisciplinary propulsion research and technology includes systems analysis, icing technology, high temperature materials, and advanced propulsion concepts. Icing research brings together disciplines such as fluid mechanics and heat transfer to improve the analytical tools required for predicting icing effects, and to develop advanced ice protection systems. The goal of the icing research is to develop the technology base required to provide improved all-weather capability for civil and military aircraft. High temperature materials technology is aimed at providing improved durability and reliability of higher temperature propulsion system components including ceramics through the development of advanced materials and improved experimental and analytical tools. The advanced propulsion concepts program is aimed at high efficiency and low emission gas turbine technology.

In engine systems research, Lewis is developing focused propulsion technology for specific engines and propulsion systems. Research and technology in this area involves small engines (gas turbines and intermittent combustion engines), advanced turboprops, and new, innovative propulsion systems, such as supersonic through-flow compression systems. Applications for this focused propulsion system research include subsonic transports, commuters, general aviation, rotorcraft, supersonic Short Takeoff and Vertical Landing (STOVL) aircraft, supersonic and hypersonic aircraft.

The Lewis aeropropulsion technology program is supported by advanced propulsion system studies and by propulsion facilities ranging from small research test rigs to large propulsion system altitude tanks and wind tunnels.

| | Permanent Civil Service Workyears |
|---|---|
| SPACE RESEARCH AND TECHNOLOGY.................................. .............. | 473 |

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 high and low thrust primary and auxiliary propulsion, cryogenic fluid management in microgravity, and space communications and advanced electronics for these areas of emphasis. This includes associated materials technology, structural analysis and life prediction technology, computational fluid dynamics, power management and distribution technology including fault tolerance and autonomy and advanced development work in support of the space station, its evolutionary growth, and other future space applications. In-space flight experiments are defined, developed and implemented in the context of the above technology areas and in the underlying basic sciences. In major roles, Lewis will pursue the Civil Space Technology Initiative (CSTI) programs in power, propulsion and sensors and the power, propulsion and cryogenic elements involved in operations technology, transfer vehicle technology and exploration technology in support of the Pathfinder program.

The Lewis primary propulsion programs emphasize the extension and advancement of the technologies of hydrogen- or hydrocarbon-fueled engines such as the Space Shuttle Main Engine and Advanced Launch Systems etc., toward long-life, reusable, serviceable, cost-effective systems for Earth-to-orbit applications. This concentrates on thrust chamber cooling and life, critical turbomachinery components, advanced structural analysis and life prediction, diagnostics and automated control via expert systems. Advanced propulsion concepts are also studied.

Another major thrust is to provide the technology at the component and system level for the next generation of cryogenic hydrogen/oxygen orbital and lunar Martian transfer propulsion systems in the areas of performance, life and reusability and autonomy based on expert systems. Emphasis is on combustion and heat transfer, long-life lightweight reusable components and subsystem assemblies and testbeds, high expansion area nozzles, and health monitoring and diagnostics. Cryogenic fluid management storage and transfer technologies for space based engines, cryogenic fluid depots in space and for the National Aero-Space Plane are investigated. Arcjets and high power magnetoplasmadymanic thrusters are also being developed.

The Lewis low thrust propulsion programs are directed toward Space Station Freedom, satellite and scientific exploration applications. Technologies for gaseous hydrogen-oxygen thrusters, resistojets capable of using various fuels, arcjets, inert gas ion, and high temperature thrusters for storable reactants are being developed.

Lewis does basic science and technology work in addition to conducting in-space science and technology experiments in materials, combustion and fluid dynamics in reduced gravity. This activity is coordinated with the scientific community in universities, industry, and government. Critical space experiments in support of power and propulsion technology advancements are also carried out under programs involving university, industry and NASA centers.

Space power programs are focused toward evolutionary space station, lunar/planetary surface and rover power and other future space mission needs. This includes solar photovoltaic, solar dynamic, electrochemical energy conversion and storage, nuclear energy conversion, thermal management, and power component and circuit development. The photovoltaic program seeks improvement in solar cell efficiency and life with a potential reduction in cost. In solar dynamics a higher efficiency alternative that reduces weight and area at high power levels is sought. Electrochemical research supports extended operating life and improved energy density for batteries and fuel cells. The nuclear energy conversion program is directed toward the development of advanced static and dynamic thermal energy conversion technologies and associated subsystems. Major emphasis is placed on the free piston Stirling heat engine technology as the advanced dynamic conversion system for nuclear and solar thermal sources.

Fault-tolerant, radiation-hard power component, circuit and system autonomy technologies for hundred kilowatt and above power systems are being investigated and demonstrated at the system testbed level. Interactions between the space plasma environment and the power systems are also being studied.

The space communications program includes applied research and advanced development in microwave electron beam amplifiers, microwave solid-state devices, and antenna systems. The program consists of efforts to develop advanced concepts, techniques, and communications systems components which will enable growth in the utilization of the radio frequency spectrum to frequencies well beyond 100GHz. A tunable backward wave oscillator for sensor applications in the 200-1000 GHz range is being developed.

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..................... | 122 |

Activities at Lewis are directed toward understanding and defining a class of airbreathing propulsion systems, using hydrogen fuel, that are applicable to orbital accelerator, and hypersonic cruise vehicles. These activities include advancements in variable geometry inlets and nozzles, characterizing a family of materials and cooling concepts compatible with extremely hot reusable engine and airframe structures, development of the computational methods necessary to analyze and define the flow in complex internal ducts and passages; and conducting the studies necessary to integrate these components into an efficient and capable propulsion system.

| | |
|---|---|
| COMMERCIAL PROGRAMS AND TECHNOLOGY UTILIZATION................... | 12 |

The Space Commercialization program at Lewis will continue to assist industry in evaluating the commercial potential of space by providing the Lewis Research Center's ground-based facilities and microgravity aircraft, and technical expertise for evaluation and testing of ideas/concepts.

The 1990 technology utilization program at Lewis will continue to concentrate on the identification and evaluation of technology which can be transferred to the non-aerospace industry, and on the development of new methods to communicate, transfer and license NASA-developed technology consistent with recent legislative actions.

| | |
|---|---|
| SAFETY, RELIABILITY & QUALITY ASSURANCE.......................... | 2 |

In 1990, Lewis will continue and expand the research and technology activities in support of fire-safety design requirements for Space Station Freedom and advanced spacecraft. Lewis has established itself as a lead center in microgravity combustion and spacecraft fire-safety applications through past and ongoing studies, both out-of-house and in the unique microgravity facilities existing at Lewis.

Also in 1990, Lewis will continue efforts to enhance the safety, reliability and performance of NASA's aerospace primary and secondary batteries as well as battery power systems.

| | Permanent Civil Service Workyears |
|---|---|
| CENTER MANAGEMENT AND OPERATIONS................................. | 553 |

Center Management and Operations Support is defined as support or services being provided to all Lewis organizations which cannot be directly identified to a benefitting program or project, The Civil Service personnel involved are:

Director and Staff - The Center Director, Deputy Director, and immediate staff, e.g., the Comptroller, Equal Opportunity, External Affairs, Chief Counsel, Health Services, Interagency and Industry Programs, University Programs and Safety, Reliability and Quality Assurance.

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

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

## SUMMARY OF RESOURCES REOUIREMENTS

### Funding Plan by Function

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. Personnel and Related Costs...... | 125,457 | 127,546 | 131,885 | 138,343 |
| 11. Travel.......................... | 3,332 | 3,767 | 3,445 | 3,719 |
| III. Operation of Installation........ | 53,113 | 60,140 | 58,870 | 65,728 |
| A. Facilities Services.......... | (26,757) | (30,248) | (30,266) | (31,639) |
| B. Technical Services........... | (12,039) | (14,607) | (12,512) | (14,649) |
| C. Management and Operations.... | (14,317) | (15,285) | (16,092) | 119,440) |
| Total, fund requirements... | 181,902 | 191,453 | 194,200 | 207,790 |

## RESOURCES REQUIREMENTS BY FUNCTION

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of | Dollars | |
| **I. PERSONNEL AND RELATED COSTS**........... | 125.457 | 127,546 | 131.885 | 138.343 |

Summary of Fund Reauirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | | | | |
| 1. Compensation | | | | |
| a. Full-time permanent........ | 104,898 | 106,698 | 109,034 | 114,571 |
| b. Other than full-time permanent | 1,123 | 977 | 1,207 | 1,245 |
| c. Reimbursable Detailees..... | 9 | 0 | 0 | 0 |
| d. Overtime and other compensation | 1.904 | 1,808 | 1.910 | 1.966 |
| Subtotal, Compensation..... | 107,934 | 109,483 | 112,151 | 117,782 |
| 2. Benefits...................... | 15,803 | 16.217 | 17,931 | 18.639 |
| Subtotal, Compensation and Benefits................... | 123,737 | 125,700 | 130,082 | 136.421 |
| B. Supporting Costs | | | | |
| 1. Transfer of personnel.......... | 53 | 153 | 110 | 170 |
| 2. Personnel training............ | 1.667 | 1,693 | 1.693 | 1.752 |
| Subtotal, Supporting Costs | 1.720 | 1,846 | 1,803 | 1.922 |
| Total, Personnel and Related Costs | 125.457 | 127,546 | 131.885 | 138.343 |

## Explanation of Fund Reauirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| A. Compensation and Benefits.......... | 123.737 | 125.700 | 130.082 | 136,421 |
| 1. Compensation.................. | 107,934 | 109.483 | 112,151 | 117.782 |
| a. Full-time permanent........ | 104,898 | 106,698 | 109,034 | 114,571 |

The increase from the 1989 budget to the 1989 current estimate reflects the January pay raise and the cost of additional FTE (manpower augmentation).

## Basis of Cost for Permanent Workyears

In 1990, the cost of permanent workyears will be $114,571,000. The increase from 1989 is calculated as follows:

| | | |
|---|---|---|
| Cost of FTP Workyears in 1989.......................................................... | | $109,034 |
| Cost Changes in 1990.......................................................... | | 8,434 |
| Within grade and career advances: | | |
| Full year effect of 1989 actions................. | 1,068 | |
| Partial year effect of 1990 actions............. | 2,491 | |
| Additional FTE................................. | 3,623 | |
| Full year cost of 1989 pay raise................. | 822 | |
| Changes in Reimbursements...................... | 430 | |
| Turnover effects:.......................................................... | | -2,897 |
| Full year effect of 1989 savings.................. | 127 | |
| Partial year effect of 1990 savings................ | -3,024 | |
| Cost of FTP Workyears in 1990.......................................................... | | 114.571 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars | | |
| b. Other than full-time permanent | | | | |
| 1. Cost................... | 1,123 | 977 | 1,207 | 1,245 |
| 2. Workyears.............. | 68 | 56 | 58 | 62 |

The distribution of 1990 workyears is as follows:

Distribution of Other Than Full-Time Permanent Workvears

| Program | Workvears |
|---|---|
| Development programs............................................. | 16 |
| Youth opportunity programs...................................... | 7 |
| Other temporary programs........................................ | 39 |
| Total......................................................... | 62 |

The increase from the 1989 budget estimate to the 1989 current estimate is due to a increase in the part-time permanent program and the 1989 pay raise. The increase in 1990 reflects the full year effect of the 1989 pay raises.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| c. Overtime and other compensation | 1,904 | 1,808 | 1,910 | 1,966 |

Overtime and other compensation includes overtime, holiday pay, incentive awards, Sunday permium pay, and night work differential. The use of overtime and other compensation is primarily for off-peak operation of major facilities. The 1989 increase reflects the 1989 pay raise. The 1990 increase reflects the full year effect of the 1989 pay raise.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Benefits........................ | 15,803 | 16,217 | 17.931 | 18.639 |

The following are the amounts of contribution by category:

| | | | | |
|---|---|---|---|---|
| Retirement Fund and Thrift Plan.. | 8,811. | 9,372 | 9,640 | 10,115 |
| Employees Life Insurance......... | 188 | 256 | 191 | 193 |
| Employee Health Insurance........ | 3,797 | 3,475 | 4,832 | 5,036 |
| Workmen's compensation........... | 519 | 550 | 483 | 472 |
| FICA............................ | 1,292 | 1,118 | 1,419 | 1,444 |
| Medicare........................ | 1,189 | 1,434 | 1,349 | 1,362 |
| Other Benefits.................. | 7 | 12 | 17 | 17 |
| Total....................... | 15.803 | 16.217 | 17.931 | 18.639 |

The increase from the 1989 budget estimate to the 1989 current estimate reflects the increase of additional FTE's, an increase in health care costs, and the effect of the 1989 pay raise. The increase in the 1990 estimate is due to the full year effect of the 4.1% pay raise, the increase in health care costs and additional FTE's.

| | | | | |
|---|---|---|---|---|
| B. Supporting Costs................. | 1.690 | 1.846 | 1.723 | 1.792 |
| 1. Transfer of personnel........ | 53 | 153 | 110 | 170 |

The decrease from the 1989 budget estimate to the 1989 current estiamte reflects a decrease in the number of new employees eligible for these benefits. The 1990 budget estimate reflects additional FTE's and an anticipated increase in prices of goods and services.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Personnel training............... | 1.667 | 1.693 | 1,693 | 1.752 |

The purpose of the training program is to provide for the development and education of civil service employees to more efficiently support Lewis roles and missions. The 1990 budget estimate reflects Lewis' emphasis on the skills needed to support acquisition of the power system for the Space Station and additional training in the areas of office automation.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 11. **TRAVEL**............................ | 3,332 | 3,767 | 3,445 | 3,719 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel................ | 1,988 | 2,794 | 2,095 | 2,369 |
| B. Scientific & Tech. Development Travel....................... | 755 | 530 | 761 | 761 |
| C. Management & Operations Travel | 589 | 443 | 589 | 589 |
| Total, Travel.............. | 3,332 | 3,767 | 3,445 | 3,719 |

Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Program Travel................ | 1,988 | 2,794 | 2,095 | 2,369 |

Program Travel is directly related to the accomplishment of the Center's mission. These funds are necessary for the management of major contractual programs in aeronautical research and technology, Space Station, space propulsion, materials research and development and space energy processes and systems technology. The decrease from the 1989 budget estimate to the 1989 current estimate is a reduction of travel at Lewis to accommodate the reduced budget and the need to meet travel requirements in the other categories. The 1990 estimate reflects anticipated increases primarily associated with Space Station activities.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| B. Scientific & Tech. Development Travel............................. | 755 | 530 | 761 | 761 |

Scientific and technical development travel provides employees the opportunity to participate in meetings and seminars with other representatives of the aerospace community. The benefits derived from exposure to technological advances outside Lewis, as well as to present both accomplishments and problems to their associates is invaluable. Many of the meetings are working panels convened to solve problems for the benefit of the Government. The increase from the 1989 budget estimate to the 1989 current estimate reflects continuation of the 1988 number of presentations of technical papers to the scientific community through 1990.

| | | | | |
|---|---|---|---|---|
| C. Management & Operations Travel....... | 589 | 443 | 589 | 589 |

Management and operations travel is required for the direction and coordination of general management matters. It includes travel in such areas as personnel, financial management, procurement, travel of the Center's top management to NASA Headquarters and other NASA Centers, training travel, and local transportation. The 1989 current estimate and the 1990 budget estimate reflect a continuation of the 1988 level of effort.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| III. **OPERATION OF INSTALLATION**......... | 53.113 | 60.140 | 58.870 | 65.728 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Facilities Services........... | 26,757 | 30,248 | 30,266 | 31,639 |
| B. Technical Services............ | 12,039 | 14,607 | 12,512 | 14,649 |
| C. Management & Operations....... | 14.317 | 15.285 | 16.092 | 19,440 |
| Total, Operation of Installation | 53,113 | 60,140 | 58.870 | 65,728 |

Explanation of Fund Reauirements

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

The decrease from the 1989 budget estimate to the 1989 current estimate is caused by lower than expected utility rates and deferral of ADP equipment. The 1990 estimate provides for expected rate increases in the support contractor and utility areas coupled with additional contractor workyears.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. FACILITIES SERVICES................... | 26.757 | 30,248 | 30,266 | 31,639 |

Summary of Fund Reauirements

| | | | | |
|---|---|---|---|---|
| 1. Maintenance & Related Services..... | 8,551 | 9,043 | 9,506 | 10,770 |
| 2. Custodial Services................. | 4,648 | 5,294 | 5,362 | 5,403 |
| 3. Utility Services................... | 13.558 | 15.911 | 15.398 | 15.466 |
| Total, Facilities Services | 26.757 | 30,248 | 30.266 | 31,639 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Maintenance & Related Services..... | 8.551 | 9.043 | 9,506 | 10,770 |

This activity provides for the operation and maintenance of facilities at the Cleveland site and at the Plum Brook Station. Facilities maintenance includes buildings and grounds maintenance and maintenance of heating, ventilating, and air-conditioning systems and equipment. The increase from the 1989 budget estimate to the 1989 current estimate reflects the reinstatement of activities deferred in 1988. The 1990 estimate reflects reduced support contractor manpower offset by expected contractor rate increases.

| | | | | |
|---|---|---|---|---|
| 2. Custodial Services................. | 4.648 | 5,294 | 5.362 | 5.403 |

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 increase from the 1989 budget estimate to the 1989 current estimate reflects contractor rate increases. The increase from the 1989 current estimate to the 1990 estimate reflects contractor rate increases and increased manpower to support the opening of new facilities.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 3. Utilitv Services.............. | 13.558 | 15,911 | 15.398 | 15.466 |

Electrical power is provided by the local utility company. Natural gas is the primary heating fuel with oil as a backup fuel. A support contractor operates the central heating plant. The decrease from the 1989 budget estimate to the 1989 current estimate is due to lower utility rates than originally expected The increase from 1989 to 1990 is based on an expected small increase in electrical power rates.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| B. TECHNICAL SERVICES................ | 12.039 | 14.607 | 12.512 | 14.649 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing...... | 7,229 | 10,023 | 7,322 | 8,559 |
| 2. Scientific and Technical Information.................. | 2,759 | 4,584 | 3,005 | 3,458 |
| 3. Shop and Support Services...... | 2.051 | 0 | 2,185 | 2,632 |
| Total, Technical Services | 12.039 | 14,607 | 12.512 | 14.649 |

Explanation of Fund Reauirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Automatic Data Processing...... | 7.229 | 10,023 | 7,322 | 8,559 |

Funding provides for administrative data processing, including operations, maintenance, and periodic replacement of equipment. The 1989 current estimate reflects a restructured equipment replacement plan with some deletions and deferral of other ADP equipment purchases until 1990 and later. The FY 1990 estimate includes the purchase of disks and controllers for the administrative computer deferred from 1989.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 2. Scientific and Technical Information.................. | 2,759 | 4.584 | 3.005 | 3.458 |

Included in this activity is the support of the Center's Library, educational programs, and public information services. Funding for operation of the Visitor Information Center (VIC), conduct of tours and special events, construction and transport of special exhibits, and related activities are also included. The decrease from the 1989 budget estimate to the 1989 current estimate reflects a reduction in planned purchases of library equipment, supplies & materials and subscription services. The 1990 budget restores some subscription services and deferred equipment purchases along with expected support contractor rate increases.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 3. Shop and Support Services...... | 2.051 | 0 | 2,185 | 2,632 |

Funding provides photographic and graphic services as well as support of the related facilities and supplies and equipment. The increase from the 1989 budget estimate to the 1989 current estimate reflects the cost of maintaining these facilities and a correction in the directed Appropriation Realignment transfer implemented in 1988. The increase in the 1990 budget provides for previously deferred equipment purchases along with a small increase in support contractor manpower.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| C. MANAGEMENT AND OPERATIONS.......... | 14,317 | 15.285 | 16.092 | 19.440 |

Summarv of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications.. | 1,604 | 1,721 | 3,138 | 3,179 |
| 2. Printing and Reproduction...... | 557 | 784 | 538 | 642 |
| 3. Transportation................. | 3,564 | 3,602 | 3,291 | 3,990 |
| 4. Installation Common Services... | 8.592 | 9.178 | 9,125 | 11,629 |
| Total, Management and Operations | 14.317 | 15,285 | 16,092 | 19,440 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Administrative Communications...... | 1.604 | 1,721 | 3.138 | 3.179 |

This estimate provides local and long distance telephone service and non-telephone communications. Local telephone service includes the leased lines and equipment to serve the Center population. Non-telephone communications include telex, advanced record system teletype, rapidfax, datafax, teleconference equipment, oceanic cable service, and usage charges for airline reservation services. The increase in the 1989 current estimate is based on higher FTS charges than originally anticipated and telephone equipment purchases. The 1990 budget estimate continues that rate increase.

| | | | | |
|---|---|---|---|---|
| 2. Printing and Reproduction......... | 557 | 784 | 538 | 642 |

The estimate for administrative printing includes the operating costs of the printing and reproduction facility as well as supplies, materials, and equipment. All common processes of duplication, including photostating, blueprinting and microfilming are included. The decrease from the 1989 budget estimate to the 1989 current reflects deferral of equipment purchases until 1990 and later. The increase from the 1989 current estimate to the 1990 includes the purchase of some of the deferred equipment along with expected support contractor rate increases.

| | | | | |
|---|---|---|---|---|
| 3. Transportation. .... .... | 3.564 | 3.602 | 3.291 | 3.990 |

This activity includes the cost of the support contract for bus, mail and package delivery, stock issuance and administrative aircraft maintenance. It also includes moving and hauling services and motor vehicle purchase, lease and maintenance. The decrease from the 1989 budget estimate to the 1989 current estimate is due to a change in the support contractor funding plan as well as deferral of supplies and equipment. The increase in 1990 represents purchase of deferred equipment, an increase in the number of flight hours on the administrative aircraft and full year funding for support contractors.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 4. Installation Common Services........ | 8,592 | 9.178 | 9,125 | 11,629 |

This funding provides administrative services for Center management and staff at the Cleveland and Plumbrook sites. Also included is the cost of staff medical examinations, clinic support, medical supplies and equipment, special x-ray equipment for the occupational health program, and equipment for the physical fitness facility. Services are provided by a support contractor. This function also includes funding for maintenance and periodic replacement of administrative equipment and supplies, and postage. The small decrease from the 1989 budget estimate to the 1989 current estimate is due primarily to deferral of administrative equipment replacement purchases. The 1990 increase reflects increased support contractors, rate increases and equipment deferrals from 1989.

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

STAFFING SUMMARY

| | | |
|---|---|---|
| | 313 | 328 |
| MERGYGM 16% | | 1740 |
| | 503 | 503 |
| TI | 2675 | 2778 |

**OFFICE OF THE DIRECTOR**

| | 89 | 90 |
|---|---|---|
| SES | 3 | 3 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 0 | 0 |
| WAGE | 0 | 0 |
| TOTAL | 6 | 6 |

TOTAL

**OFFICE OF EXTERNAL AFFAIRS**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 21 | 21 |
| WAGE | 0 | 0 |
| TOTAL | 23 | 23 |

**OFFICE OF RLT ASSESSYENT**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 1 | 1 |
| GS/GM 15 | 4 | 4 |
| GS/GM 14 | 3 | 3 |
| OTHER GS/GM | 3 | 3 |
| WAGE | 0 | 0 |
| TOTU | 12 | 12 |

**OFF. OF INTERAGENCY & INDUSTRY PGMS.**

| | 1992 | |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 2 | 2 |
| OTHERWGM | 10 | 10 |
| WAGE | 0 | 0 |
| TOTAL | 16 | 16 |

**OFFICE OF SAFETY, RELIABILITY & QA**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 10 | 10 |
| OTHER GS/GM | 35 | 35 |
| WAGE | 0 | 0 |
| TOTAL | 47 | 47 |

**OFFICE OF THE CHEF COUNSEL**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 5 | 5 |
| OTHER GS/GM | 5 | 5 |
| WAGE | 0 | 0 |
| TOTU | 11 | 11 |

**OFFICE OF EQUAL OPPORTUNITY PGMS.**

| | 19% | |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 4 | 4 |
| WAGE | 0 | 0 |
| TOTU | 4 | 4 |

**OFFICE OF OCCUPATIONAL MEDICINE**

| | 19% | |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 4 | 4 |
| WAGE | 0 | 0 |
| TOTAL | 6 | 6 |

**AERONAUTICS DIRECTORATE**

| | 89 | 90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 2 | 2 |
| WAGE | 0 | 0 |
| TOTAL | 5 | 5 |

**AEROSPACE TECH DIRECTORATE**

| | 19% | |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHERWGM | 1 | 1 |
| WAGE | 0 | 0 |
| TOTAL | 2 | 2 |

**SPACE STATION SYSTEMS DIRECTMUTE**

| | 89 | 90 |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 2 | 2 |
| WAGE | 0 | 0 |
| TOTAL | 4 | 4 |

**SPACE FLT SYSTEMS DIRECTORATE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 1 | 1 |
| WAGE | 0 | 0 |
| TOTAL | 1 | 1 |

**ENGINEERING DIRECTORATE**

| | 19% | |
|---|---|---|
| SES | 2 | 2 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 2 | 2 |
| WAGE | 0 | 0 |
| TOTAL | 4 | 4 |

**TECHNUAL SERVICES DIRECTORATE**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 1 | 1 |
| WAGE | 0 | 0 |
| TOTAL | 2 | 2 |

**ADMINISTRATION & COMPINISR SERVICES DIRECTORATE**

| | 19% | |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 1 | 1 |
| WAGE | 0 | 0 |
| TOTAL | 3 | 3 |

**OFFICE OF THE COMPTROLLER**

| | 19% | |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 0 | 0 |
| OTHER GS/GM | 1 | 1 |
| WAGE | 0 | 0 |
| TOTAL | 2 | 2 |

**ADVANCED PLANNING AND ANALYSIS OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 4 | 4 |
| GS/GM 14 | 4 | 4 |
| OTHER GS/GM | 15 | 20 |
| WAGE | 0 | 0 |
| TOTAL | 23 | 28 |

**INSTRUMENTATION & CONTROL TECH. OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 4 | 3 |
| GS/GM 14 | 12 | 12 |
| OTHER GS/GM | 26 | 27 |
| WAGE | 0 | 0 |
| TOTAL | 43 | 42 |

**INTERNAL FLUID MECHANICS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 12 | 12 |
| GS/GM 14 | 16 | 16 |
| OTHER GS/GM | 56 | 64 |
| WAGE | 0 | 0 |
| TOTAL | 85 | 93 |

**PROPULSION SYSTEYS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 14 | 13 |
| GS/GM 14 | a | 29 |
| OTHERGYGM | 83 | 86 |
| WAGE | 0 | 0 |
| TOTAL | 127 | 130 |

**AEROPROPULSION FAC & EXPTS. DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 7 | 7 |
| GS/GM 14 | 22 | 22 |
| OTHER GS/GM | 71 | 84 |
| WAGE | 0 | 0 |
| TOTAL | 101 | 114 |

**MATERIALS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 11 | 11 |
| GS/GM 14 | 17 | 18 |
| OTHER GS/GM | 75 | 73 |
| WAGE | 0 | 0 |
| TOTAL | 104 | 103 |

**STRUCTURES DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 1 | 1 |
| GS/GM 15 | 11 | 11 |
| GS/GM 14 | 8 | 9 |
| OTHER GS/GM | 44 | 42 |
| WAGE | 0 | 0 |
| TOTAL | 65 | 64 |

**SPACE PROPULSION TECHNOLOGY DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 6 | 7 |
| GS/GM 14 | 14 | 15 |
| OTHERWGM | 58 | 55 |
| WAGE | 0 | 0 |
| TOTAL | 79 | 78 |

**POWER TECHNOLOGY DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 12 | 12 |
| GS/GM 14 | 22 | 24 |
| OTHER GS/GM | 71 | 66 |
| WAGE | 0 | 0 |
| TOTAL | 106 | 103 |

**SPACE COYM DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 5 | 6 |
| GS/GM 14 | 11 | 12 |
| OTHER GS/GM | 59 | 54 |
| WAGE | 0 | 0 |
| TOTAL | 76 | 73 |

**PROJECT CONTROL OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 4 | 4 |
| OTHER GS/GM | 12 | 20 |
| WAGE | 0 | 0 |
| TOTAL | 18 | 26 |

**SYST ENGINEERING & INTEGRATION OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 5 | 5 |
| GS/GM 14 | 7 | 9 |
| OTHERWGM | 27 | 42 |
| WAGE | 0 | 0 |
| TOTAL | 39 | 57 |

**PNOTOVOLTAU PDWE MODULE DIVISION**

| | | |
|---|---|---|
| GS/GM 15 | | |
| GS/GM 14 | | |
| OTHER GS/GM | 30 | 37 |
| WAGE | | |
| TOTAL | 39 | 43 |

**SOLAR DYNAM POWER MODULE DIVISION**

| | 19% | |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 6 | 8 |
| OTHER GS/GM | 21 | 31 |
| WAGE | 29 | 40 |
| TOTAL | | 41 |

**ELECTRICAL SYSTEMS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 6 | 6 |
| GS/GM 14 | 6 | 8 |
| OTHER GS/GM | 39 | 38 |
| WAGE | 0 | 0 |
| TOTAL | 52 | 52 |

**OPS & SPECUL PROJECTS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 4 | 4 |
| GS/GM 14 | 6 | 7 |
| OTHER GS/GM | 28 | 30 |
| WAGE | 0 | 0 |
| TOTAL | 39 | 42 |

**ACTS PROJECT OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 5 | 5 |
| GS/GM 14 | 5 | 5 |
| OTHER GS/GM | 33 | 35 |
| WAGE | 0 | 0 |
| TOTAL | 44 | 46 |

**SPACE EXPERIMENTS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 12 | 12 |
| OTHER GS/GM | 55 | 57 |
| WAGE | 0 | 0 |
| TOTAL | 71 | 73 |

**ADVANCED SPACE ANALYSIS OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 5 | 5 |
| OTHER GS/GM | 22 | 23 |
| WAGE | 0 | 0 |
| TOTAL | 30 | 31 |

**CRYOGENIC FLUID TECHNOLOGY OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 16 | 0 |
| WAGE | 0 | 0 |
| TOTU | 18 | 2 |

**ATLAS/CENTAUR PWWECT OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 2 | 2 |
| GS/GM 14 | 5 | 5 |
| OTHER GS/GM | 7 | 17 |
| WAGE | 0 | 0 |
| TOTAL | 15 | 25 |

**SOFTWARE ENGINEERING OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 2 | 2 |
| OTHERWGM | 7 | 10 |
| WAGE | 0 | 0 |
| TOTAL | 10 | 14 |

**ENGINEERING SUPPORT OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 2 | 2 |
| OTHER GS/GM | 6 | 8 |
| WAGE | 0 | 0 |
| TOTAL | 8 | 10 |

**ELECTRONIC & CONTROL SYSTEMS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 5 | 5 |
| GS/GM 14 | 7 | 7 |
| OTHER GS/GM | 43 | 45 |
| WAGE | 0 | 0 |
| TOTAL | 56 | 58 |

**PROPULSION & FLUID SYSTEMS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 4 | 4 |
| GS/GM 14 | 7 | 7 |
| OTHER GS/GM | 45 | 49 |
| WAGE | 0 | 0 |
| TOTAL | 57 | 61 |

**STRUCTURAL SYSTEMS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 3 | 3 |
| GS/GM 14 | 7 | 7 |
| OTHER GS/GM | 46 | 48 |
| WAGE | 0 | 0 |
| TOTAL | 56 | 59 |

**FACILITY PLIWNING OFFICE**

| | | |
|---|---|---|
| THER GS/GM | | |
| AGE | | |
| TOTU | - | - |

**TEST INSTALLATIONS DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 6 | 6 |
| WAGE | 351 | 353 |
| TOTAL | 358 | 360 |

**FACILITIES OPS. & MAINT. DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 2 | 2 |
| OTHER GS/GM | 101 | 102 |
| WAGE | 49 | 49 |
| TOTAL | 152 | 153 |

**FABRICATION SUPPORT DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | |
| OTHER GS/GM | 23 | |
| WAGE | 97 | |
| TOTAL | 121 | 119 |

**FACILITIES ENGINEERING DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 6 | 6 |
| GS/GM 14 | 15 | 15 |
| OTHER GS/GM | 68 | 68 |
| WAGE | 0 | 0 |
| TOTAL | 90 | 90 |

**PERSONNEL DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 4 | 4 |
| OTHER GS/GM | 44 | 44 |
| WAGE | 0 | 0 |
| TOTAL | 49 | 49 |

**COMPUTER SERVICES DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 1 | 1 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 5 | 5 |
| GS/GM 14 | 13 | 13 |
| OTHER GS/GM | 108 | 110 |
| WAGE | 0 | 0 |
| TOTAL | 127 | 129 |

**LOGISTICS MGMT. DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 35 | 36 |
| WAGE | 0 | 0 |
| TOTAL | 36 | 37 |

**TECHNICAL INFORMATION SERVICES DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 0 | 0 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 34 | 36 |
| WAGE | 6 | 6 |
| TOTAL | 31 | 43 |

**RESOURCES ANALYSIS & MANAGEMENT OFFICE**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 6 | 6 |
| OTHER GS/GM | 25 | 27 |
| WAGE | 0 | 0 |
| TOTAL | 32 | 34 |

**FINANCIAL MGMT. DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 1 | 1 |
| OTHER GS/GM | 40 | 42 |
| WAGE | 0 | 0 |
| TOTAL | 42 | 44 |

**PROCUREMENT DIVISION**

| | 89 | 90 |
|---|---|---|
| SES | 0 | 0 |
| GS/GM 16 | 0 | 0 |
| GS/GM 15 | 1 | 1 |
| GS/GM 14 | 5 | 5 |
| OTHER GS/GM | 79 | 84 |
| WAGE | 0 | 0 |
| TOTAL | 85 | 90 |

NASA HEADQUARTERS/
SPACE STATION
PROGRAM OFFICE

**RESEARCH AND PROGRAM MANAGEMENT**

**FISCAL YEAR 1990 ESTIMATES**

**NASA HEADQUARTERS**

**AND**

**SPACE STATION PROGRAM OFFICE**

## DESCRIPTION

NASA Headquarters is located at *400* Maryland Avenue, SW, Washington, D.C., and occupies other buildings in the District of Columbia, Maryland and Virginia.

### HEADOUARTERS ROLES AND MISSIONS

The mission of Headquarters is to plan and provide executive guidelines for the implementation of national space and aeronautics programs consistent with the objectives stated in the National Aeronautics and Space Act of 1958, as amended. These objectives are to:

--Extend our knowledge of the Earth, its environment, the solar system, and the universe;

--Expand practical applications of space technology;

--Develop, operate, and improve manned and unmanned space vehicles;

--Improve the civil and military usefulness of aeronautical vehicles, while minimizing their environmental effects and energy consumption;

--Disseminate pertinent findings to potential users; and

--Promote international cooperation in peaceful activities in space.

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

<u>Office of Space Flight</u> - Plans, directs, executes, and evaluates the research, development, acquisition, and operation of space flight programs. Included in these programs is the Space Shuttle, a key element of the National Space Transportation System (NSTS). The NSTS Director, located at Headquarters, and his two Deputies, located at the centers, have full responsibility and authority for operations and conduct of the NSTS, including budget, schedule, program requirements, engineering, and performance. They report directly to the Associate Administrator for Space Flight. Also included in the NSTS are the orbiters, engines, external tanks, solid rocket boosters, and ground and flight systems. The Office of Space Flight develops and implements policy for all system users to interface with the NSTS, and promotes improvements in safety, reliability, and effectiveness of NSTS operational performance. Responsibilities also include the use of Expendable Launch Vehicles for NASA and other civil government programs, Spacelab, Upper Stages, Advanced Programs, and other developmental space-based transportation programs. This office also maintains relationships with industry, international organizations, foreign entities, universities, the scientific community, and other government agencies with respect to space flight programs in coordination with the Office of External Relations.

<u>Office of Space Station</u> - Responsible for the design, development, test evaluation, and overall management of the Space Station Freedom program. Included in these efforts are the development of program policy and budget formulation, program direction to the various elements supporting the Space Station, external affairs (in conjunction with the Office of External Affairs) and commercialization evaluation (in conjunction with the Office of Commercial Programs). Also, included are requirements definition and control; system development; configuration control; end-to-end program integration; test and verification; development oversight and assessment; and technical and administrative support. In addition, the Office of Space Station coordinates an outreach program to all potential users of the Station and is responsible for ensuring that user requirements are built into the station design and that potential users are kept informed of the Station status and evolution. Since the Space Station Freedom includes elements from the European Space Agency, Canada, and Japan, responsibilities include the coordination and integration of their Space Station elements with those of the U.S. elements and the subsequent planning for operations and utilization of the Space Station Freedom. Other responsibilities include program directions for the definition and development of a Flight Telerobotics Servicer, planning for Space Station evolution including advanced technology (in conjunction with the Office of Aeronautics and Space Technology and the Office of Exploration) and operations planning and execution.

Office of Space Science and Applications - Responsible for research and development efforts utilizing a variety of flight system and ground-based observations to increase man's knowledge of the universe. The Earth, Sun, Moon, the planets, interplanetary space, other stars and galaxies, and the interaction among those bodies and systems are all objects of these investigations, as well as assuring medical safety and understanding the basic mechanisms of biological processes using the unique capabilities of the space program. Responsibilities also include conducting research and development activities leading to demonstration and transfer of space-related technology and capabilities which can be effectively applied and used for practical benefits on Earth. These research and development activities involve the following program areas: earth observations, environmental observations, communications, material processing in space, and information systems.

Office of Aeronautics and Space Technology - Plans, directs, executes, and evaluates the aeronautical and space research and technology programs as well as the aero-space plane technology programs. The aeronautics program develops technologies which are responsive to national aviation needs and which culminate in a safer, more efficient, economical and environmentally acceptable air transportation system. The space research and technology program provides the enabling technologies, validated at a level suitable for user-readiness, for future space missions through basic and applied research programs. The objective of basic research programs is to gain a fuller knowledge and understanding of the fundamental aspects of phenomena and observables in critical disciplines. Applied research programs, developed and implemented based on requirements provided by the potential users of the technology, develop technology for specific applications and deliver products in the form of proven hardware, software and design techniques and data. 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 aerothermodynamics, air-breathing propulsion, and structural systems for transatmospheric vehicles. The Office of Aeronautics and Space Technology is also responsible for coordinating the total NASA program of supporting research and technology related to specific programs and projects to insure a comprehensive, properly balanced agency research and technology program.

Office of Space Operations - Develops, implements, and operates tracking, data acquisition, command, communications, and data processing facilities, systems and services required for support of all NASA flight missions. This office also performs a management overview function for NASA administrative communications.

Office of Safety, Reliability, Maintainability and Quality Assurance - The Office of SRM&QA 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 quality and. productivity improvements), focusing on these activities will enhance operational success of NASA programs. The office also provides overall technical review of NASA programs and projects to ensure development efforts and mission operations are being conducted on a sound engineering basis with proper controls and attention to development risk.

Office of Commercial Programs - Provides a focus within NASA for an agency-wide 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. This Office also provides a focus within NASA for an agency-wide program to stimulate technological innovation in the U.S., use of Small Business to help meet Federal research and development needs, and to encourage commercial applications of Federally supported research innovations.

General - The Headquarters responsibilities include providing a balanced Agency Headquarters work-force capable of:

- Planning, formulating, and advocating executive direction to national programs to implement the objectives stated in the National Aeronautics and Space Act of 1958, as amended;

- Administering operational and logistical support to those Headquarters elements concerned with carrying out the mission of the National Aeronautics and Space Administration; and

- Providing adequate facilities to house the work-force in Washington, D.C.

The Headquarters work-force consists of professional and clerical staff organized into the program offices indicated above and appropriate supporting staff offices. Funding for salaries, travel and necessary support services are included in this portion of the budget submission. Each office is assigned a function consistent with the NASA mission. The number of personnel authorized to an office is determined by management based on the approved personnel ceiling for the Agency and the functions to be performed. The composition of the staff of an office is determined by the head of the office based on the office ceiling and the function to be performed. All personnel are appointed and paid consistent with classification standards established by the Office of Personnel Management. Overall Agency direction is provided by the Administrator, and his personal office staff. The Agency currently has eight installations, and the Jet Propulsion Laboratory, throughout the United States which perform Agency operational missions under direction of the Headquarters staff.

Technical support required by Headquarters is performed primarily by support contractors. Administrative support is provided by the in-house work-force assisted by miscellaneous contract services. Such support includes communications, printing, equipment, transportation, occupational medicine and health, and other administrative support services.

## SPACE STATION FREEDOM PROGRAM OFFICE

### DESCRIPTION

Space Station Freedom Program Office was established in September, 1987. It is located in a three story, 110,147 square foot building in Reston, Virginia, approximately twenty one miles from downtown Washington, D.C. The building, known as Parkridge III, is leased by NASA from the Jet Propulsion Laboratory.

### ROLES AND MISSIONS

The Space Station is the most complex and long-term program that NASA has yet attempted. It includes participation not only by every NASA center, but also the European Space Agency, the Japanese, and the Canadians. There are four prime work package contractors for the United States elements and hundreds of first, second, and third tier subcontractors who will be providing support. The Station is planned to be on orbit for thirty years and is being designed so that its hardware and systems can be modified and enhanced to coincide with evolving requirements and improvements in technology. After a thorough analysis of the various approaches that could be taken to manage so disparate a program, NASA determined that a program office be established with its primary purpose being the day to day management, coordination, and control of these various program elements and participants. The Space Station Freedom Program Office in Reston, Virginia was established to undertake this responsibility.

The Space Station Freedom Program Office in Reston is utilized solely for management of the Space Station; it is not used for activities of any ocher NASA program. Its primary functions consist of program management, development, and control, including requirements definition and control; systems engineering, analysis, and integration; operations capability development; end-to-end program integration, test, and verification; and budget execution and control. This office, known as Space Station Level II, gets its policy direction from the Office of the Associate Administrator for Space Station at NASA Headquarters in Washington, D.C. (Level I) and then provides direction to the program participants in carrying out this policy. In order to facilitate this effort, the various Level II functions have been assigned to the following specific offices:

Office of the Program Director - Consists of the Space Station Freedom Program Director and the assistant and associate directors. Directs management and review of the program. Directs configuration changes, exercises budget control, manages program reserves, and plays a critical role in evaluating the efforts of the work package contractors and NASA centers. Takes policy direction from Level I and ensures that this policy gets translated into key program objectives which are the monitored for technical, schedule and budgetary compliance.

Program Scientist Office - Services as the user community ombudsman and user issues advisor. Ensures that the scientific perspective established by the Level I Chief Scientist Office is incorporated in all Level II management and technical approaches.

Program Support Office - Provides administrative operations support such as personnel, travel, supply and equipment, and records management. Maintains liaison with Level I Policy Division and assists them in the preparation of position papers, presentations, and Congressional testimony. Performs contract management functions for the Level II contracts including requirements definition, performance assessment, and technical direction.

Program Integration Office - Maintains configuration management for the entire program. Coordinates and tracks configuration control board activities. Baselines the program requirements and controls changes to the baseline. Keeps program documentation updated. Monitors and directs the NASA field centers implementation of configuration and documentation management. Controls total program integration. Performs special studies involving multiple Space Station Freedom Program Office groups. Conducts and participates in design reviews.

Program Control Group - Directs budget preparation and integration and maintains financial control of the various Space Station budgets. Oversees and tracks the development, status, and updating of program plans and schedules including schedule analysis and risk assessment. Develops and maintains the program work breakdown structure. Performs analysis of cost, schedule, and manpower including the development of data bases for resource tracking and control. Formulates cost models and assesses design to cost, cost/engineering trades, and option development.

Information Systems Services Program Group - Provides strategic and technology planning for software engineering including test bed programs and industry liaison. Oversees Space Station Freedom data systems development including end-to-end architecture and system testing, assurance, and performance assessment. Coordinates the Software Support Environment and Technical Management and Information Systems activities (performed by Lockheed and Boeing respectively). Provides system operations and user support. Oversees development, integration, and testing management of the Space Station Information System.

Program Utilization and Operations Group - Provides utilization planning for the Space Station including user requirements and accommodations processes definition and control and user integration and operations definition and control. Manages space operations facilities implementation, space operations concept assessment and space operations requirements integration and advocacy. Assesses the facilities and processing concepts for ground operations including the ground support equipment, transportation, and ground verification and test. Performs utilization and operations cost modeling and analysis, systems engineering and integration assessment, technical operations planning, and manifest integration. Serves as the utilization and operations interface with the international partners.

System Engineering and Integration Group - Develops the overall architecture and engineering requirements for the Space Station Freedom. Defines and assembly sequence and allocates the functional and resource parameters such as weight and power. Evaluates performance of the station systems and determines if they meet the design criteria. Provides for element integration and test including development and control of integration requirements and elements requirements. Manages maintainability and commonality. Develops and controls the integration and checkout concepts and the master verification plan. Oversees development of the various types of support equipment. Manages the verification of hardware, software, and on-orbit assembly.

International Programs Group - Maintains liaison with the international partners ensuring that international participation is consistent with existing policies and agreements. Manages the integration of their hardware, coordinates operational compatibility, and develops operations plans consistent with their requirements. Directs data exchange and the establishment of security measures.

## SUMMARY OF RESOURCES REQUIREMENTS

### Funding Plan by Function

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| I. Personnel and Related Cost................ | 96,963 | 102,027 | 113,380 | 127.038 |
| II. Travel.................................. | 7,603 | 9,833 | 10,965 | 12.666 |
| III. Operation of Installation................. | 100,845 | 136.311 | 104,634 | 130.985 |
| A. Facilities Services................... | (22,500) | (26,051) | (22,558) | (30,916) |
| B. Technical Services.................... | (50,023) | (66,667) | (50,611) | (63,938) |
| C. Management and Operations.............. | (28.322) | (43,593) | (31.465) | (36,131) |
| Total, fund requirement............. | 205,411 | 248,171 | 228.979 | 270,689 |

FY 1990 CONGRESSIONAL BUDGET
DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM

| NASA HEADQUARTERS | 1988 ACTUAL | 1989 BUDGET ESTIMATE | 1989 CURRENT ESTIMATE | 1990 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION (HQ PROGRAM OFFICE - LEVEL 1) | 48 | 48 | 50 | 52 |
| SPACE FLIGHT PROGRAMS.................... | 161 | 184 | 171 | 175 |
| SPACE TRANSPORTATION CAPABILITY DEV. | 48 | 47 | 51 | 52 |
| SPACE SHUTTLE....................... | 113 | 137 | 120 | 123 |
| SPACE SCIENCE AND APPLICATIONS.......... | 176 | 179 | 187 | 197 |
| PHYSICS AND ASTRONOMY............... | 50 | 53 | 54 | 56 |
| LIFE SCIENCES....................... | 24 | 23 | 25 | 28 |
| PLANETARY EXPLORATION............... | 24 | 27 | 25 | 28 |
| SPACE APPLICATIONS.................. | 78 | 76 | 83 | 85 |
| AERONAUTICS AND SPACE TECHNOLOGY........ | 111 | 115 | 120 | 120 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 53 | 56 | 57 | 57 |
| SPACE RESEARCH AND TECHNOLOGY....... | 52 | 52 | 56 | 56 |
| TRANSATMOSPHERIC RESEARCH & TECH.... | 6 | 7 | 7 | 7 |
| COMMERCIAL PROGRAMS.................... | 34 | 35 | 36 | 37 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE. | 62 | 60 | 66 | 72 |
| TRACKING AND DATA PROGRAMS.............. | 55 | 56 | 58 | 60 |
| SUBTOTAL DIRECT.................... | 647 | 677 | 688 | 713 |
| CENTER MANAGEMENT AND OPERATIONS...... | 673 | 739 | 715 | 718 |
| SUBTOTAL [FULL-TIME PERMANENTS) .... | 1,320 | 1,416 | 1,403 | 1,431 |
| OTHER CONTROLLED FTE'S.................. (PMI's/CO-OPS/OTFTP's) | 120 | 134 | 120 | 139 |
| HEADQUARTERS TOTAL (FTE) | 1,440 | 1,550 | 1,523 | 1,570 |
| SPACE STATION PROJECT OFFICE (LEVEL II) FTP | 144 | 143 | 218 | 348 |
| GRAND TOTAL FTE | 1,584 | 1,693 | 1,741 | 1,918 |

## RESOURCES REQUIREMENTS BY FUNCTION

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| I. PERSONNEL AND RELATED COSTS.................... | 96.963 | 102,027 | 113,380 | 127.038 |

### Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Comvensation and Benefits | | | | |
| 1. Compensation | | | | |
| a. Full-time permanent.................. | 72,304 | 74,242 | 81,959 | 90,140 |
| b. Other than full-time permanent....... | 3,386 | 3,865 | 3,902 | 4,519 |
| c. Reimbursable detailees............... | 581 | 700 | 598 | 604 |
| d. Overtime and other compensation..... | 2.636 | 2,443 | 2,948 | 3.228 |
| Subtotal, Compensation | 78,907 | 81,250 | 89,407 | 98,491 |
| 2. Benefits................................ | 10,046 | 12,947 | 12,152 | 13.312 |
| Subtotal, Compensation & Benefits. | 88,953 | 94,197 | 101,559 | 111,803 |
| B. Supporting Costs | | | | |
| 1. Transfer of personnel................... | 3,784 | 1,492 | 4,045 | 6,572 |
| 2. Office of Personnel Management Services.. | 1,473 | 1,435 | 1,966 | 2,650 |
| 3. Personnel training...................... | 2.753 | 4,903 | 5.810 | 6.013 |
| Subtotal, Supporting Costs........ | 8.010 | 7,830 | 11.821 | 15.235 |
| Total, Personnel and Related Costs....... | 96,963 | 102,027 | 113.380 | 127,038 |

## Explanation of Fund Reauirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| A. Compensation and Benefits................... | 88,953 | 94,197 | 101,559 | 111,803 |
| 1. Compensation........................... | 78,907 | 81,250 | 89,407 | 98,491 |
| a. Full-time permanent.................. | 72,304 | 74,242 | 81,959 | 90,140 |

The change in compensation from the 1989 Budget Estimate to the 1989 Current Estimate is due to the increased work years, the 1989 pay raise, and increased overtime. Compensation increases from the 1989 Current Estimate and to 1990 Budget Estimates are due to increased work years, the full year effect of the 1989 pay raise, and the full year effect of within-grade and career advancements.

### Basis of Cost for Permanent Positions

In 1990 the cost of permanent work-years will be $90,140,000. The increase from 1989 results from the following:

| | | |
|---|---|---|
| Cost of full-time permanent work-years in 1989 | | $ 81,959 |
| Cost increases in 1990 | | + 8,972 |
| Within grade and career advances: | | |
| Full year effect of 1989 actions | +$1,272 | |
| Partial year effect of 1990 actions | +$1,633 | |
| Additional FTE | +$5,294 | |
| Full Year Effect of the 1989 Payraise | +$ 773 | |
| Changes in Reimbursements | + 0 | |
| Turnover Effect | | - 791 |
| Full Year 1989 Effect | +$ 86 | |
| Part Year 1990 Effect | -$ 877 | |
| Cost of FTP Workyears in 1990 | | $ 90.140 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| b. Other than full-time permanent | | | | |
| (1) cost............................. | 3,386 | 3,865 | 3,902 | 4,519 |
| (2) Work-years....................... | 153 | 157 | 154 | 173 |

The distribution of 1990 work-years is as follows:

Distribution of Other Than Full-Time Permanent Work-years

| Program | Work-years |
|---|---|
| Development programs.......................................... | 48 |
| Summer employment programs.................................... | 0 |
| Opportunity programs.......................................... | 34 |
| Other temporary............................................... | 91 |
| Total......................................................... | 173 |

The increase from the 1989 budget estimate to the 1989 current estimate is due to the 1989 pay raise. The increase from the 1989 current estimate to the 1990 budget estimate is due to the increased workyears in development programs and the full year effect of the 1989 pay raise.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| c. Reimbursable detailees.................. | 581 | 700 | 598 | 604 |

The services of a small group of military officers and civilian detailees from other government agencies are used by NASA Headquarters where such assignments are of mutual benefit. The decrease from the 1989 budget estimate to the current estimate is consistent with 1988 experience. The increase from 1989 to the 1990 budget estimate is due to normal salary growth for promotions and other pay adjustments.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| d. Overtime and other compensation......... | 2,636 | 2,443 | 2,948 | 3,228 |

The increases from the 1989 budget estimate to the 1989 current estimate and from 1989 to the 1990 budget estimate are due to the 1989 pay raise and the planned increase in civil service personnel.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Benefits.................................. | 10,046 | 12.947 | 12.152 | 13,312 |

The following are the amounts of contribution by category:

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| Retirement Fund and Thrift Plan......... | 5,650 | 6,598 | 6,570 | 7,353 |
| Employee life insurance................. | 142 | 153 | 156 | 175 |
| Employee health insurance............... | 1,972 | 1,687 | 2,930 | 3,279 |
| Workmen's compensation.................. | 541 | 546 | 534 | 328 |
| FICA.................................. | 701 | 2,850 | 897 | 1,004 |
| Medicare.............................. | 789 | 963 | 814 | 911 |
| Other benefits........................ | 251 | 150 | 251 | 262 |
| Total........................... | 10,046 | 12.947 | 12.152 | 13.312 |

The decrease from the 1989 budget estimate the 1989 current estimate is due to a reduced estimate for FICA based on 1988 experience offset by increases in health benefits rates. The increases from 1989 to the 1990 budget estimate are due to the increase in the number of civil service employees and the full-year effect on the 1989 pay raise.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| B. Supporting Costs............................ | 8,010 | 7,830 | 11,821 | 15,235 |
| 1. Transfer of uersonnel................... | 3,784 | 1.492 | 4.045 | 6.572 |

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 1989 budget estimate to the 1989 current estimate is due to a revised estimate of the average relocation cost based on 1988 experience and the expectation that more eligible employees will use the relocation services contract. The increase from 1989 to the 1990 budget estimate is due to the growth in the number of relocations associated with the hiring effort in 1990.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Office of Personnel Management services.. | 1.473 | 1,435 | 1,966 | 2,650 |

Headquarters reimburses the Office of Personnel Management (OPM) for investigation of new hires for the entire Agency. The cost of investigations is a function of two variables, the number of investigations to be conducted, and the unit charge made by the Office of Personnel Management to other agencies. Also included is a payment to OPM for Federal wage system surveys. The increases from the 1989 budget estimate are based on 1988 experience, OPM mandated reinvestigations of current employees, and the increased Headquarters Civil Service FTE.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 3. Personnel training..................... | 2.753 | 4.903 | 5,810 | 6.013 |

The maintenance and expansion of skills is essential in carrying out the Agency's many complex technical programs. Part of the training consists of courses offered by other Government agencies, usually for a fee. The remainder of the training is provided through non-government sources. The costs are for tuition, fees and related costs for training at colleges, universities, technical institutions, and for the cost of seminars and workshops. The increase from the 1989 budget estimate to the 1989 current estimate results from the need to increase agencywide mission-related training in response to a growing workforce and an aging management component and the need for more management and executive development to prepare the next generation of NASA leaders. The increase from the 1989 Current Estimate to the FY 90 Budget Estimate is due to the increased Headquarters Civil Service FTE.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| II. TRAVEL..................................... | 7,603 | 9,833 | 10.965 | 12.666 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| A. Program Travel.............................. | 3,528 | 5,211 | 4,363 | 5,170 |
| B. Scientific and Technical Development Travel... | 748 | 743 | 820 | 883 |
| C. Management and Operations Travel............. | 3.327 | 3.879 | 5,782 | 6,613 |
| Total, Travel.......................... | 7,603 | 9.833 | 10.965 | 12.666 |

Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| A. Program Travel.............................. | 3.528 | 5.211 | 4.363 | 5.170 |

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. The decrease from the 1989 budget estimate to the 1989 current estimate reflects 1988 experience, plus the return of the Shuttle to full flight status. The 1990 estimate provides for a increased programmatic travel necessary to support: the space station development activities at various NASA centers; the various space science missions; Headquarters program oversight responsibilities, and addtional Space Shuttle Flights.

| | | | | |
|---|---|---|---|---|
| B. Scientific and Technical Development Travel.... | 748 | 743 | 820 | 883 |

Scientific and technical development travel permits employees to participate in meetings and seminars with other representatives of the aerospace community. This participation allows personnel to benefit from exposure to technological advances in the field which arise outside NASA, as well as to present both accomplishments and problems to their associates. Many of these meetings are working panels convened to solve certain problems for the benefit of the Government. The increases from the 1989 budget estimate to the 1989 current estimate and from 1989 to the 1990 budget estimate are due to projected travel expense increases and expanded scientific and technical development travel correlated with programmatic activities.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| C. Management and Operations Travel.............. | 3.327 | 3,879 | 5.782 | 6.613 |

Management and operations travel is for the direction and coordination of general management matters, travel by senior officials to review Center requirements and operations and career development travel in order to broaden the experience of NASA employees. Travel by functional managers in such areas as personnel, financial management, and procurement to assure Agency policies and procedures are being implemented throughout the agency, as well as local transportation and congressional travel are also included. The increase from the 1989 budget estimate to the 1989 current estimate is due to the partial year cost of lease of an administrative aircraft for critical mission travel. The increase from 1989 to 1990 is primarily due to the full year cost of the aircraft lease.

| | | | | |
|---|---|---|---|---|
| 111. OPERATION OF INSTALLATION.................. | 100,845 | 136,311 | 104,634 | 130.985 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| A. Facilities Services................. | 22,500 | 26,051 | 22,558 | 30,916 |
| B. Technical Services.................. | 50,023 | 66,667 | 50,611 | 63,938 |
| C. Management and Operations........... | 28,322 | 43.593 | 31.465 | 36,131 |
| Total, Operation of Installation.. | 100.845 | 136.311 | 104,634 | 130,985 |

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 including rental of real property, acquisition, maintenance and repair of institutional facilities and equipment, and the cost of custodial services; Technical Services including 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 including the cost of administrative communications, printing, transportation, medical supplies, and related services.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. FACILITIES SERVICES................. | 22.500 | 26.051 | 22,558 | 30.916 |

Summary of Fund Reauirements

| | | | | |
|---|---|---|---|---|
| 1. Rental of Real Property.................. | 17,111 | 17,477 | 17,134 | 17,782 |
| 2. Maintenance and Related Services.......... | 4,447 | 7,684 | 4,694 | 12,177 |
| 3. Custodial Services....................... | 942 | 890 | 730 | 957 |
| Total, Facilities Services............ | 22.500 | 26.051 | 22.558 | 30,916 |

Explanation of Fund Reauirements

| | | | | |
|---|---|---|---|---|
| 1. Rental of Real Propertv.................. | 17.111 | 17.477 | 17,134 | 17.782 |

NASA Headquarters is comprised of a complex of office space located in six buildings in the District of Columbia, the Scientific and Technical Institute Facility (STIF) near Baltimore Maryland, and the Space Station Program Office (SSPO) in Reston, VA. The buildings located in the District of Columbia are government owned or leased facilities for which NASA must provide reimbursement to the General Services Administration in accordance with P. L. 92-313. The STIF facility is subleased from the DOD and the SSPO is leased from a commercial owner. The increase from 1989 to the 1990 budget estimate is due to increased costs per square foot and an increase in the amount of leased space.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 2. Maintenance and Related Services.......... | 4,447 | 7,684 | 4.694 | 12.177 |

This estimate includes maintenance, repair and alterations of buildings such as partition changes, auxiliary air conditioning systems for ADP equipment, telephone changes and general buildings maintenance. The decrease to the 1989 current estimate from the budget estimate reflects 1988 deferral of maintenance and repair projects and the rephasing of Headquarters consolidation activities. The increase in FY 1990 reflects projected expenses to consolidate all NASA Headquarters into one building.

| | | | | |
|---|---|---|---|---|
| 3. Custodial Services...................... | 942 | 890 | 730 | 957 |

These funds cover security guard services in the various Headquarters buildings. They also include reimbursement to GSA for the installation and maintenance of security alarm systems and equipment in the NASA Headquarters buildings. The decrease from the 1989 budget estimate to the 1989 current estimate is due to partial year funding of security guard services. The increase from 1989 to the 1990 budget estimate provides full year funding for guard services.

| | | | | |
|---|---|---|---|---|
| B. TECHNICAL SERVICES.......................... | 50.023 | 66.667 | 50.611 | 63.938 |
| Summary of Fund Requirements | | | | |
| 1. Automatic Data Processing............... | 27,895 | 36,992 | 28,544 | 37,184 |
| 2. Scientific and Technical Information..... | 18,037 | 24,192 | 17,974 | 22,525 |
| 3. Shop and Support Services................ | 4.091 | 5.483 | 4.093 | 4,229 |
| Total, Technical Services............ | 50,023 | 66,667 | 50,611 | 63,938 |

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |

## Explanation of Fund Requirements

| | | | | |
|---|---|---|---|---|
| 1. Automatic Data Processing................ | 27,895 | 36,992 | 28,544 | 37,184 |

This estimate provides for the lease, purchase, maintenance, programming and operations services of automatic data processing (ADP) equipment. The decrease from the 1989 budget to the 1989 current estimate reflects the rephasing of planned agencywide administrative systems developments and rephasing of funding requirements for support contracts. The increase from 1989 to the 1990 budget estimate is due to full year funding of support contract costs, contract rate increases, funding of ADP development activities, and implementation of a security program required by the Federal Computer Security Act of 1987.

| | | | | |
|---|---|---|---|---|
| 2. Scientific and Technical Information..... | 18,037 | 24,192 | 17,974 | 22,525 |

The activities contained in this subfunction are educational-informational programs and the NASA Headquarters technical library.

The education and information programs provide for the gathering and disseminating of information about the Agency's programs to the mass communications media, the general public, and to the educational community at the elementary and secondary levels. Assistance to the mass communications media includes the gathering and exposition of newsworthy material in support of their requests, and takes such forms as press kits, news releases, television and radio information tapes and clips, and feature material. Increased research effort in TV transmission from space and distribution to the public on earth is included in this budget. This effort will continue for several years. Research, development, and operational missions in aeronautics and space provide substantive knowledge and serve as an educational stimulus to students and teachers. NASA responds to expressed needs of students by developing curriculum supplements in space-related areas such as physics, biology, chemistry, and math; assistance to over 1,000 teacher workshops and professional educationmeetings; and participation in science fairs. This program also provides for equal employment opportunity exhibits and films to relate to high schools, colleges and the public, and the key roles that women and minorities have in the United States space program.

The decrease from the 1989 budget estimate to the 1989 current estimate is due to rephasing of contract funding requirements, and deferral of new requirements based on funding limitations. The increase from 1989 to the 1990 budget estimate is due to full year funding of contracts and the deferred information requirements associated with both the return of the space shuttle to full flight status, and the development of the space station.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 3. Shop and Support Services................ | 4,091 | 5,483 | 4,093 | 4,229 |

These funds provide for the continuation of studies on parts applications, NASA-wide safety, reliability ,quality assurance standards, graphic and photo processing services. The decrease from the 1989 budget estimate to the 1989 current estimate and the 1990 estimate is based on deferring requirements because of funding reductions. This 1990 budget estimate provided for continuation of the current service level.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| c. MANAGEMENT AND OPERATIONS................... | 28.322 | 43.593 | 31,465 | 36,131 |

Summarv of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications........... | 4,112 | 6,789 | 5,101 | 5,434 |
| 2. Printing and Reproduction................ | 2,095 | 3,785 | 2,583 | 2,909 |
| 3. Transportation.......................... | 696 | 7,108 | 712 | 1,054 |
| 4. Installation Common Services............ | 21,419 | 25,911 | 23,069 | 26,734 |
| Total, Management and Operations..... | 28,322 | 43,593 | 31,465 | 36,131 |

## Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 1. Administrative Communications | 4.112 | 6.789 | 5.101 | 5.434 |

Included in this category are the costs of leased lines, long distance tolls, telephone exchange services, and other communications. The decrease from the 1989 budget estimate to the 1989 current estimate reflects 1988 experience and expected rate changes. The 1990 estimate is based on projected FTS rate increases and increased usage requirements.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Printing and Reproduction | 2.095 | 3.785 | 2.583 | 2.909 |

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 decrease from the 1989 budget estimate to the 1989 current estimate reflects a deferral of the planned replacement of photo copying equipment as well as 1988 experience. The 1990 estimate reflects an increase in costs associated with the dissemination of technical information related to space science and space station development activities, but continued deferral of the planned photo copying replacement.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 3. Transportation | 696 | 7,108 | 712 | 1.054 |

Transportation services include rental of trucks, as well as the movement of supplies, materials, equipment and related items. Also included is the cost of operating and maintaining the administrative aircraft which is assigned to the Jet Propulsion Laboratory. The decrease from the 1989 budget estimate to the 1989 current estimate results from a decision to lease an administrative aircraft rather than purchase. The lease costs are shown in management operations travel. The 1990 budget estimate reflects projected 1989 experience as well as increased transportation service for the Reston Space Station activity.

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| 4. Installation Common Services............. | 21.419 | 25.911 | 23.069 | 26.734 |

This function provides for those services which support the Headquarters, such as: patent services, maintenance and repair of office equipment and vehicles; minor Government services; contract histories; trucking and labor services. The decrease from the 1989 budget estimate to the 1989 current estimate is due to deferred maintenance activities because of funding reductions. The 1990 Budget estimate is the result of inclusion of previously deferred items and the expansion of services for the planned additional stafing level.

## ORGANIZATION AND STAFFING
## NASA HEADQUARTERS

**HEADQUARTERS SUMMARY STAFFING**

| | FY 89 | FY 90 |
|---|---|---|
| EXCEPTED & SES | 205 | 205 |
| GM/GS 18 | 1 | 1 |
| GM/GS 17 | 1 | 1 |
| GM/GS 15 | 368 | 368 |
| GM/GS 14 | 215 | 215 |
| ALL OTHER GM/GS | 638 | 638 |
| WAGE BOARD | 6 | 6 |
| TOTAL | 1,434 | 1,434 |

**ADMINISTRATOR**
FY 1989: 41
FY 1990: 41

**HEADQUARTERS OPERATIONS**
FY 1990:

**PROCUREMENT**
FY 1990:

**EQUAL OPPORTUNITY PROGRAMS**
FY 1989: 21
FY 1990: 21

**COMMERCIAL PROGRAMS**
FY 1989: 37
FY 1990: 37

**EXPLORATION**
FY 1989: 10
FY 1990: 10

**NASA COMPTROLLER**
FY 1989: 111
FY 1990: 111

**GENERAL CWNSEL**
FY 1989: 38
FY 1990: 38

**MANAGEMENT**
FY 1989: 167
FY 1990: 167

**SAFETY, RELIABILITY, MAINTAINABILITY, & QUALITY ASSURANCE**
FY 1989: 61
FY 1990: 61

**EXTERNAL RELATIONS**
FY 1989: 89
FY 1990: 89

**COMMUNICATIONS**
FY 1989: 55
FY 1990: 55

**SPACE SCIENCE 8 APPLICATIONS**
FY 1989: 192
FY 1990: 192

**AERONAUTICS & SPACE TECHNOLOGY**
FY 1989: 122
FY 1990: 122

**SPACE FLIGHT**
FY 1989: 175
FY 1990: 175

**SPACE STATION (LEVEL I)**
FY 1989: 54
FY 1990: 54

**SPACE OPERATIONS**
FY 1989: 60
FY 1990: 60

ORGANIZATION AND STAFFING
NASA HEADQUARTERS

SPACE STATION FREEDOM
PROGRAM OFFICE (LEVEL II)
SUMMARY STAFFING

| | FY 89 | FY 90 |
|---|---|---|
| EXCEPTED & SES | 49 | 58 |
| GM/GS 15 | 87 | 105 |
| GM/GS 14 | 51 | 61 |
| ALL OTHER GM/GS | 151 | 169 |
| TOTAL | 338 | 393 |

SPACE STATION FREEDOM
PROGRAM OFFICE
(LEVEL II)

FY 1989: 314
FY 1990: 359

LEVEL II SUPPORT
ACTIVITY

FY 1989: 24
FY 1990: 34

INSPECTOR GENERAL

**RESEARCH AND PROGRAM MANAGEMENT**

**FISCAL YEAR 1990 ESTIMATES**

**OFFICE OF INSPECTOR GENERAL**

**DESCRIPTION**

The NASA Office of Inspector General (OIG) is located at *400* Maryland Avenue, SW, Washington, D.C.. **OIG** field locations include offices at Ames Research Center, California; Goddard Space Flight Center, Maryland; Jet Propulsion Laboratory, California; Johnson Space Center, Texas; Kennedy Space Center, Florida; Langley Research Center, Virginia; Lewis Research Center, Ohio, and Marshall Space Flight Center, Alabama.

**OFFICE OF INSPECTOR GENERAL ROLES AND MISSIONS**

NASA **OIG** was created in *1978* by an Act of Congress (P.L. *95-452)* as an independent and objective unit within the Agency. The purposes and mission of the **OIG** are to:

-- Conduct and supervise audits and investigations relating to NASA's programs and operations;

-- Promote economy, efficiency, and effectiveness in the administration of the programs and operations;

-- Prevent and detect fraud, waste and abuse in these programs and operations; and

-- Keep the NASA Administrator and the Congress fully and currently informed about NASA programs, deficiencies relating to the administration of such programs, and the necessity for and progress of corrective actions.

FY 1990 CONGRESSIONAL BUDGET
DISTRIBUTION OF PERMAMENT WORKYEARS BY PROGRAM

| INSPECTOR GENERAL | 1988 ACTUAL | 1989 BUDGET ESTIMATE | 1989 CURRENT ESTIMATE | 1990 BUDGET ESTIMATE |
|---|---|---|---|---|
| SPACE STATION | 0 | 0 | 0 | 0 |
| SPACE FLIGHT PROGRAMS | 0 | 0 | 0 | 0 |
| SPACE TRANSPORTATION CAPABILITY DEV | 0 | 0 | 0 | 0 |
| SPACE SHUTTLE | 0 | 0 | 0 | 0 |
| SPACE SCIENCE AND APPLICATIONS | 0 | 0 | 0 | 0 |
| PHYSICS AND ASTRONOMY | 0 | 0 | 0 | 0 |
| LIFE SCIENCES | 0 | 0 | 0 | 0 |
| PLANETARY EXPLORATION | 0 | 0 | 0 | 0 |
| SPACE APPLICATIONS | 0 | 0 | 0 | 0 |
| AERONAUTICS AND SPACE TECHNOLOGY | 0 | 0 | 0 | 0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | 0 | 0 | 0 | 0 |
| SPACE RESEARCH AND TECHNOLOGY | 0 | 0 | 0 | 0 |
| TRANSATMOSPHERIC RESEARCH & TECH | 0 | 0 | 0 | 0 |
| COMMERCIAL PROGRAMS | 0 | 0 | 0 | 0 |
| SAFETY, RELIABILITY & QUALITY ASSURANCE | 0 | 0 | 0 | 0 |
| TRACKING AND DATA PROGRAMS | 0 | 0 | 0 | 0 |
| SUBTOTAL DIRECT | 0 | 0 | 0 | 0 |
| CENTER MANAGEMENT AND OPERATIONS | 119 | 151 | 136 | 136 |
| SUBTOTAL (FULL-TIME PERMANENTS) | 119 | 151 | 136 | 136 |
| OTHER CONTROLLED FTE'S.. (PMI's/CO-OPS/OTFTP's) | 9 | 10 | 10 | 10 |
| GRAND TOTAL (FULL-TIME EQUIVALENTS) | 128 | 161 | 146 | 146 |

## SUMMARY OF RESOURCES REQUIREMENTS

### Funding Plan by Function

| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I. Personnel and Related Cost................. | 6,529 | 8,801 | 7,930 | 8,115 |
| II. Travel.................................... | 326 | 345 | 345 | 360 |
| 111. Operation of Installation.................. | 261 | 301 | 301 | 320 |
| A. Facilities Services................... | (---) | (---) | (---) | (---) |
| B. Technical Services.................... | (261) | (221) | (256) | (275) |
| C. Management and Operations.............. | (---) | (80) | (45) | (45) |
| Total, fund requirement............. | 7,116 | 7,949 | 8,576 | 8,795 |

In FY 1990 the Office of Inspector General is a separate appropriation. Prior to FY 1990, funds for this office were included in the Research and Program Management Appropriation.

## RESOURCES REQUIREMENTS BY FUNCTION

| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| I **PERSONNEL AND RELATED COSTS** ...................... | 6.529 | 8.801 | 7,930 | 8,115 |

Summary of Fund Requirements

| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| A. Compensation and Benefits | | | | |
| 1. compensation | | | | |
| a. Full-time permanent................. | 5,119 | 6,523 | 6,100 | 6,200 |
| b. Other than full-time permanent...... | 162 | 185 | 200 | 200 |
| c. Overtime and other compensation..... | 98 | 85 | 100 | 100 |
| Subtotal, Compensation............. | 5,379 | 6,793 | 6,400 | 6,500 |
| 2. Benefits............................... | 646 | 928 | 850 | 900 |
| Subtotal, Compensation & Benefits... | 6,025 | 7,721 | 7,250 | 7.400 |
| B. Supporting Costs | | | | |
| 1. Transfer of personnel................... | 412 | 1,025 | 600 | 625 |
| 2. Personnel training...................... | 46 | 55 | 40 | 45 |
| 3. OPM Services............................ | 46 | --- | 40 | 45 |
| Subtotal, Supporting Costs.......... | 504 | 1.080 | 680 | 715 |
| Total, Personnel and Related Costs.. | 6,529 | 8,801 | 7,930 | 8,115 |

## Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| A. Compensation and Benefits.................. | 6.025 | 7.721 | 7.250 | 7,400 |
| 1. Compensation.......................... | 5.379 | 6.793 | 6,400 | 6,500 |
| a. Full-time permanent................ | 5,119 | 6,523 | 6,100 | 6,200 |

## Basis of Cost for Permanent Positions

In 1990 the cost of permanent workyears will be $6,200,000. The increase from 1989 results from the following:

| | | |
|---|---|---|
| Cost of full-time permanent workyears in 1989 | | $6,100 |
| Cost Changes in 1990 | | + 256 |
| Within-grade and career advances: | | |
| Full year effect of 1989 actions | + 69 | |
| Partial year effect of 1990 actions | +127 | |
| Additional FTE | 0 | |
| Full Year effect of 1989 Payraise | + 60 | |
| Changes in Reimbursements | 0 | |
| Turnover Effect | | - 156 |
| Full year 1989 effect | -108 | |
| Part year 1990 effect | - 48 | |
| Cost of full-time permanent workyears in 1990 | | $6,200 |

| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| b. Other than full-time permanent | | | | |
| (1) cost...................... | 162 | 185 | 200 | 200 |
| (2) Workyears.................. | 9 | 10 | 10 | 10 |

The 1990 estimate is essentially level with 1989.

| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| c. Overtime and other compensation.. | 98 | 85 | 100 | 100 |

The increase from the 1989 Budget estimate to the 1989 current estimate reflects 1988 actual experience.

| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Benefits........................... | 646 | 928 | 850 | 900 |

The following are the amounts of contributions by category:

| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| Retirement Fund and Thrift Plan ........ | 394 | 617 | 554 | 598 |
| Employee life insurance................. | 10 | 13 | 12 | 13 |
| Employee health insurance.............. | 138 | 132 | 124 | 128 |
| Workmen's compensation................. | 0 | 54 | 54 | 52 |
| FICA................................. | 49 | 38 | 36 | 37 |
| Medicare............................. | 55 | 74 | 70 | 72 |
| Total............................ | 646 | 928 | 850 | 900 |

The decrease from the 1989 Budget estimate to the 1989 Current estimate reflects the latest projected staffing levels. The increase from the 1989 current estimate to the 1990 budget estimate is due to the increased cost of Federal Employee Retirement Benefits as new civil service employees in the Federal Employees Retirement System replace leaving employees in the Civil Service Retirement System.

| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| B. Supporting Costs........................ | 504 | 1,080 | 680 | 715 |
| 1. Transfer of personnel................ | 412 | 1,025 | 600 | 625 |

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 decrease from the 1989 budget estimate to the 1989 Current estimate is due to the decrease in the level of personnel currently planned as compared with those orginally planned for this function.

| | | | | |
|---|---|---|---|---|
| 2. Personnel training................... | 46 | 55 | 40 | 45 |

The maintenance and expansion of skills through various training and educational activities, is essential in carrying out the Inspector General's Mission. Part of the training consists of courses offered by other Government agencies, usually for a fee. The remainder of the training is provided through nongovernment sources. The costs are for tuition, fees and related costs for training at colleges, universities, technical institutions, and for the cost of seminars and workshops. The slight increase in 1990 is needed to fund additional training requirements resulting from a 1988 revision to the GAO audit standards.

| | | | | |
|---|---|---|---|---|
| 3. OPM Services (HQs only).............. | 46 | --- | 40 | 45 |

The costs associated with the Office of Personnel Management's (OPM) investigation of new hires for the Office of Inspector General is included here.

| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| 11. TRAVEL.................................. | 326 | 345 | 345 | 360 |

Summary of Fund Requirements

Travel funding is required to carry out audit, investigation and management duties. The increase from the 1989 current estimate to the 1990 budget estimate is due to higher anticipated airline costs per trip.

| | | | | |
|---|---|---|---|---|
| 111. OPERATION OF INSTALLATIONS................. | 261 | 301 | 301 | 320 |

Summary of Fund Requirements

| | | | | |
|---|---|---|---|---|
| Technical Services...................... | 261 | 221 | 256 | 275 |
| Management and Operations................ | 0 | 80 | 45 | 45 |
| Total, Operation of Installation...... | 261 | 301 | 301 | 320 |

Explanation of Fund Reauirements

Operation of Installation provides a broad range of services, supplies, and equipment in support of the Inspector General's activities.

The increase from the 1989 current estimate to the 1990 budget estimate is due to the needed replacement of existing computer equipment that, d~ to its age, is now beginning to fail.

| | | | | |
|---|---|---|---|---|
| A. Technical Services...................... | 261 | 221 | 256 | 275 |

Summary of Fund Requirements

This estimate provides for all equipment, including the lease, purchase, maintenance, programming and operations services of automated data processing (ADP) equipment. NASA provides common services items such as office space, communications, supplies, and printing and reproduction at no charge to the office of Inspector General.

| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| B. Management and Operations | --- | 80 | 45 | 45 |

Summarv of Fund Requirements

| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications | --- | 31 | --- | --- |
| 2. Printing and Reproduction | --- | 4 | --- | --- |
| 3. Installation Common Services | --- | 45 | 45 | 45 |
| Total, Management and Operations | --- | 80 | 45 | 45 |

Explanation of Fund Requirements

| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 1. Administrative Communications | --- | 31 | --- | --- |

Included in the 1989 budget estimate are the costs of local telephone services for the Inspector General's office. These costs are provided at no charge to the Inspector General, by NASA, in the 1989 current estimate and 1990 budget estimate.

| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 2. Printing and Reproduction | --- | 4 | --- | --- |

Costs of printing and reproduction services used by the Office of Inspector General are included in the 1989 budget estimate. These costs are provided at no charge to the Inspector General by NASA, in the 1989 current estimate and 1990 budget estimate.

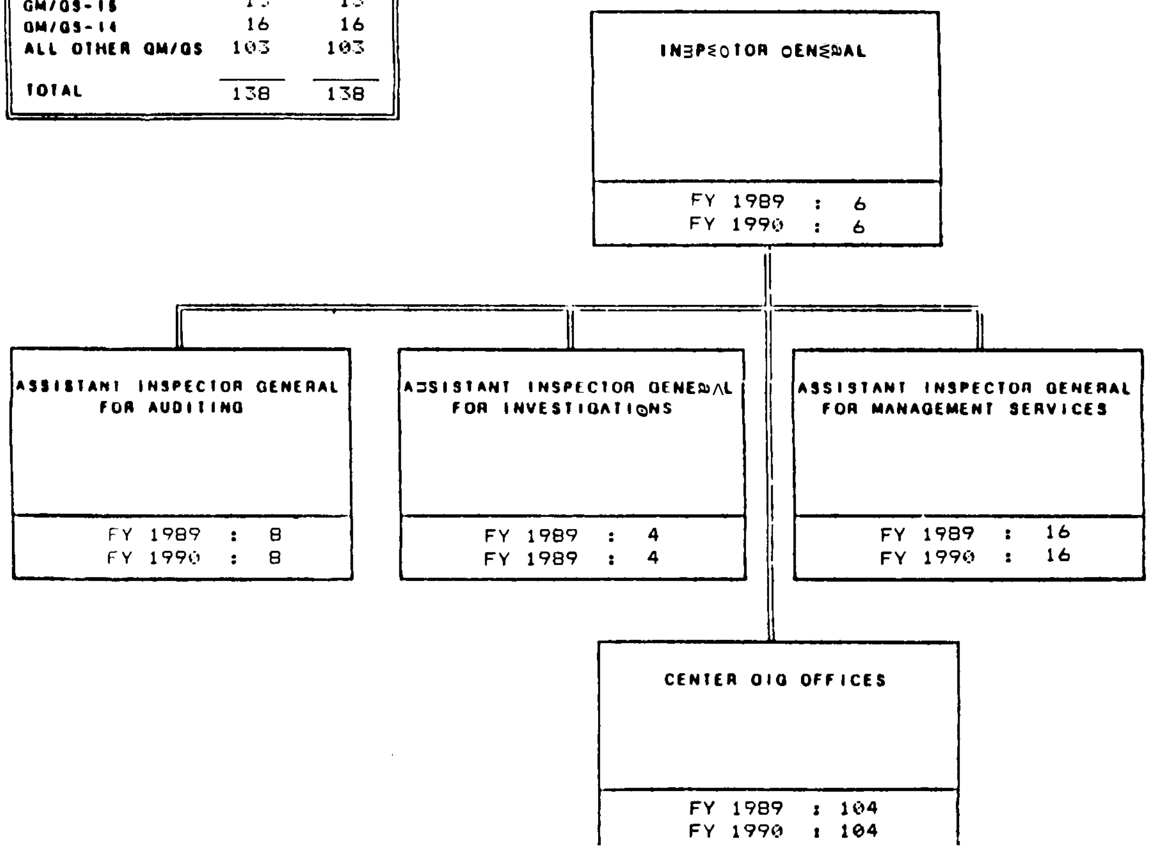
| | 1988 Actual | 1989 Budget Estimates | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| 3. Installation Common Services | --- | 45 | 45 | 45 |

Included in this category are miscellaneous expenses within the Inspector General's Office.

ORGANIZATION AND STAFFING

OFFICE OF INSPECTOR GENERAL

| INSPECTOR GENERAL SUMMARY | FY 89 | FY 90 |
|---|---|---|
| EXCEPTED & SES | 6 | 6 |
| GM/GS-15 | 13 | 13 |
| GM/GS-14 | 16 | 16 |
| ALL OTHER GM/GS | 103 | 103 |
| TOTAL | 138 | 138 |



APPROPRIATION
REALIGNMENT

SPECIAL ANALYSES

RESEARCH AND PROGRAM MANAGEMENT

FISCAL YEAR 1990 ESTIMATES

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 (hazardous testing), Table Mountain, California (atmospheric remote sensing, solar studies and astronomy), Kennedy Space Center, Florida (supports JPL launches at KSC), McLean, Virginia (provides support to the Technology and Applications Program Office), (provides technical and scientific support to the Space Station), and Washington, D.C. (supports the Visiting Senior Scientist Program).

At Pasadena, the Laboratory occupies 177 acres of land of which 156 acres are owned by NASA and 21 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 Eastern Launch Site Office is located at Kennedy Space Center; the other east coast offices are leased. 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, 1988, was approximately $688,179,790.

The Jet Propulsion Laboratory is a Government-owned installation that is staffed and managed by the California Institute of Technology. Contract NAS7-918 between NASA and Caltech governs research, development, and related activities at the Laboratory with facilities being provided under a separate facilities contract NAS7-920(F). The cost of operating JPL for NASA activities is borne by the Research and Development and the Space Flight, Control, and Data Communications appropriations, except for the lease or purchase 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, power, structures, guidance and control systems, thermal control, electronics, and others. The Laboratory is also assigned responsibility for selected automated Earth-orbital projects and for the development and application of earth remote sensing technology and instruments. Implicit in these assignments is a broad range of engineering, scientific, and management functions devoted to:

1. The conduct of complete spaceflight projects, including overall project management and all phases of project activity beginning with mission design and following with spacecraft design, development, testing, flight operations, and data analysis.

2. The development and operation of the Deep Space Network (DSN) which provides tracking and data acquisition services for all NASA projects involving missions beyond near-Earth orbits.

3. Continuing programs of scientific investigation, research and analysis, and technology development.

In more specific terms, the principal Laboratory activities in support of NASA can be categorized as follows:

Solar System Exploration - Since the beginning of the Nation's space activities, JPL has devoted a major part of its efforts to exploration of the planets, their satellites, and the interplanetary medium. The Laboratory has had project management responsibility for all of the Mariner missions, including design, fabrication, assembly and testing of the spacecraft. During more than two decades, beginning with the Mariner 2 flight to Venus in 1962, these missions produced enormous scientific returns.

The Jet Propulsion Laboratory was a major participant in the Viking project, carrying out, among other assignments, the Development of the two orbiters which, each carrying a lander, reached Mars during the summer of 1976. The Viking mission operations were repeatedly extended as the spacecraft far out-lived their design lifetimes. Operations were completed in 1983 when Viking Lander I, the last operating unit of the four, ceased functioning

In the continuing series of planetary missions, JPL has management responsibility for the Voyager mission. The two Voyager spacecraft were launched in 1977 and made close flybys of Jupiter and its major satellites in 1979. In 1980 and 1981, the Voyager spacecraft encountered Saturn. Each of these four Voyager planetary encounters resulted in major scientific discoveries and obtained unique data. It became evident that both spacecraft would remain in good operating condition following the Saturn encounters, and, in consequence, the Voyager mission was 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 management center for the Galileo project and is developing the orbiter in-house. The Ames Research Center is responsible for the probe development.

The Ulysses Project is a cooperative effort between NASA and the European Space Agency (ESA) to study the sun at high solar latitudes. JPL is managing the development of the United States instruments which will fly on 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 from 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 is developing the spacecraft and synthetic aperture radar under contracts to JPL.

The Mars Observer mission will undertake planet-wide studies of the composition and physical state of Martian materials, examine the major surface forming processes and their time scales, and explore the structure and circulation aspects of the atmosphere. The Jet Propulsion Laboratory is the management center with responsibility for the scientific payload, and has contracted with industry for development of the spacecraft bus.

The Comet Rendezvous Asteroid Flyby (CRAF)/Cassini program, building upon the discoveries made by the Pioneer and Voyager spacecraft, will provide unprecedented information on the origin and evolution of our solar system and will help explain how the necessary building blocks for the chemical evolution of life are formed elsewhere in the universe. Development and long lead procurement items for the CRAF/CASSINI spacecraft will be initiated in FY 1990 in order to achieve an August 1995 launch to the comet KOPPF and an April 1996 launch to Saturn.

Astrophysics - Consistent with its role as a center for Earth-orbital spacecraft development, JPL managed the Infrared Astronomical Satellite (IRAS) project which was launched in January 1983. This was a cooperative mission with the Netherlands and the United Kingdom. The spacecraft itself was designed and built in the Netherlands. JPL was responsible for the infrared telescope development, system testing activities, and data analysis. Flight operations were completed in November 1983. IRAS has been a highly successful scientific undertaking, producing a data base comprised of photometric observations of asteroids, stars, and galaxies in four wavelength bands from near to far infrared. This unique database is of such size that analysis will continue for many years.

Earth Science and Applications - In the area of space applications, JPL is a principal center for work in oceanographic applications of space technology. Development was initiated in FY87 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 observation. Major flight instruments and experiments, include the Spaceborne Imaging Radar (SIR), the Atmospheric Trace Molecule Spectroscopy (ATMOS) experiment, the High-Resolution Imaging Spectrometer (HIRIS), Wide Field/Planetary Camera (WPFC), Microwave Limb Sounder (MLS), and the Scatterometer.

Other important areas of research in space applications include geodynamics and plate tectonics.

Space Station - JPL performs a program requirements and assessment function for the Office of Space Station (OSS). This support consists of developing and implementing staffing and program requirements necessary for the accomplishment of the OSS mission and assessing the performance of NASA center activities in meeting those requirements. To accomplish this goal, JPL has been tasked with the responsibility of developing, maintaining and updating a program requirements document which details the staffing and management requirements of each program, the responsibilities of each program on a day-to-day basis, and outlines how the various systems and subsystems integrate.

JPL is also responsible for providing Flight Test Telerobotics Servicer systems engineering support to the Goddard Space Flight Center (GSFC). This support consists of JPL assisting GSFC in systems support definition of FTS flight test and in-house phasing activity, and the integration of JPL products into the GSFC Demonstration Integration and Test Facility. Additionally, the systems group at JPL is tasked with the responsibility of developing hardware control algorithms and software for delivery to GSFC in support of the Flight Test Telerobotics Servicer.

Spacecraft Flight Operations - The Jet Propulsion Laboratory is responsible for the design, development, maintenance, and operation of NASA's worldwide Deep Space Network (DSN) and a multi-mission Space Flight Operations Center (SFOC). The DSN tracking stations are located in California, Spain, and Australia, and support projects involving flights beyond near-Earth orbit. The Space Flight Operations Center is located at JPL, and is the facility for actual day-to-day operations of deep-space missions. JPL has also implemented the Network Consolidation Program which co-locates major 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 provide an efficient, technically advanced, and cost effective means of operation.

Research and Analysis - The Jet Propulsion Laboratory maintains an effective program of advanced technical development to provide sound technologies for present and prospective project assignments and to further the general capabilities of NASA. Areas of involvement include spacecraft advanced technology and development, controls and robotics, space power, structures, microelectronics and sensors, information systems, advanced computer concepts, and satellite communications. The Laboratory participates in scientific experiments on both JPL-managed and non-JPL managed flight projects. This participation includes not only the performance of scientific investigations, but also major commitments to the development of scientific instruments for use in space missions. Ground-based research programs are carried out in the planetary sciences, physics and astronomy, and Earth and ocean physics. These activities involve broad collaboration with the scientific and academic communities and with staff members from other NASA field installations.

JET PROPULSION LABORATORY
FY 1990 SIMULATED RESEARCH AND PROGRAM MANAGEMENT (R&PM)
DISTRIBUTION OF PERMANENT WORKYEARS BY PROGRAM

| | FY 1988 Actual Workyears | FY 1989 Budget Estimate | FY 1989 Current Estimate | FY 1990 Budget Estimate |
|---|---|---|---|---|
| Space Station | 73 | 33 | 78 | 77 |
| Space Flight Programs | 21 | 25 | 23 | 23 |
| Space Transportation Capability Dev. | 13 | 14 | 14 | 14 |
| Space Shuttle | 8 | 11 | 9 | 9 |
| Space Science and Applications | 1,731 | 1,739 | 1,848 | 1,824 |
| Physics and Astronomy | 107 | 141 | 114 | 114 |
| Life Science | 12 | 11 | 13 | 13 |
| Planetary Exploration | 1,062 | 1,066 | 1,134 | 1,118 |
| Space Applications | 550 | 521 | 587 | 579 |
| Commercial Programs | 3 | 4 | 3 | 3 |
| Aeronautics and Space Technology | 170 | 169 | 182 | 179 |
| Aeronautics R&T | 1 | 2 | 1 | 1 |
| Space R&T | 169 | 167 | 181 | 178 |
| Safety, Reliability, Maintainability & Quality Assurance (OSRMQA) | 6 | 10 | 6 | 6 |
| Tracking and Data Advanced Systems | 422 | 387 | 451 | 445 |
| DIRECT SUPPORT | 519 | 533 | 523 | 515 |
| CENTER MANAGEMENT AND OPERATIONS | 1,281 | 1,325 | 1,289 | 1,270 |
| Total, Permanent Workyears | 4,226 | 4,225 | 4,403 | 4,342 |

JET PROPULSION LABORATORY
FY *1990* SIMULATED RESEARCH AND PROGRAM MANAGEMENT (R&PM)
**FUNDING PLAN BY FUNCTION**

| | FY 1988 Actual | FY 1989 Budget Estimate | FY 1989 Current Estimate | FY 1990 Budget Estimate |
|---|---|---|---|---|
| I. Personnel and Related Costs. . . . . . . . . . . | 264,435 | 276,900 | 287,399 | 300,339 |
| 11. Travel . . . . . . . . . . . . . . . . . . . . . | 12,876 | 14,172 | 14,410 | 14,729 |
| 111. Operation of Installation. . . . . . . . . . . . | 66,506 | 69,650 | 70,630 | 72,182 |
| A. Facilities Services. . . . . . . . . . . . . | (29,628) | (29,901) | (31,040) | (30,211) |
| B. Technical Services . . . . . . . . . . . . . . | (11,024) | (13,659) | (11,532) | (12,137) |
| C. Management and Operations. . . . . . . . . . | (25,854) | (26,090) | (28,058) | (29,834) |
| Total, Fund Requirements . . . . . . . . . . | 343,817 | 360.722 | 372.439 | 387,250 |

**EXPLANATION OF FUND REQUIREMENTS**

**I. PERSONNEL AND RELATED COSTS . . . . . . . . . . . 264,435 276,900 287,399 300,339**

The increase from the *1989* Budget Estimate to the *1989* Current Estimate is due to the change in estimated workforce levels, revised salary estimates based on *1988* experience, and related benefit costs. The increase from the *1989* Current Estimate to the *1990* Budget Estimate is due to normal salary increases, associated increases in personnel benefits, and the change in the estimate workforce level.

JET PROPULSION LABORATORY
FY 1990 SIMULATED RESEARCH AND PROGRAM MANAGEMENT (R&PM)
FUNDING PLAN BY FUNCTION

| | FY 1988 Actual | FY 1989 Budget Estimate | FY 1989 Current Estimate | FY 1990 Budget Estimate |
|---|---|---|---|---|
| II. TRAVEL. . . . . . . . . . . . . . . . . . . . . | 12,876 | 14,172 | 14,410 | 14,729 |

The increase from the 1989 Budget Estimate to the 1989 Current Estimate is due to increased workforce and the reassessment of travel requirements based on current programmatic activities and anticipated travel associated with preparation for Magellan and Galileo launches. The increase from the 1989 Current Estimate to the 1990 Budget Estimate reflects increased Travel Costs levels and FY 1990 launch activities.

| | FY 1988 Actual | FY 1989 Budget Estimate | FY 1989 Current Estimate | FY 1990 Budget Estimate |
|---|---|---|---|---|
| 111. OPERATION OF INSTALLATION . . . . . . . . . | 66,506 | 69,650 | 70,630 | 72,182 |
| A. Facilities Services . . . . . . . . . . . | (29,628) | (29,901) | (31,040) | (30,211) |

The increase from the 1989 Budget Estimate to the 1989 Current Estimate is primarily attributable to a reassessment of includable costs and increased equipment costs. The net decrease from the 1989 Current Estimate to the 1990 Budget Estimate is due to higher utilities costs offset by reduced building lease costs.

| | FY 1988 Actual | FY 1989 Budget Estimate | FY 1989 Current Estimate | FY 1990 Budget Estimate |
|---|---|---|---|---|
| B. Technical Services. . . . . . . . . . . | (11,024) | (13,659) | (11,532) | (12,137) |

The decrease from the 1989 Budget Estimate to the 1989 Current Estimate reflects a reassessment of includable technical services which are expected to continue in future fiscal years. The increase from the 1989 Current Estimate to the 1990 Budget Estimate results from price changes.

| | FY 1988 Actual | FY 1989 Budget Estimate | FY 1989 Current Estimate | FY 1990 Budget Estimate |
|---|---|---|---|---|
| C. Management and Operations . . . . . . . | (25,854) | (26,090) | (28,058) | (29,834) |

The increase from the 1989 Budget Estimate to the 1989 Current Estimate is due to revised estimates for supplies and materials and equipment. The increase from the 1989 Current Estimate to the 1990 Budget Estimate is due to increased business volume, and price increases.

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

**FISCAL YEAR 1990 ESTIMATES**

**SUMMARY OF AIR TRANSPORTATION**

**OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY**

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| Research and Development | 359,150 | 456,400 | 438,900 | 526,300 |
| Construction of Facilities | 42,800 | 63,800 | 52,500 | 71,100 |
| Research and Program Management | 302,700 | 351,800 | 323,800 | 342,600 |
| Total | 704,650 | 872,000 | 815,200 | 940,000 |
| Number of direct workyears associated with air transportation | 3,188 | 3,278 | 3,242 | 3,324 |

The goal of the NASA Aeronautics Research and Technology program is to conduct aeronautical research and develop technology to strengthen U.S. leadership in civil and military aviation. This goal is supported by five comprehensive program objectives: (1) emphasize emerging technologies with potential for major advances in capacity and performance; (2) maintain NASA's laboratory strength by repairing and modernizing critical aging national facilities, providing advanced scientific computational capabilities and enhancing staff technical excellence; (3) ensure timely transfer of research results to the U.S. aeronautics community through reports, conferences, workshops and cooperative research programs with industry; (4) ensure strong university involvement to broaden the nation's base of technical expertise and innovation; and (5) provide technical expertise and facility support to the Department of Defense (DOD), other government agencies, and U.S. industry for major aeronautical programs. The program is based on a strong commitment to revitalize American competitiveness in the world aviation marketplace, enhance the safety and capacity of the national airspace system, and assure U.S. superiority for national security.

With the U.S. challenged as never before in aeronautics, the FY 1990 estimate reflects the need to address critical barriers and strengthen technology development in selected high payoff areas that are vital to our long-term leadership in aviation. NASA's FY 1990 aeronautics program is focused on achieving the bold objectives established in the report, "National Aeronautical R&D Goals: Technology for America's Future," by the Office of Science and Technology Policy (OSTP), and by its sequel report, "Agenda for Achievement," which enunciates an eight-point action plan for achieving the goals.

NASA, in conjunction with DOD, is developing the technology for future aerospace vehicles in the joint National Aero-Space Plane (NASP) program. The objective of the NASA Transatmospheric Research and Technology program is to accelerate the development of the critical enabling technologies for a revolutionary new class of hypersonic/transatmospheric vehicles for the future. Such vehicles could be capable of horizontally taking off from and landing on conventional runways, using airbreathing propulsion up to, or near, orbital speed, and providing rapid and lower cost access to space.

The NASP Phase 2 program will establish the technology base for the decision in the last quarter of calendar year 1990 as to whether to proceed to Phase 3 the design, construction, and flight testing of the X-30. Activities are directed toward completion of all contracted and technology maturation tasks now underway and toward providing the plan for the X-30 procurement and testing. There will be special emphasis on testing of components and hardware acquired earlier in the program, with extensive test programs to be accomplished in a variety of NASA and many other government- and contractor-owned facilities. There will be a concentrated effort to complete the design and analysis computational fluid dynamics (CFD) programs that have been developed and evaluated in the conduct of the Phase 2 program. Each of the contractors and the government design team will provide a risk assessment and complete an independent assessment of the technologies and their integration into vehicle concepts that will satisfy the NASP program, the X-30 goal of a reusable, hydrogen-fueled, airbreathing, horizontal takeoff and landing, aerospace plane with single-stage-to-orbit capability.

The research and program management funding in FY 1990 provides for the salaries and travel of 3324 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

FY 1990 BUDGET

EQUIPMENT TO BE PLACED AT NASA INSTALLATIONS

| | 1990 (Thousands of Dollars) |
|---|---|
| Research and Development | 291,335.5 |
| Space station | 134,637.5 |
| Space transportation capability development | 52,329.0 |
| Physics and astronomy | 7.862.0 |
| Planetary exploration | 2.862.0 |
| Life sciences | 270.0 |
| Space applications | 10,782.0 |
| Aeronautical research and technology | 71.218.0 |
| Transatmospheric research and technology | 681.0 |
| Space research and technology | 10,694.0 |
| Space flight. control and data communications | 213,061.5 |
| Shuttle production and capability development | 118,458.0 |
| Space transportation operations | 76.069.0 |
| Space and ground network. communication and data systems | 17,912.5 |
| Expendable launch vehicles | 622.0 |
| Total | 504,397.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAUTICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER BLDG, 258, 21-84-03 | NUMERICAL AERODYNAMIC SIMULATION | PROVIDES A LARGE-SCALE-HIGH PERFORMANCE COMPUTATIONAL RESOURCB FOR SOLVING THREE DIMENSIONAL VISCOUS FLUID FLOW EQUATIONS SPECIFICALLY ORIENTED TOWARD THE SOLUTION OF AERODYNAMIC AND FLUID DYNAMIC PROBLEMS. | 28800.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER BLDG. N-243, 21-01-04 | SIMULATION COMPUTER REPLACEMENT | UPGRADES SIMULATION CAPABILITIES TO SUPPORT ONGOING AND FUTURE PROGRAMS, REPLACING EXISTING EQUIPUENT. | 2100.0 |
| AERONAUTICAL RESEARCH AND TECHNOLOGY | AMES RESEARCH CENTER BLDG. 257, 21-07-06 | AIRCRAFT SYSTEM HODELING AND CONTROL/ADVANCED CONCEPTS SIMULATOR | REPLACES AIRCRAFT SYSTEMS MODELING CONTROL COMPUTER USED TO DRIVE THE ADVANCED CONCEPTS FLIGHT SIMULATOR TO PROVIDE INCREASED SPEED WITH WHICH COCKPIT DISPLAY AND CONTROL SYSTEMS RESPOND TO PILOT INPUTS AND SIMULATED EXTERNAL EVENTS FOR BETTER SIMULATION OF A REAL-TIUE FLIGHT ENVIROMENT. | 200.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAUTICAL RESEARCH & TECHNOLOGY | AMES RESEARCH CENTER BLDG. # 22, 40x80 FT. WIND TUNNEL HIGH BAY 21-88-02 | LARGE ROTOR TEST APPARATUS | ALLOWS TESTING OF LARGE ROTOR SYSTEMS FOR TECHNOLOGY DEVELOPMENT OF ROTORCRAFT IN THE AREAS OF IMPROVED AERODYNAMIC PERFORMANCE, LOW NOISE AND VIBRATION, AND ENHANCED STABILITY. | 850.0 |
| AERONAUTICAL RESEARCH & TECHNOLOGY | AMES RESEARCH CENTER 40x80-, 80x120-, AND 7x10-FOOT WIND TUNNELS AND OUTDOORS AERONAUTICS RESEARCH FACILITY, 21-89-01 | UPGRADE NATIONAL FULL-SCALE AERODYNAMIC COMPLEX (NFAC) SUPPORT SYSTEM | REPLACES CURRENT DATA SUPPORT SYSTEM TO PROVIDE REAL-TIME, NEAR REAL-TIME AND DATA DELIVERY FUNCTIONS FOR ALL NFAC TESTS. | 1200.0 |
| AERONAUTICAL RESEARCH & TECHNOLOGY | AMES RESEARCH CENTER 40x80-FOOT WIND TUNNEL BLDG. # 221, 21-89-02 | ROTOR DATA ACQUISITION SYSTEM | SYSTEM WILL ALLOW DATA ACQUISITION OF ROTOR SYSTEMS IN NFAC FACILITIES FOR TECHNOLOGY DEVELOPMENT OF ROTORCRAFT IN THE AREAS OF ACOUSTIC ANALYSIS, AERODYNAMIC PERFORMANCE, ROTORCRAFT VIBRATION. | 500.0 |
| AERONAUTICAL RESEARCH & TECHNOLOGY | AMES RESEARCH CENTER BLDG. # 211, RMS. 150 AND 155, 21-89-08 | REPLACE 11/750 AND MAIL COMPUTER SUBSYSTEM | SUBSYSTEM SERVES AS TESTBED FOR NETWORK RELATED SOFTWARE AND HARDWARE. | 250.0 (54.0 SPACE RESEARCH & TECHNOLOGY) |
| AERONAUTICAL RESEARCH & TECHNOLOGY | AMES RESEARCH CENTER CENTRAL COMPUTER FACILITY, BLDG. # 233, 21-89-11 | FRONT END FOR SUPERCOMPUTER | PROVIDES A CENTRAL ACCESS POINT FOR SUPERCOIPUTER, RELEIVING IT OF SONE JOB PREPARATION AND DISTRIBUTION TASKS AND EASING THE COMMUNICATION WORKLOAD OM USER WORK STATIONS. | 320.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAUTICAL RESEARCH & TECHNOLOGY | AMES RESEARCH CENTER CENTRAL COMPUTER FACILITY BLDG. N 233, 21-89-15 | LEASE OF CRAY DISKS/SECURE COMPUTER FACILITY | PROVIDES ABILITY TO STORE CLASSIFIED DATA IN SECURE COMPUTER FACILITY. | 286.0 |
| AERONAUTICAL RESEARCH & TECHNOLOGY | AMES RESEARCH CENTER BLDG. 221, RM. 97, 21-90-01 | REPLACEMENT OF VAX 11/750 (COMPUTER UPGRADE AND TERMINALS) | REPLACES COMPUTER USED FOR WIND-TUNNEL POST-TEST ANALYSIS TO MEET INCREASED ANALYSIS REQUIREMENTS. | 270.0 |
| AERONAUTICAL RESEARCH & TECHNOLOGY | AMES RESEARCH CENTER BLDG. N 257, MAN-VEHICLE SYSTEMS RESEARCH FACILITY 21-90-02 | COCKPIT MOTION SYSTEM FOR ADVANCED CONCEPTS FLIGHT SIMULATOR | UPGRADE TO INCLUDE MOTION CAPABILITY EQUIVALENT TO FAA PHASE II-CERTIFIED SIMULATORS TO SUPPORT EFFORTS SUCH AS WIND SHEAR INVESTIGATIONS. | 600.0 |
| AERONAUTICAL RESEARCH & TECHNOLOGY | AMES RESEARCH CENTER DRYDEN FLIGHT RESEARCH FACILITY, 21-90-04 | DATA NETWORK | PROVIDES TIMELY AND SECURE ACCESS TO FLIGHT RESEARCH AND MISSION SUPPORT DATA AND ALLOWS TRANSFER OF DATA BETWEEN FACILITIES AT HIGH BANDWIDTH. | 297.0 |
| AERONAUTICAL RESEARCH & TECHNOLOGY | AMES RESEARCH CENTER DRYDEN FLIGHT RESEARCH FACILITY, 21-90-05 | FLIGHT DATA ACCESS SYSTEM | INTEGRATES FUNCTIONS OF FLIGHT DATA ACQUISITION, ANALYSIS, ARCHIVING, AND USER PROCESSING AND WILL REDUCE TIME REQUIRED BY RESEARCHERS TO ACCESS DATA. | 495.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAUTICAL RESEARCH & TECHNOLOGY | LEWIS RESEARCH CENTER BLDG. 142, 22-84-03 | TRADAR III HARDWARE | REPLACES OBSOLETE TRANSIENT DATA RECORDING HARDWARE AND PROVIDES A CENTRAL SYSTEM WITH A 200-CHANNEL CAPACITY. | 405.0 (80.0 SPACE RESEARCH & TECHNOLOGY) |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LEWIS RESEARCH CENTER BLDG. 142, 22-88-01 | CLUSTER CENTRAL PROCESSING UNIT | EXPANDS CAPABILITY TO MEET INCREASED RESEARCH DEMANDS. | 1100.0 (237.0 SPACE RESEARCH & TECHNOLOGY) |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LEWIS RESEARCH CENTER BLDG.142, 21-18-02 | ESCORT III AUGMENTATION | PROVIDES FOR REPLACEMENT OF CENTRAL PROCESSING UNIT AND GRAPHICS PERIPHERALS TO IMPROVE RESPONSE TIME BY PROVIDING FASTER UYVATE M T E AND MORE EXTENSIVE CALCULATIONS. | 562.0 (71.0 SPACE RESEARCH & TECHNOLOGY) |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LEWIS RESEARCH CENTER BLDG. 142, 22-88-03 | SHARED MASS STORAGE | PROVIDES ADDITIONAL HIGH CAPACITY DISK STORAGE TO MEET INCREASING DEMANDS. | 213.0 (42.0 SPACE RESEARCH & TECHNOLOGY) |
| AERONAUTICAL RESEARCH & 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. | 710.0 (140.0 SPACE RESEARCH & TECHNOLOGY) |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LEWIS RESEARCH CENTER BLDG. 142, 22-89-01 | AMDAHL 5860/MVS REPLACEMENT | REPLACES EXISTING SYSTEM WITH MORE SPEED AND MAIN MEMORY TO MEET INCREASED DEMANDS. | 541.0 (107.0 SPACE RESEARCH & TECHNOLOGY) |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LEWIS RESEARCH CENTER BLDG. 142, 22-89-02 | PARALLEL PROCESSOR | ALLOWS FOR PARALLEL PROCESSING WITH EXISTING CODES AND THE DEVELOPMENT AND EVALUATION OF NEW PARALLEL ALGORITHMS IN SUPPORT OF PWID DYNAMICS RESEARCH. | 710.0 (140.0 SPACE RESEARCH & TECHNOLOGY) |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAUTICAL RESEARCH & TECHNOLOGY | LEWIS RESEARCH CENTER CENTERWIDE, 22-89-04 | LEWIS INFORMATION MANAGEMENT SYSTEM | PROVIDES SCIENTIFIC AND ENGINEERING WORK STATIONS AND PRINTERS. | 1842.0 (363.0 SPACE RESEARCH & TECHNOLOGY) |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LEWIS RESEARCH CENTER CENTERWIDE, 22-89-07 | INTERACTIVE COMPUTER ASSISTED RESEARCH ENGINEERING (ICARE) | PROVIDES FOR HIGH RESOLUTION COLOR GRAPHICS TERMINAL, WORK STATIONS, AND HARD COPY UNIT TO ENHANCE ICARE CAPABILITIES OF THE GRAPHICS AND CAD/CAM BASE WHICH SUPPORT THE RESEARCH PROGRAMS. | 710.0 (140.0 SPACE RESEARCH & TECHNOLOGY) |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LEWIS RESEARCH CENTER BLDG. 142, 22-89-11 | ESCORT D HARDWARE UPGRADE | PROVIDES FOR DATA ACQUISITION, TEST MONITORING, AND DATA RECORDING FOR MEDIUM SIZED TEST FACILITIES. | 250.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAUTICAL RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER BLDG. 1268, 23-87-02 | MIDRANGE COMPUTERS | UPGRADES 6 MIDRANGE PROCESSORS TO REPLACE EXISTING EQUIPMENT AND PROVIDE A 50-PERCENT INCREASE IN COMPUTING POWER TO ACCOMMODATE PRESENT AND FUTURE AEROSPACE RESEARCH REQUIREMENTS. | 2014.0 (309.0 SPACE RESEARCH & TECCHNOLOGY) |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER BLDG. 1220, 23-87-04 | AVIONICS INTEGRATION RESEARCH LABORATORY UPGRADE | UPGRADES EXISTING SYSTEM TO PROVIDE ADDITIONAL STORAGE CAPACITY. | 105.0 |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER BLDG. 1192, 23-87-09 | COMPUTATIONAL FLUID DYNAMICS LABORATORY SUPER MINI-COMPUTER | PROVIDES MEDIUM SPEED COMMUNICATIONS AND FILE SERVICE FOR WORK STATIONS AND HIGH BANDWITH COMMUNICATIONS SERVICE TO CENTRAL SCIENTIFIC COMPUTER COMPLEX. | 100.0 |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER CENTERWIDE, 23-88-02 | SUPERCOMPUTER WORK STATION SUBSYSTEM | PROVIDES MODERN WORK STATIONS TO SUPPORT COMPUTATIONAL FLUID DYNAMICS TECHNOLOGY DEVELOPMENT. | 125.0 (25.0 SPACE RESEARCH & TECHNOLOGY) |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER BLDGS. 1268A AND 1220 23-88-04 | VISUAL SYSTEMS FOR FLIGHT SIMULATORS | PROVIDES FOR SCENE PROJECTION AND COCKPIT WINDOW DISPLAY EQUIPMENT COMPATIBLE WITH CGI SYSTEM TO SUPPORT PILOTED FLIGHT SIMULATOR RESEARCH EFFORTS. | 110.0 |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER BLDG. 1268, 23-88-08 | SUPERCOMPUTER AUGMENTATION | ACQUISITION OF SUPERCOMPUTER CENTRAL PROCESSING UNIT TO PROVIDE INCREASED CAPACITY TO SUPPORT RESEARCH IN SUCH AREAS AS COMPUTATIONAL FLUID DYNAMICS, STRUCTURES, AND MATERIALS. | 4294.0 (655.0 SPACE RESEARCH & TECHNOLOGY) |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY (90) OBLIGATION ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAUTICAL RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER BLDG. 1268, 23-88-11 | LASER PRINTER/PLOTTER SYSTEM | REPLACES 17 IMPACT PRINTERS AND 4 ELECTROSTATIC PLOTTERS IN THE CENTRAL SCIENTIFIC COMPUTER COMPLEX WHICH GENERATES 3 MILLION PAGES OF PRINTED OUTPUT AND WORKING PLOTS PER MONTH. | 300.0 (46.0 SPACE RESEARCH & TECHNOLOGY) |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER BUILDING 1229 23-89-01 | COMPUTATIONAL STRUCTURES MINI SUPERCOMPUTER | SUPPORTS COMPUTATIONALLY INTENSIVE STRUCTURAL ANALYSIS PROBLEMS AND ENABLES THE STUDY OF PARALLEL PROCESSING COMPUTATIONAL METHODS ON URGE-SCALE PROBLEMS. | 340.0 |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER BLDG. 1241, 23-89-06 | SUPERSONIC/HYPERSONIC AERODYNAMIC FACILITY DATA SYSTEM UPGRADE. | SUPPORTS SEVERAL WIND TUNNELS AND REPLACES ANTIQUATED SYSTEMS. | 13.0 |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER BLDG.1247, 23-as-09 | LOW TURBULENCE PRESSURE TUNNEL DATA SYSTEM UPGRADE | UPGRADES SYSTEM TO SUPPORT RESEARCH DATA REQUIREMENTS. | 211.0 (32.0 SPACE RESEARCH 4 TECHNOLOGY) |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER CENTERWIDE 23-89-10 | NUMERICAL AERODYNAMIC SIMULATION (NAS) WORK STATIONS | ALLOWS USERS OF THE NAS TO FULLY EXPLOIT THE CAPABILITIES OF THE NAS SUPERCOMPUTERS IN PERFORMING COMPUTATIONAL FLUID DYNAMICS AND COMPUTATIONAL STRUCTURAL MECHANICS ANALYSES. | 500.0 (100.0 SPACE RESEARCH & TECHNOLOGY) |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER BLDG. 1268A, 23-89-12 | ADVANCED AIR TRAFFIC CONTROLLER SUITE SIMULATOR | UPGRADES AND EXPANDS EXISTING FACILITY TO MEET FAA SPECIFICATIONS FOR FLIGHT CONTROL RESEARCH. | 300.0 |
| AERONAUTICAL RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER BLDG. 1242, 23-90-02 | 0.3 METER CRYOGENIC TUNNEL DATA SYSTEM UPGRADE | UPGRADES DATA ACQUISITION SYSTEM TO MEET RESEARCH DATA REQUIREMENTS. | 337.0 (51.0 SPACE RESEARCH & TECHNOLOGY) |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY (90) OBLIGATION ($ IN THOUSANDS) |
|---|---|---|---|---|
| AERONAUTICAL RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER BLDG. 1212, 23-90-03 | 4x7 METER TUNNEL DATA SYSTEM UPGRADE | UPGRADES DATA ACQUISITION SYSTEM TO MEET RESEARCH DATA REQUIREMENTS. | 842.0 (128.0 SPACE RESEARCH & TECHNOLOGY) |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSATLLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE RESEARCH & TECHNOLOGY | LANGLEY RESEARCH CENTER BLUC.1232, 2J-88-09 | SECURE COMPUTER AIDED DESIGN FACILITY | PROVIDES FOR A 31-BIT SUPER MINICOMPUTER, WORK STATIONS, AND ASSOCIATED PERIPHERALS IN A SECURE ENVIRONMENT TO SUPPORT MULTIDISCIPLINARY ADVANCED TRANSPORTATION CONCEPTUAL DESICN PROGRAMS. | 100.0 |
| SPACE RESEARCH & TECHNOLOGY | LANGLEY RESEARCII CENTER BLDG. 1232, 23-90-01 | SPACECRAFT ANALYSIS SUPER-MINICOMPUTER | INCREASE CAPABILITY TO SATISFY SPACECRAFT ANALYSIS COMPUTATIONAL REQUIREMENTS. | 600.0 |

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE AH) GROUND NEIWORK. COMMUNICATIONS AND DATA SYSTEMS | AYES RESEARCH CENTER LOCATION 210F-01. 900260 | RESEARCH ENGINEEAING DIVISION- I-R/T PROCESSING & DISPLAY SYS UPGRADES OFIAIR | GROUNO NETWORK | 684.6 |
| SPACE AND GROUND NETWORM. COMMUNICATIONS AND OAIA SYSTEMS | GODDARD SPACE FLIGHT CENTER LOCATION 5103 BK, 900050 | MISSION AND DATA OPERATIONS TEST BED PRO MISSION AND OAIA OPERATIONS TEST BED PROCESSING | COMMUNICATIONS AND OAIA SYSTEMS | 1028.0 |
| SPACE AND GROUND NETWORK. COMMUNICATIONS AND DAIA SVSIEMS | GODDARD SPACE FLIGHT CENIER LOCATION 5105-AZ, 900068 | NETWORK MISCELIANEOUS SUPPORT SYSTEM-NETWORK MISCELLANEOUS SUPPORI SYSTEM | COMMUNICATIONS AND DATA SYSTEMS | 3625.0 |
| SPACE AH) GROUND NETYORK. COMMUNICATIONS AND DATA SYSTEMS | GODDARD SPACE FLIGHT CENIER LOCATION 5106-AE, 900070 | MULTI SATELLITE OPERATIONS CONIROL CENIE-MULTI-SATELLITE OPERAIIONS CONTROL CENICR | COMMUNICATIONS AND UAIA SVSIEMS | 3415.0 |
| SPACE AND GROUND NETYORK. COMMUNICATIONS AND DAIA SYSTEMS | GODDARD SPACE FLIGHT CENIER LOCATION 5106-BB, 900076 | COMMAND MANAGEMENT SYSTEM- | COMMUNICATIONS AND DATA SYSTEMS | 400.0 |
| SPACE AND GROUND NETWORK. COMMUNICATIONS AND DAIA SYSTEMS | GODDARD SPACE FLIGHT CENTER LOCATION 5106-BC, 900078 | OPERATIONS SUPPORI COMPUTING FACILITY SY-OPERATIONS SUPPORT COMPUTING FACILITY SVSIEY | COMMUNICATIONS AND DATA SYSTEMS | 1100.0 |
| SPACE ANI GROUND NETWORK, COMMUNICATIONS AND OAIA SYSTEMS | GODDARD SPACE FLIGHT CENIER LOCATION 5103-BK, 900162 | MISSION AN0 OAIA OPERAIIONS TEST BED PRO-MISSION AND DATA OPERATIONS TEST BED PROCESSING | COMMUNICATIONS AND OAIA SYSTEMS | 800.0 |

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | JET PROPULSION LABORATORY LOCATION 5512-00, 900026 | DEEP SPACE NETWORK OPERATIONAL SYSTEMS-COMMAND PROCESSOR FOR DEEP SPACE | GROUND NETWORK | 1000.0 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | JET PROPULSION LABORATORY LOCATION 5512-00, 900028 | DEEP SPACE NETWORK OPERATIONAL SYSTEMS-5TH LINK PROCESSOR FOR TELEMETRY, MONITOR & CONT | GROUND NETWORK | 1470.0 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | JET PROPULSION LABORATORY LOCATION 5512-00, 900030 | DEEP SPACE NETWORK OPERATIONAL SYSTEMS TRACKING PROCESSOR REPLACEMENT FOR DSN | GROUND NETWORK | 750.0 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | JET PROPULSION LABORATORY LOCATION 5512-00, 900034 | DEEP SPACE NETWORK OPERATIONAL SYSTEMS-SYSTEM FOR HIGH RATE TELEMETRY | GROUND NETWORK | 1400.0 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | JET PROPULSION LABORATORY LOCATION 5512-00, 900036 | GROUND COMM. FAC IL IIV OPERATIONAL SYS.-GROUND COMMUNICATIONS FACILITY UPGRADE | COMMUNICATIONS AND DATA SYSTEMS | 1716.0 |
| SPACE AND GROUND NETWORK, COMMUNICATIONS AND DATA SYSTEMS | JET PROPULSION LABORATORY LOCATION 5512-00, 900040 | NETWORK OPS. CONTROL CENTER. SYSTEM-NETWORK OPS CONTROL CENTER | GROUND NETWORK | 514.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPADILIIV | HEADQUARTERS LOCATION 1000- . 900020 | ADP UPGRD/REPLACE SYS (M) | LAUNCH AND MISSION SUPPUR | 1300.0 |
| SPACE SHUTTLE PRODUCTION AM) OPERATIONAL CAPABILITY | MARSHALL SPACE FLIGHT CFNIER LOCATION 6206-DB, 890108 | SOFTWARE & DAIA MANAGEMENT-ADIO FLOATING POINT EXPANSION, BLDG 4481 | SPACF SHUTTLE MAIN ENGINE (SSME) | 250.0 |
| SPACF SHUTTLE PRODUCTION AND OPERATIONAL CAPADILIIV | MARSHALL SPACE FLIGHT CENTER LOCAIIUN 6206-D8, 890110 | SOFTWARE & DATA MANAGEMENT-CI 5000 ANALOG EQUIPMENT REPLACEMENT, BLDG 4487 | SPACE SHUTTLE MAIN ENGINE (SSME) | 600.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPADILIIV | MARSHALL SPACE FLIGHT CENTER LOCATION 6208-46, 890134 | MATERIALS & PROCESSES-UPGRADE VAX FOR MATERIALS DATA BASE | SOLID ROCKET BOOSTER | 1075.0 |
| SPACE SHUTTLE PRODUCTION AMI OPERATIONAL CAPABILITY | MARSHALL SPACE FLIGHT CENIER LOCATION 6202-01, 900018 | SLIDELL COMPUIER COMPLEX, SCC-EXTERNAL TANK NCR/DATA PATH INC PROC/TERM REPL | EXTERNAL TANK | 497.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | MARSHALL SPACF FLIGHT CENTER LOCAIION 6202-01, 900020 | SLIDELL COMPUIER COMPLEX, SCC-UNISYS 1480 DISK PURCHASE | EXIERNAL TANK | 283.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPADILIIV | MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01, 900022 | SLIDELL COMPUTER COMPLEX. SCC-EXTERNAL TANK RADIO FREQ TRANSACTOR TERMINALS | EXTERNAL TANK | 325.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE SHUTTLE PRUOUCTION AND OPERATIONAL CAPABILITY | MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01, 900024 | SI~DELLCOMPUTER COMPLEX, SCC-UNISYS 400 TERMINAL REPLACEMENT | EXTERNAL TANK | 632.0 |
| SPACE SHUTTLE PROOUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CFNICR LOCATION 7208-FA, 890060 | SHUTTLE MISSION SIMULATOR UPGRADES-FACILITY UPGRADE COMPUIER ACQUISITION | LAUNCII AND MISSION SUPPORT | 1334.0 |
| SPACE SHUTTLE PROUUCTION AND OPERATIONAL CAPABILITY | JOIINSON SPACF CENTER LOCATION 7281-GM, 890212 | INTEGRATED MANAGEMENT INFORMATION CENTER-INTEGRATE | LAIJNCII AND MISSION SUPPORT | 1500.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7203-FA, 900018 | MISSION CONIROL CENTER UPGRADES-MCC HOST COMPUTER AUGMENTATION - AIR FORCE PROJECT | ORBITER | 1600.0 |
| SPACE SHUTTLE PROOUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7203-FA, 900026 | MISSION CONIROL CFNIER UPGRADES-MCC TELEMETRY PUUCESSING COMPUTER REPLACEMENT | LAUNCH AND MISSION SUPPORT | 719.0 |
| SPACE SHUTTLE PROOUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7203 FA, 900028 | MISSION CONTROL CENIER UPGRADES-MISSION CONTROL CENIER NEIYORK HANDLER | LAUNCII AND MISSION SUPPORT | 1456.0 |
| SPACE SHUTTLE PROOUCIION ANU OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7203 FA, 900030 | MISSION CONIROL CENTER UPGRADES MISSION CONIROL CENTER UPGRADE | LAUNCII AND MISSION SUPPORT | 1190.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7203-FA, 900034 | MISSION CONTROL CENTER UPGRADES-TRAJECTORY PROCESSING COMPUTER REPLAC'MT-AIR FORCE | ORBITER | 376.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7257-EA, 900126 | ENGINEERING SIMULATIONS LABORATORY-SIMULATION SYSTEMS BRANCH PURCHASE/AUGMENT AF PROJ | ORBITER | 403.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7211-FA, 900150 | SOFTWARE PRODUCTION FACILITY - UPGRADES-SOFTWARE PRODUCTION FACILITY REPLACEMENT | LAUNCH AND MISSION SUPPORT | 393.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7277-FA, 900152 | SOFTWARE PRODUCTION FACILITY - UPGRADES-SPF MAINFRAME UPGRADE - AIR FORCE PROJECT | ORBITER | 3000.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7281-WA, 900156 | INTEGRATED MANAGEMENT INFORMATION CENTER-INTEGRATE | SUPPORT AND MISSION | 7800.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER LOCATION 7208-FA, 900182 | SHUTTLE MISSION SIMULATOR UPGRADES-SHUTTLE MISSION SIMULATOR COMPUTER LEASE | LAUNCH AND MISSION SUPPORT | 3852.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER LOCATION 7609-P6, 890030 | CHECKOUT, CONTROL & MONITOR SYSTEM II-CHECKOUT, CONTROL AND MONITOR SYSTEM II | LAUNCH SITE EQUIPMENT | 2664.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPICE SHUTTLE PRODUCTION AND OPCRATIONAL CAPABILITY | KENNEDY SPACE CENTER LOCATION 7601-F1, 890036 | CENTRAL DATA SYSTEM-CENTRAL OAIA SYSTEM | LAUNCH SITE EQUIPMENT | 11300.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER LOCATION 7601-M1, 890040 | CHECKOUT, CONTROL • MONITOR SYSTEM-CCMS SURVIVABILITY | LAUNCH SITE EQUIPMENT | 3500.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER LOCATION 7601-WA, 890048 | SHUTTLE PROCESSING DATA MANAGEMENT SYSTE SHUTTLE PROCESSING OAIA MANAGEMENT SYSTEM II | LAUNCH SITE EQUIPMENT | 13000.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER LOCATION 7601-SA, 900014 | LAUNCH TEAM TRAINING SYSTEM- | LAUNCH SITE EQUIPMENT | 5100.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACC CENTER LOCATION 7609 LH, 900034 | ARTIFICIAL INTELLIGENCE DEVELOPMENT SYST-ARTIFICIAL INTELLIGENCE DEVELOPMENT SYSTEM | LAUNCH SITE EQUIPMENT | 300.0 |

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER 76-90-15 | HYDROGEN MASS SPECTROMETER | MONITOR ORBITER L7 FOR HYDROGEN LEAKAGE IN A HELIUM BACKGROUND. | 165.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER LC-39, SHUTTLE LANDING AND FACILITY INDUSTRIAL AREA, 76-90-16 | PHOTO OPTICS SYSTEM MODERNIZATION | PHOTOGRAPHIC ANALYSIS OF CHECKOUT AND LAUNCH OF THE SHUTTLE VEHICLE. | 1500.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER LCC, PADS, MLPs, VAB, SAEF-L, O&C, 76-90-17 | DIGITAL OPERATIONAL INTERCOM SYSTEM (OIS-D) | PROVIDE COMMUNICATIONS FOR SHUTTLE AND PAYLOAD PROCESSING AND REPLACE AGENCY'S OIS-A COMMUNICATIONS SYSTEM. | 5225.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER KSC FACILITIES, 76-90-18 | WIDEBAND FIBER OPTIC TRANSMISSION SYSTEM (WB FO TS) | TRANSMIT SHUTTLE PAYLOAD, CARGO, OPERATION TV, AND OTHER DATA IN KSC FACILITIES. | 1313.0 |
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | KENNEDY SPACE CENTER KSC FACILITIES, 76-90-19 | ORBITER MAINTENANCE AND REFURBISHMENT FACILITY UPGRADE TO ORBITER PROCESSING FACILITY CONFIGURATION | ORBITER SAFING AND DESERVICING PRIOR TO MAINTENANCE AND CHECKOUT. | 28335.0 |

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE SHUTTLE PRODUCTION AND OPERATIONAL CAPABILITY | JOHNSON SPACE CENTER BLDG. 30 /35, 72-90-04 | HISSION CONTROL CENTER/ SHUTTLE HISSION SIMULATOR REPLACEMENT UPGRATE | REPLACE OBSOLETE EQUIPMENT AND PARTS NO LONGER MANUFACTURED | 51.8 |

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE TRANSPORTATION OPERAIIONS | MARSHALL SPACE FLIGHT CCNIER LOCATION 6201-AII. 890018 | SYSTEMS DEVELOPMENT 8 IMPLEMENTATION, DR-DATA REDUCTION COMPUTER AUGMENTA I ION | FLIGHT HARDWARE | 442.0 |
| SPACE TRANSPORTATION OPERAIIONS | MARSHALL SPACF FLIGHT CENTER LOCATION 6219-27, 890030 | SYSTEMS DEVELOPMENT & IMPLEMENTATION SPU-SHUTTLE NODE AUGMENTATION | FLIGHT HARDWARE | 1092.0 |
| SPACE TRANSPORTATION OPERAIIONS | MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01, 890190 | SLIDELL COMPUTER COMPLEX, SCC-UNISERVO SUBSYSTEM REPLACEMENT | FLIGHT HARDWARE | 356.0 |
| SPACE IRANSPORIAIION OPERAIIONS | MARSHALL SPACE FLIGHT CENIER LOCATION 6202-01, 890192 | SLIDELL COMPUIER COMPLEX, SCC-UNISYS 1100/91 PROCESSOR SYSTEM | FLIGHT IIARDYARE | 348.0 |
| SPACE IRANSPORIAIIUN OPERATIONS | MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01, 890194 | SLIDELL COMPUTER COMPLEX, SCC-XEROX 4050 PRINTERS | FLIGHT HARDWARE | 321.0 |
| SPACE IRANSPORIAIION OPERATIONS | MARSHALL SPACE FLIGHT CENTER LOCATION 6201-01. 900014 | ENGINEERING ANALYSIS & OAIA SYSTEM, EADS-HIGH CAPACITY MASS STORAGE | FLIGHT HARDWARE | 417.0 |
| SPACE IRANSPORTAI ION OPERAIIONS | MARSHALL SPACE FLIGHT CENIER LOCATION 6200- , 900038 | MSFC ADP ACTIVITY-ACTIONS WITH 1 YR. COSTS < $250K & CUM. COSTS < $1MIN | FLIGHT HARUYARE | 021.0 |
| SPACE IRANSPORTAI ION OPERAIIONS | MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01, 900040 | SLIDELL COMPUIER COMPLEX. SCC-UNISYS 1100/90 INTEGRATED SCIENTIFIC PRCSSR SYS | FLIGHT HARDWARE | 956.0 |

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SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE TRANSPORTATION OPERATIONS | MARSHALL SPACE FLIGHT CENTER LOCATION 6202-01, 900042 | SLIDELL COMPUTER COMPLEX, SCC-UNISYS 8450 DISC REPLACEMENT | FLIGHT HARDWARE | 284.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7100- . 890026 | JSC - ADP ACTIVITY-ACTIONS WITH 1 YR COSTS <$250K - CUM. COSTS <$1M | FLIGHT OPERATIONS | 5911.6 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7101-FA, 890030 | CENTRAL COMPUTING FACILITY-CENTER INFORMATION SYSTEM UPGRADE | FLIGHT OPERATIONS | 450.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7201-FA, 890034 | CENTRAL COMPUTING FACILITY-CENTER INFORMATION SYSTEM AUGMENTATION | FLIGHT OPERATIONS | 2481.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7201-FA, 890040 | CENTRAL COMPUTING FACILITY-CENTER INFORMATION NETWORK REPLACEMENT | FLIGHT OPERATIONS | 685.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 73144-SA, 890102 | MAN-SYSTEMS LABORATORIES-S&LSD NETWORKING AND CPU REPLACEMENT | FLIGHT OPERATIONS | 724.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7166 DA, 890166 | FLIGHT TRAINING & PLANNING FACILITIES-REAL TIME DATA SYSTEM HARDWARE | FLIGHT OPERATIONS | 500.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7266-DA, 890172 | FLIGHT TRAINING & PLANNING FACILITIES-AUTOMATION EQUIPMENT SYSTEM HARDWARE | FLIGHT OPERATIONS | 1908.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7266-DA, 890176 | FLIGHT TRAINING & PLANNING FACILITIES-MISSION OPS DIRECTORATE INFORMATION SYSTEM | FLIGHT OPERATIONS | 440.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7101-FA. 1190178 | CENTRAL COMPUTING FACILITY-LEASE TO OYN UNISYS EQUIPMENT | FLIGHT OPERATIONS | 3901.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7208-DA, 890284 | SHUTTLE MISSION SIMULATOR COMPUTER LEASE | FLIGHT OPERATIONS | 1731.1 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7274-DA, 890192 | FLIGHT DESIGN COMPUTATIONAL FACILITY-UNISYS 1100 LEASE | FLIGHT OPERATIONS | 1778.2 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7201-FA. 900012 | CENTRAL COMPUTING FACILITY UPGRADE | FLIGHT OPERATIONS | 811.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7210-EA, 900076 | AVIONICS SYSTEMS-REPLACEMENT OF OBSOLETE EQUIPMENT | FLIGHT OPERATIONS | 390.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7222-EA. 900080 | STRUCTURES & MECHANICS ENG'G SYSTEMS AUTOMATIC DATA PROC EQUIP LIFECYCLE HARDWARE REP | FLIGHT OPERATIONS | 514.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7222-EA, 900084 | STRUCTURES & MECHANICS ENG'G SYSTEMS-CAD/CAE/CAM WORKSTATION UPGRADES | FLIGHT OPERATIONS | 170.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7234-EA, 900092 | CREW SYSTEMS ENGINEERING LABORATORY-ENHANCEMENT OF CAD/CAM SYSTEM | FLIGHT OPERATIONS | 850.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENTER LOCATION 7134-EA. 900094 | CREW SYSTEMS ENGINEERING LABORATORY-ENHANCEMENT OF CREW & THERMAL SYS DIV ANALYSIS SYS | FLIGHT OPERATIONS | 325.0 |

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| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE IRANSPORIAIION OPERAIIONS | JOHNSON SPACE CENIER LOCATION 7136-EA. 900106 | COMMUNICATIONS ENGINEERING SYSTEMS-REPLACE TRACKING & COMMUNICATIONS DIVISION VAX | FLIGHT OPERAIIONS | 350.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENIER LOCAIION 7257-EA. 900114 | ENGINEERING SIMULATIONS LABORATORY-AVIONIC SVSIEYS DEVELOP LAO HARDWARE PURCHASE | FLIGHT OPERATIONS | 500.0 |
| SPACE TRANSPORTATION OPERATIONS | JOHNSON SPACE CENIER LOCATION 7257-EA. 900118 | ENGINEERING SIMULATIONS LABORATORY-HARDWARE UPGRADES OF INTELLIGENT SVSIEYS LA8 | FLIGHT OPERATIONS | 1000.0 |
| SPACE TRANSPORTATION OPERA7IONS | JOHNSON SPACE CENIER LOCAIION 7157-EA. 900122 | ENGINEERING SIMULATIONS LABORATORY-REPLACE SYS DEVELOP'T & SIMULATION DIV COYPU7ER | FLIGHT OPERAIIONS | 768.0 |
| SPACE IRANSPORIAIION OPERATIONS | JOHNSON SPACE CENIER LOCATION 7157-EA. Yo0124 | ENGINEERING SIMULATIONS LABORATORY-SIMULATION SVSIEYS BRANCH ARRAY PROCESSOR | FLIGHT OPERAIIONS | 1500.0 |
| SPACE TRANSPORTATION OPERAIIUNS | JOHNSON SPACE CENIER LOCATION 7263-EA. 900134 | RESEARCH & ENGINEERING OFFICE AUTOMATION NETWORK AUGMENTATION | FLIGHT OPERATIONS | 250.0 |
| SPACE IRANSPURIAIION OPERATIONS | JOHNSON SPACE CENIEa LOCATION 7157-EA. 900184 | ENGINEERING SIMULATIONS LABORATORY-CYBER 840 5 YEAR LEASE/PURCHASE | FLIGHT OPERATIONS | 300.0 |
| SPACE TRANSPORTATION OPERAIIUNS | KENNEDY SPACE CENIER LOCATION 7602-03, 890022 | KENNEDY INVENIORV MANAGEMENT SYSTEM-KENNEDY INVENTORY YANAGEMENI SYSTEM | FLIGHT OPERAIIUNS | 517.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE TRANSPORTATION OPERATIONS | KENNEDY SPACE CENIER LOCATION 7612-A3, 890054 | ARTEMIS SYSTEM FOR PAYLOAD MANAGEMENT-ARTEMIS SYSIEY FOR PAYLOAD MANAGEMENT | LAUNCH AND LANDING OPERATIONS | 402.0 |
| SPACE TRANSPORTATION OPERATIONS | KENNEDY SPACE CFNIER LOCAIION 1601-AI. 890070 | COMPUTER SYSTEM SUPPORT | FLIGHT OPERATIONS | 1146.0 |
| SPICE TRANSPORTATION OPERATIONS | KENNEDY SPACE CFNIER LOCAIION 7601-S5, 900016 | IPS SOFTWARE DEVELOPMENT NETWORK-IPS SOFTWARE DEVELOPMENT NETWORK | LAUNCH AND LANDING OPERAIIONS | 775.1 |
| SPACE TRANSPORTATION OPERATIONS | KENNEDY SPACE CENICR LOCAIION 7609-LC, 900036 | ADVANCED LAUNCH OPERAIIONS SYSTEM-ADVANCED LAUNCH OPERAIIONS SYSTEM | LAUNCH AND LANDING OPERAIIONS | 650.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE STATION | HEADQUARTERS LOCATION 1001-T1, 890053 | TECHNICAL & MGT. INFORMATION SYSTEM-SPACE STATION PROGRAM SUPPORT | MANAGEMENT AND INTEGRATION | 0102.0 |
| SPACE STATION | LEWIS RESEARCH CENTER LOCATION 2201-04, 890110 | HIGH SPCEO COMPUTATIONAL SYSTEM-SUPER-COMPUTER HARDWARE | POWER SYSTEM | 1125.0 |
| SPACE STATION | MARSHALL SPACE FLIGHT CENTER LOCATION 6208-XX, 890130 | MATERIALS b PROCESSES-SPACE STATION ASSEMBLY AND OPERATIONS SIMULATOR | PRESSURIZEO YODULES | 750.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7285-FA, 890314 | SOFTWARE SUPPORT ENVIRONMENT-SSE DEVELOPMENT FACILITY HOST SYSTEM | MANAGEMENT AND INTEGRATION | 2555.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7305-OA, 900036 | SPACE STATION SUPPORT SYSTEMS-JSC TECHNICAL MANAGEMENT • INFORMATION SYSTEM • | OPERATIONS/ UTILIZATION DEVELOPMENT (OUCD) | 864.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7205-DA, 900042 | SPACE STATION SUPPORT SYSTEMS-SPACE STATION DEVELOPMENT LAB | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 400.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7205 DA, 900044 | SPACE STATION SUPPORT SYSTEMS-SPACE STATION INFORMATION SYSTEY • | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 1900.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7205-DA, 900046 | SPACE STATION SUPPORT SYSTEMS-SPACE STATION OPS SUPPORT CONTRACT TRANSITION • | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 500.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE STATION | JOHNSON SPACC CENTER LOCAIION 7205-DA, 900050 | SPACE STATION SUPPORT SVSIEMS-SYSTEM INTEGRATION & CONNECT IVIIV * | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCD) | 600.0 |
| SPACE STATION | JOHNSON SPACC CENTER LOCATION 7505-FA. 900052 | SPACE STATION SUPPORT SYSTEMS-SPACE STA SUPPORT AUTOMATIC DATA PROCCSSING H/W | OPERATIONS/ UTILI2ATION CAPABILITY DEVELOPMENT (OUCD) | 865.0 |
| SPACE STAIION | JOHNSON SPACC CENTER LOCATION 7205-FA, 900054 | SPACE STATION SIIPPORI SVSIEMS-SPACE STA SUPPORT CENTER SYSTEM | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCO) | 403 O |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7206-FA, 900062 | SPACE STATION TRAINING FACILITY-SPACE STA TRAINING FACILIIV COMPUTER ACQUISITION | OPERATIONS/ UTICIZATION CAPABILITY DEVELOPMENT (OUCD | 398.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7207-FA, 900066 | SPACE STATION CONTROI CENIER-SPACE STA CONTROL CENTER COMPUTER ACQUISITION | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCO | 4700.0 |
| SPACE SIAIION | JOHNSON SPACE CENTER LOCATION 7210-EA, 900068 | AVIONICS SYSTEMS-CONTINUOUS STELLAR TRACKING ATIITUDE REF (CSTAR) | ASSEMBLY HARDWARE/ SUBSYSTEMS | 370.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCAIION 7210-EA. 900070 | AVIONICS SYSTEMS-GUIDANCE, NAVIGATION. & CONTROL EMULATOR TESTBED | ASSEMBLY HARDWARE/ SUBSYSTEMS | 300.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7210-EA. 900078 | AVIONICS SYSTEMS-SPICE TRANSPORTATION SYS FLIGHT OAIA SYS UPGRADE | ASSEMBLY HARDWARE/ SUBSYSTEMS | 700.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7157-EA. 900110 | ENGINEERING SIMULATIONS LABORATORY-ADVANCED SYSTEM OEVELOPMENT LAB | ASSEMBLY HARDWARE/ SUBSYSTEMS | 600.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7257-EA. 900112 | ENGINEERING SIMULATIONS LABORATORY-AUGUMENT SPACE STA AUTO INTEG & ASSEM FACILITY SYS | ASSEMBLY HARDWARE/ SUBSYSTEMS | 1365.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7257-EA. 900120 | ENGINEERING SIMULATIONS LABORATORY-INTELLIGENT SYSTEMS BRANCH SYSTEM AUTOMATION | ASSEMBLY HARDWARE/ SUBSYSTEMS | 400.0 |
| SPACE STATION | JOHNSON SPICE CENTER LOCATION 7257-LA. 900128 | ENGINEERING SIMULATIONS LABORATORY-SIMULATION SYSTEMS BRANCH PURCHASE/AUGMENTATION | ASSEMBLY HARDWARE/ SUBSYSTEMS | 500.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7283 KA, 900158 | JSC SPACE STA PROJ OFF OATA | MANAGEMENT AND INTEGRATION | 4431.0 |
| SPACE STATION | JOHNSON SPACE CENTER LOCATION 7283-KA, 900160 | JSC SPACE STA PROJ OFF OAIA SUPPORT SYST-DATA SIPPORT SYSTEM TMIS-COMPATIBLE HARDWARE | MANAGEMENT A M INTEGRATION | 1984.0 |
| SPACE STATION | KENNEDY SPACE CENTER LOCATION 7604-EA, 890056 | SPACE STATION COMPUIER AIDED | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCO) | 5116.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE STATION | KENNEDY SPACE CENIFR LOCATION 7609-FD, 890058 | SPACE STATION SOFTWARE DEVELOPYENI FACIL-SPACE STATION SOFIWARE DEVELOPYENI FACILITY | OPERATIONS/ UTILIZATION CAPABILITY DEVELOPMENT (OUCO) | 8000.0 |
| SPACE STATION | KENNEDY SPACE CENIER LOCATION 7612-1A, 890060 | SPACE STATION LOGISTICS | OPERATIONS/ UTILIZATION CAPABILITY OEVELOPYENI (OUCD) | 2023.0 |
| SPACE STATION | KENNEDY SPACE CENIER LOCAIION 7609-FB, 900030 | SPACE STATION TEST, CONTROL & MONITOR SY-SPACE STATION TEST CONTROL & MONITOR SYSTEM | OPERATIONS/ UTILIZATION CAPAHILITY OLVLLOPYENI (OUCO) | 10000.0 |
| SPACE STATION | KFNNCVY SPACE CENIER LUCAIION 7610-KC, 900038 | SPACF STATION MANAGEMENT INFORMATION SYS-SPACE STATION MANAGEMENT INFORMATION SYSTEM | OPERATIONS/ UTILIZATION CAPABILITY OEVELOPYENI (OUCD) | 1114.0 |
| SPACE STATION | KENNEDY SPACE CENIER LOCATION 7612-02, 900046 | PAVLOAO DATA MANAGEMENT SYSTEM-PAYLOAD DATA MANAGEMENT SYSTEM | OPERATIONS/ UTILIZATION CAPABILITY OEVELOPYENI (OUCD) | 1500.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE STATION | GODDARD SPACE FLIGHT CENTER BLDG. 11, 51-90-01 | MINI MASTER ARMS | ROBOTICS LABORATORY INTEGRATION EVALUATION. | 500.0 |
| SPACE STATION | GODDARD SPACE FLIGHT CENTER BLDG. 11, 51-90-02 | LASER TRACKER | CALIBRATION OF LABORATORY ROBOTS AND EVALUATION OF LASER TRACKERS. | 250.0 |
| SPACE STATION | GODDARD SPACE FLIGHT CENTER BLDG. 11, 51-90-03 | SPACE STATION MOCKUP CONTROLLER | SERVES FTS ROBOT CONTROLLER IN SPCE STATION NODE. | 250.0 |
| SPACE STATION | GODDARD SPACE FLIGHT CENTER: BLDG. 11, 51-90-04 | SOFTWARE DEVELOPMENT SYSTEM | DESIGN, CODE AND TEST ROBOT CONTROL SYSTEMS. | 300.0 |
| SPACE STATION | GODDARD SPACE FLIGHT CENTER BLDG. 11, 51-90-05 | WORKSTATION ROBOT INTERFACE | NETWORK WORKSTATIONS TO ROBOTS & SOFTWARE DEVELOPMENT SYSTEM. | 250.0 |
| SPACE STATION | KENNEDY SPACE CENTER CENTERWIDE, 76-90-01 | COVERED SHIPPING FIXTURE | TRANSPORT SPACE STATION MODULES TO AND FROM MANUFACTURING SITES, WORK PACKAGING CENTER AND LAUNCH SITES. | 156.0 |
| SPACE STATION | KENNEDY SPACE CENTER SPACE STATION PROCESSING FACILITY, 76-90-02 | TRANSPORT & DOLLIES | TRANSPORT SPACE STATION MODULES WITHIN THE PROCESSING FACILITY. | 54.0 |
| SPACE STATION | KENNEDY SPACE CENTER SPACE STATION PROCESSING FACILITY, 76-90-03 | GASEOUS HELIUM DISTRIBUTION SYSTEM | PROVIDE THE SPACE STATION MODULES WITH LEAK CHECK AND BOTTLE FILL DURING THE INTEGRATION, TESTING AND PROCESSING OPERATIONS. | 106.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUHBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE STATION | KENNEDY SPACE CENTER PACE STATION PROCESSING FACILITY 76-90-04 | 60 Hz ELECTRICAL POWER SYSTEM | DISTRIBUTE ELECTRICAL POWER THROUGHOUT SPACE STATION PROCESSING FACILITY | 1,350.0 |
| SPACE STATION | KENNEDY SPACE CENTER SPACE STATION PROCESSING FACILITY 76-90-05 | DIGITAL OPERATION INTERFACILITY COMMUNICATION SYSTEM | INFORM HEALTH/STATUS OF THE SYSTEMS BEING OPERATED. | I,861.0 |
| SPACE STATION | KENNEDY SPACE CENTER SPACE STATION PROCESSING FACILITY 76-90-06 | WIDEBAND TRANSMISSION | PROVIDE WIDEBAND CAPABILITIES FOR VIDEO, DIGITAL, AND ANALOG DATA FROM THE SSPF TO THE COMMUNICATION DIBTRIBUTION AND BWITHINC CENTER. | 158.0 |
| SPACE STATION | KENNEDY SPACE CENTER SPACE STATION PROCESSING FACILITY 76-90-07 | SPECIAL POWER | SIMULATE ON ORBIT POWER FOR VERIFICATION AND INTEGRATION. | 810.0 |
| SPACE STATION | KENNEDY SPACE CENTER SPACE STATION PROCESSING FACILITY 76-90-00 | ELEMENT ROTATION STAND | ESTABLISH VARIABLE AXIS. | 65.0 |
| SPACE STATION | KENNEDY SPACE CENTER SPACE STATION PROCESSING FACILITY 76-90-09 | ELECTRICAL-MECHANICAL INTERFACE TEST EQUIPMENT | HATING OF GROUND SUPPORT EQUIPMENT/SPACE STATION UODULE INTERFACES FOR CHECKOUT. | 293.0 |
| SPACE STATION | KENNEDY SPACE CENTER SPACE STATION PROCESSING FACILITY 76-90-10 | INSTRUMENTATION CABLING | SPACE STATION MODULE AND EXPERIMENT PROCESSING. | 1,306.0 |
| SPACE STATION | KENNEDY SPACE CENTER SPACE STATION PROCESSING FACILITY, 76-90-11 | DOCKING RING VERIFICATION | VERIFY DOCKING RING MECHANISM UECHANICAL AND ELECTRICAL INTERFACES DURING GROUND | 25.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY (90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE STATION | KENNEDY SPACE CENTER SPACE STATION PROCESSING FACILITY 76-90-12 | GASEOUS NITROGEN DISTRIBUTION PRESSURE TESTING. | MODULE SERVICING AND LEAK. | 1229.0 |
| SPACE STATION | KENNEDY SPACE CENTER SPACE STATION PROCESSING FACILITY 76-90-13 | AMMONIA SYSTEM | PROCESSING OF SOME ELEMENTS UNDERGOING CHECKOUT IN THE SSPF. | 1273.0 |
| SPACE STATION | KENNEDY SPACE CENTER SPACE STATION PROCESSING FACILITY 76-90-14 | ENVIRONMENTAL CONTROL SYSTEM (ECS) | SPACE STATION CABIN AND AVIONICS COOLING. | 1486.0 |
| SPACE STATION | JOHNSON SPACE CENTER BLDG. 30, ADMIN. WING 72-90-01 | PROCESSING SYSTEM FOR OPAS DEVELOPMENT | PROVIDE A COMMON EXECUTION ENVIRONMENT FOR THE OPERATIONS PLANNING AND ANALYSIS SYSTEM | 2100.0 |
| SPACE STATION | JOHNSON SPACE CENTER BLDG. 35, 72-90-02 | SPACE STATION CONTROL CENTER AND TRAINING FACILITY | SUPPORT THE DEVELOPMENT, TRAINING, AND OPERATIONAL NEEDS OF SPACE STATION GROUND SYSTEM. | 9990.0 |
| SPACE STATION | JOHNSON SPACE CENTER BLDG. 10, EAST WING, 72-90-03 | MILLING MACHINE | REPLACE OBSOLETE 10 FT. PLANER FOR AEROSPACE WORLD PURPOSES. | 101.5 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE APPLICATIONS | GODDARD SPACE FlIGHT CENTER LOCATION 5101-AA, 900014 | SPACE AND EARTH SCIENCES COMPUTING CENTE-SPACE AH) EARTH SCIENCES COMPUTING CENTER | DATA SYSTEMS | 4333.0 |
| SPACE APPLICAIIONS | GODDARD SPACE FLIGHT CtNIER LOCAIION 5101-AB, 900016 | NATIONAL SPICE SCIENCE DATA CENTER SYSTE-NATIONAL SPACE SCIENCE DAIA CENTER | DATA SYSTEMS | 387.0 |
| SPACE APPLICATIONS | JET PROPULSION LABORATORY LOCATION 5500- , 900012 | JPL - ADP ACTIVITY-ACTIONS WITH CUMULATIVE COSTS LESS THAN $1M | APPL SVSIEYS ANALYSES AND STUDIES | 2561.0 |
| SPACE APPLICAIIONS | JET PROPULSION LABORATORY LUCAIION 5500- , 900014 | JPL - ADP ACTIVITY-WORKSTATIONS ● SUPER- MINI'S FOR TOPEX | OCEAN TOPOGRAPHY EXPERIMENT (TOPEX) | 300.0 |
| SPACE APPLICAIIONS | JET PROPULSION LABORATORY LOCATION 5511-AA, 900016 | ADMINISTRATIVE APPLICATIONS SYSTEMS-IBM 3090-120E UPGRADE FOR ADMINISTRATIVE SUPPORI | APPL SYSTEMS ANALYSES AND STUDIES | 1004.0 |
| SPACE APPLICAIIONS | JET PROPULSION LABORATORY LOCATION 5511-AA, 900018 | ADMINISTRATIVE APPLICAIIONS SYSTEMS-IBM 3090-120; ADMIN. COMP SERVICES SUPPORT | APPL SVSIEYS ANALYSES AND STUDIES | 388.0 |
| SPACE APPLICAIIONS | JET PROPULSION LABORATORY LOCATION 5511-CN, 900020 | COMMUNICATIONS AND NETWORM EQUIPMENT-INST. LOCAL AREA NETWORK SUPPORT | APPL SYSTEMS ANALYSES AND STUDIES | 331.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE APPLICATIONS | JET PROPULSION LABORATORY LOCATION 5516-DR, 900056 | SPACE MISSION DATA REDUCTION & RECORDS-IBM 3090-150; FLIGHT PROJ SUPPORT | APPL SYSTEMS ANALYSES AND STUDIES | 575.0 |
| SPACE APPLICATIONS | JET PROPULSION LABORATORY LOCATION 5517-SS, 900068 | ENGINEERING SERVICES SUPPORT SYSTEM-CAD/CAE WORKSTATIONS | APPL SYSTEMS ANALYSES AND STUDIES | 500.0 |
| SPACE APPLICATIONS | JET PROPULSION LABORATORY LOCATION 5517-SS, 900070 | ENGINEERING SERVICES SUPPORT SYSTEM-VAX RXXX SERIES PROCESSOR SCIENTIFIC PROCESSING | APPL SYSTEMS ANALYSES AND STUDIES | 500.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| PLANETARY EXPLORATION | JET PROPULSION LABORATORY LOCATION 8516-DP, 800052 | FLIGHT PROJ. DEVELOPMENT & PROTOTYPE SYS-MARS OBSERVER WORKSTATIONS | MISSION OPERATIONS & DATA ANALYSIS | 800.0 |
| PLANETARY EXPLORATION | JET PROPULSION LABORATORY LOCATION 8516-DP, 800054 | FLIGHT PROJ DEVELOPMENT & PROTOTYPE SYS-MAGELLAN SFOC ADAPTION SYSTEM | MISSION OPERATIONS & DATA ANALYSIS | 2000.0 |
| PLANETARY EXPLORATION | JET PROPULSION LABORATORY LOCATION 8516-SE, 800058 | FLIGHT PROJ SCIENCE & ENG. SYSTEMS-1100/81A CPU WITH DCP/40 FLIGHT PROJECT SUPPORT | GALILEO | 286.0 |
| PLANETARY EXPLORATION | JET PROPULSION LABORATORY LOCATION 8516-SE, 800060 | FLIGHT PROJ SCIENCE & ENG. SYSTEMS-1100/81B CPU WITH DCP/40 FLIGHT PROJECT SUPPORT | GALILEO | 286.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| PHYSICS AH) ASTRONOMY | AWLS RESEARCH CfNTER LOCATION 210M-OO, 890242 | SCIENCE AND APPLICATIONS AIRCRAFT DIVISI-SYSIEM REPLACEMENT OMMADA | AIRBORNE RESEARCH | 500.0 |
| PHYSICS AH) ASIRONOYV | AYES RESEARCH CtNIER LOCATION 210M-OO, 900268 | SCIENCE AND APPLICATIONS AIRCRAFT DIVISI-IMAGE PROCESSING WORKSTATIONS VO12 | AIRBORNE INSTRUMENT RESEARCH PROGRAM | 300.0 |
| PHYSICS AM) ASIRONOYV | GODDARD SPACE FLIGHT CENTER LOCATION 5103-CA, 900054 | S/C INTEGRATION AND CONTROL SYSTEM-S/C INTEGRATION AND CONIROL SVSIEM | HUBBLE SPACE TELESCOPE MAINT., REFURB. & NEY SCIENCE INSTRU.111FALSE | 800.0 |
| PHYSICS AND ASIRONOMV | MARSHALL SPACE FLIGHT CENTER LOCATION 6201- . 890014 | SYS DEV 6 IMPLMIN, MIS MULTIPLE SYSTEMS-MGMNT INFORMATION SYS PERIPHERALS AND TERMINALS | HUBBLE SPACE TELESCOPE (HST) DEVELOPMENT | 273.0 |
| PHYSICS AND ASIRONOYV | MARSHALL SPACE FLIGHT CENTER LUCAllUN 6209-69, 890150 | SYSTEMS ANALYSIS & INTEGRATION-PAYLD CREW TRAINING CUYPL DEVEL & OPER PROC SYS | SPACELAB MISSION MGT--APPROVED MISSN | 250.0 |
| PHYSICS AND ASIRONOYV | MARSHALL SPACE FLIGHT CENTER LOCATION 6201-26, 890186 | SYSTEMS DEVELOPMENT & IMPLEMENTATION MIS-MGMNT INFORMATION SYS HOST AUGMENTATION | HUBBLE SPACE TELESCOPE (HST) DEVELOPMENT | 1479.0 |
| PHYSICS A M ASTRONOMY | MARSHALL SPACE FLIGHT CENIER LOCATION 6200- . 900012 | WSFC ADP ACTIVITY-ACTION WITH 1 YR COST <$250K & CUM COST <$1M | HUBBLE SPACE TELESCOPE (HST) DEVELOPMENT | 3460.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| LIFE SCIENCES | AMES RESEARCH CENTER LOCATION 21ED-01, 890032 | INFORMATION & COMMUNICATIONS SYSTEMS D-1-CENTERWIDE & MAIL COMPUTER EDNDEV | LIFE SCIENCES SR&T | 270.3 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| EXPENDABLE LAUNCII VEHICLES | JOHNSON SPACE CCNIFR LOCATION 7106-FA. 900060 | SPACE STATION TRAINING FACILITY-SPACE STA TRAINING FACILITY ADP HARDWARE | SCOUT PROCUREMENT | 622.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER LOCATION 6206- . 890090 | SOFTWARE & DATA MANAGEMENT, INTERACTIVE GRAPHICS DESIGN SYS CENTRAL SYS REQUIREMENT | RESEARCH & TEST OPERATIONS | 780.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER LOCATION 6206-CU, 890104 | SOFTWARE & DATA MANAGEMENT-INTERACTIVE GRAPHICS DESIGN SYS MODIF BLDG 4487 | RESEARCH & TEST OPERATIONS | 800.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER LOCATION 6206-06, 890118 | SOFTWARE & DATA MANAGEMENT-ANALOG COMPUTER REPLACEMENTS, BLDG 4487 | RESEARCH & TEST OPERATIONS | 466.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER LOCATION 6206-49, 890120 | SOFTWARE & DATA MANAGEMENT-ORBITAL MANEUVERING VEHICLE DOCKING SIMLAIN HDWR | ORBITAL MANEUVERING VEHICLE (OMV) | 300.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER LOCATION 6207-72, 890116 | STRUCTURES AND DYNAMICS-INTERACTIVE GRAPHICS DESIGN SYSTEM, BLDG 4610 | RESEARCH & TEST OPERATIONS | 460.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER LOCATION 6208-45, 890132 | MATERIALS & PROCESSES-INTERACTIVE GRAPHICS DESIGN SYS. MODIF. BLDG 4101 | RESEARCH & TEST OPERATIONS | 400.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER LOCATION 6209-GD, 890144 | SYSTEMS ANALYSIS & INTEGRATION-INTERACTIVE GRAPHICS DESIGN SYSTEM MODS BLDG 4610 | RESEARCH & TEST OPERATIONS | 400.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER LOCATION 6210-GD, 890154 | PROPULSION-INTERACTIVE GRAPHICS DESIGN SYS MODS BLDG 4610 | RESEARCH & TEST OPERATIONS | 460.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER LOCATION 6212-XX, 890162 | TEST-INTERACTIVE GRAPHICS DESIGN SYSTEM, BLDG 4708 | RESEARCH & TEST OPERATIONS | 350.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER LOCATION 6210-XX, 090160 | PROPULSION-HIGH SPEED DATA TRANSFER SYS FOR EAST TEST AREA | RESEARCH & TEST OPERATIONS | 300.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER LOCATION 6201-01, 890178 | ENGINEERING ANALYSIS & DATA SYSTEM. EADS-ENGINEERING ANALYSIS & DATA SYSTEM | RESEARCH & TEST OPERATIONS | 1,152.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | JOHNSON SPACE CENTER LOCATION 7157-EA. 900116 | ENGINEERING SIMULATIONS LABORATORY-CLASS VI | RESEARCH & TEST OPERATIONS | 9800.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER LOCATION 7604-P3, 890028 | COMPUTER AIDED DESIGN/ ENGINEERING SYSTEM-COMPUTER AIDED DESIGN/ENGINEERING SYSTEM | LAUNCH SYSTEMS OPERATIONS | 1187.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER LOCATION 7605-F4, 900020 | REAL TIME DATA SYSTEM-REAL TIME DATA SYSTEM | MULTIMISSION & PAYLOAD SUPPORT EQUIP | 300.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER LOCATION 7608-KA, 900028 | DIGITAL OPERATIONAL INTERCOM SYSTEM. DEV-DIGITAL OPERATIONAL INTERCOM SYSTEM | MULTIMISSION & PAYLOAD SUPPORT EQUIP | 818.0 |

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SUMMARY OF MAJOR EQUIPMENT ACQUISITION OBLIGATIONS INCLUDED IN FY 1990 BUDGET

| PROGRAM BUDGET LINE ITEM | RECEIVING INSTALLATION BUILDING LOCATION, AND ADP/EAD CONTROL NUMBER | EQUIPMENT DESCRIPTION | PROGRAMMATIC PURPOSE | FY(90) OBLIGATIONS ($ IN THOUSANDS) |
|---|---|---|---|---|
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | KENNEDY SPACE CENTER KSC INDUSTRIAL AREA, 76-90-20 | OIS-D | COMPATIBILITY WITH THE REST OF KSC'S OIS-D SYSIEM. | 3362.0 |
| SPACE TRANSPORTATION CAPABILITY DEVELOPMENT | MARSHALL SPACE FLIGHT CENTER, EAST TEST AREA, TEST POSITION 116, NEAR BLDG. 4503, 62-90-01 | VESSEL, LH2/LCH4, 5000 GALLON 8,500 PSI | TESTING OF LARGE ENGINE COMPONENTS TO ESTABLISH A DATABASE FOR ENGINES ON TIIE ADVANCED SOUND SYSTEM PROGRAM. | 4000.0 |

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

**FISCAL YEAR 1990 ESTIMATES**

**SUMMARY OF CONSULTING SERVICES ESTIMATES**

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | | (Thousands of Dollars) | | |
| Research and Program Management | | | | |
| Consultants Employed by NASA......... | 622 | 1,300 | 1,300 | 1,300 |
| Contractual Services................. | 999 | 400 | 400 | 400 |
| Subtotal......................... | 1,621 | 1,700 | 1,700 | 1,700 |
| Research and Development | | | | |
| Contractual Services................. | 2,065 | 2,500 | 2,500 | 2,500 |
| Total, NASA...................... | 3.686 | 4.200 | 4,200 | 4,200 |

NASA uses paid consultants and consulting services contracts to provide advice and expert input in addition to or beyond that available from its in-house, civil service workforce. Management controls are established which assure that before entering into either a consultant services arrangement with an individual or consulting services contract, there is ample justification presented and the action is approved at top management levels. The use to which these services will be put is as follows:

| | 1988 Actual | 1989 Budget Estimate | 1989 Current Estimate | 1990 Budget Estimate |
|---|---|---|---|---|
| | (Thousands of Dollars) | | | |
| Research and Proeram Management | | | | |
| Consultants Employed by NASA......... | 1,622 | 1,300 | 1,300 | 1,300 |

NASA hires experts and consultants to provide expert advice and input on the selection of experiments for future space missions. The use of contract employees, in addition to NASA civil service personnel, provides the agency with an independent view that assures the selection of experiments likely to have the greatest scientific merit. Other individuals are employed to provide independent looks at technical and functional problems in order to give top management the widest possible range of views before making major decisions.

| | | | | |
|---|---|---|---|---|
| Contractual Services................ | 999 | 400 | 400 | 400 |

NASA contracts with consulting services firms for studies of management policies and programs in such areas as ADP, EEO, and the NASA Management Study group (S.C. Phillips Study). In 1990, studies will continue to provide independent assessment and expertise.

Research and Develoument

| | | | | |
|---|---|---|---|---|
| Contractual Services.................. | 2,065 | 2,500 | 2,500 | 2,500 |

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 programmatic thrust is available. Funds are required to provide external expertise and input into organizaitonal decisions, and evaluation of program effectiveness. In 1990, 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.

1990 CONGRESSIONAL BUDGET
DETAIL OF PERMAMENT POSITIONS

NASA AGENCY

| | FY 1988 ACTUAL | FY 1989 ESTIMATE | FY 1990 ESTIMATE |
|---|---|---|---|
| Executive level II | 1 | 1 | 1 |
| Executive level III | 1 | 1 | 1 |
| Executive level V | 1 | 1 | 1 |
| **Subtotal** | 3 | 3 | 3 |
| ES-6 | 47 | 52 | 54 |
| ES-5 | 112 | 123 | 126 |
| ES-4 | 260 | 282 | 293 |
| ES-3 | 41 | 52 | 50 |
| ES-2 | 19 | 21 | 21 |
| ES-1 | 10 | 13 | 12 |
| | 489 | 543 | 556 |
| GS-18 | 1 | 1 | 1 |
| GS-16 | 6 | 6 | 6 |
| GS/GM-15 | 1,931 | 2,030 | 2,084 |
| GS/GM-14 | 3,189 | 3,274 | 3,330 |
| GS/GM-13 | 4,924 | 5,075 | 5,301 |
| GS-12 | 3,037 | 3,154 | 3,254 |
| GS-11 | 2,177 | 2,289 | 2,323 |
| GS-10 | 290 | 293 | 294 |
| GS-09 | 1,312 | 1,388 | 1,388 |
| GS-08 | 294 | 309 | 313 |
| GS-07 | 961 | 1,016 | 1,206 |
| GS-06 | 617 | 633 | 653 |
| GS-05 | 1.163 | 1, 180 | 1,204 |
| GS-04 | 340 | 348 | 370 |
| GS-03 | 82 | 88 | 89 |
| GS-02 | 15 | 17 | 17 |
| | 20,339 | 21,101 | 21,833 |
| SPECIAL UNGRADED POSITIONS ESTABLISHED BY THE NASA ADMINISTRATOR | 10 | 11 | 11 |
| UNGRADED POSITIONS | 1,069 | 1,045 | 930 |
| TOTAL PERMAMENT POSITIONS | 21,910 | 22,703 | 23,333 |
| UNFILLED POSITIONS, END OF YEAR | 0 | 0 | 0 |
| TOTAL PERMAMENT EMPLOYMENT, EOY | 21,910 | 22,703 | 23,333 |

## 1990 CONGRESSIONAL BUDGET

## PERSONNEL SUMMARY

| | FY 1988 | FY 1989 | FY 1990 |
|---|---|---|---|
| AVERAGE GS/GM GRADE | 11.5 | 11.5 | 11.4 |
| AVERAGE ES SALARY | $73,543 | $76,087 | $76,674 |
| AVERAGE GS SALARY | $40,841 | 542,228 | $42,322 |
| AVERAGE SALARY OF SPECIAL UNGRADED POSITIONS ESTAB-LISHED BY NASA ADMINISTRATOR | $65,878 | $67,405 | $67,948 |
| AVERAGE SALARY OF UNGRADED POSITIONS | $30,998 | $32,275 | $33,739 |

DATE DUE

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