LAUNCH VEHICLES AND PAYLOAD OPERATIONS

FISCAL YEAR 2000 ESTIMATES

BUDGET SUMMARY

OFFICE OF SPACE FLIGHT **PAYLOAD UTILIZATION AND OPERATIONS**

SUMMARY OF RESOURCES REQUIREMENTS

	FY 1998 OPLAN 9/29/98	FY 1999 OPLAN 12/22/98	FY 2000 PRES BUDGET	Page Number
	(Thousands of Dollars)			
Spacelab	9,100	--	--	LVPO 2-3
Payload processing and support	46,700	39,200	49,300	LVPO 2-5
Expendable launch vehicle support	--	31,500	28,600	LVPO 2-8
Advanced projects	46,700	10,000	6,000	LVPO 2-10
Engineering and technical base	102,900	96,300	85,200	LVPO 2-14
Total	205,400	177,000	169,100	
Distribution of Program Amount by Installation				
Johnson Space Center	83,209	35,500	37,800	
Kennedy Space Center	52,541	67,600	79,000	
Marshall Space Flight Center	53,450	49,600	41,500	
Stennis Space Center	1,500	1,500	1,600	
Ames Research Center	500	--	--	
Langley Research Center	132	--	--	
Glenn Research Center	750	--	--	
Goddard Space Flight Center	9,800	12,800	8,200	
Headquarters	3,518	10,000	1,000	
Total	205,400	177,000	169,100	

PROGRAM GOALS

There are several goals in the Payload Utilization and Operations budget. They range from supporting the processing and flight of Space Shuttle payloads and NASA payloads launched from Expendable Launch Vehicles (ELV), to ensuring maximum return on the research investment, to reducing operations costs, to continuing to implement flight and ground systems improvements, and to supporting strategic investments in advanced technology needed to meet future requirements.

STRATEGY FOR ACHIEVING GOALS

The principal areas of activity in the Payload Utilization and Operations program are: 1) provide safe and efficient payload preparations and launch and landing services while reducing costs of Space Shuttle-related services; 2) provide mission planning, integration and processing for science application missions utilizing –the Multiple-Purpose Experiment Support Structures (MPESS) and payload pallets; 3) within Advanced Projects, identify and develop advanced technology to support Shuttle, International Space Station (ISS) and future Human Exploration and Development of Space programs to improve safety and reduce costs, promote space commercialization and technology transfer, and manage the agency's Orbital Debris program; and 4) within Engineering and Technical Base (ETB), empower a core workforce to operate Human Space Flight laboratories, technical facilities, and test beds, and stimulate science and technical competence in the United States. The Payload Utilization and Operations budget reflects a commitment to meet a wide array of programs. This includes Space Shuttle and science missions, flight hardware development and integration, space flight safety projects, and maintenance of an institutional base from which to perform NASA programs at reduced cost through re-engineering, consolidation and operational efficiency processes. Beginning in FY 1999, Expendable Launch Vehicle (ELV) mission support was consolidated and transferred from Mission to Planet Earth and Space Science to provide more focused and efficient management of launch services to be located at the Kennedy Space Center and Cape Canaveral Air Force Base in Florida. The highly successful Spacelab program has been completed.

BASIS OF FY 2000 FUNDING REQUIREMENT

SPACELAB

	FY 1998	FY 1999	FY 2000
		(Thousands of Dollars)	
Spacelab	9,100	--	--

PROGRAM GOALS

The highly successful Spacelab program has been completed.

STRATEGY FOR ACHIEVING GOALS

The Spacelab program has been completed. Spacelab hardware has been transferred to the National Air and Space Museum, to other NASA programs, and to the European Space Agency (on loan). The Program has properly disposed of any residual hardware. The last Spacelab flight (Neurolab) was launched in April 1998, with the expectation that the more permanent science laboratory flown by the International Space Station (ISS) would soon be available. In FY 1998, Spacelab operations funding for GAS, Hitchhiker payloads and the FSS, as well as the Pallets and Multi-Purpose Experiment Support Structures (MPESS) was transferred to the Payload Processing and Support budget.

SCHEDULE AND OUTPUTS

Spacelab Missions	Plan	Actual
United States Microgravity Payload (USMP-4)	October 1997	November 1997
Space Life Sciences Laboratory-4 (Neurolab)	March 1998	April 1998

	FY 1998		FY 1999		FY 2000
Flight Hardware Utilized	Plan	Actual	Plan	Revised	Plan
Long Module	1	1	--	--	--
Multi-Purpose Experiment Support Structures (MPESS)	1	1	--	--	--
Hitchhiker Experiments	8	7	--	--	--
Get Away Special Payloads	7+TBD	14	--	--	--
Contractor Workforce					
KSC (Boeing)	78	93	--	--	--
MSFC (Boeing)	70	78	--	--	--

ACCOMPLISHMENTS AND PLANS

In FY 1998, the Spacelab program supported the requirements and provided the infrastructure to fly the United States Microgravity Payload (USMP-4) and Neurolab missions. Because the Spacelab program was terminated in FY 1998, the Hitchhiker, GAS, and FSS programs were transferred to the Payload Carriers and Support program. Following the Neurolab mission, the final Spacelab program phase-down began, with the transfer of one module to the National Air and Space Museum, the transfer of considerable program hardware to other NASA programs, and disposal of residual hardware.

BASIS OF FY 2000 FUNDING REQUIREMENT

PAYLOAD PROCESSING AND SUPPORT

	FY 1998	FY 1999	FY 2000
		(Thousands of Dollars)	
Payload processing and support	46,700	39,200	49,300

PROGRAM GOALS

The primary goal for payload processing and support is to safely and efficiently assemble, test, checkout, service, and integrate a wide variety of spacecraft and space experiments that will fly on the Space Shuttle.

STRATEGY FOR ACHIEVING GOALS

The payload processing and support program provides the technical expertise, facilities and capabilities necessary to perform payload buildup; test and checkout; integration and servicing of multiple payloads; transportation to the Space Shuttle; and integration and installation into the Space Shuttle. Included in this program are operational efficiencies gained to date, as well as additional anticipated efficiencies to reduce cost and improve customer satisfaction. Efficiencies already in place have reduced processing time and error rate. Due to the termination of the Spacelab program in FY 1998, the Hitchhiker, Get Away Special (GAS) and Flight Support System (FSS) program became part of the Payload Processing and Support program in FY 1998.

Payload processing and support also funds smaller secondary payloads like the Get-Away Specials (GAS) and Hitchhiker payloads. The GAS payloads are research experiments that are flown in standard canisters, which can fit either on the side wall of the cargo bay or across the bay on the GAS bridge. They are the simplest of the small payloads with limited electrical and mechanical interfaces. Approximately 155 GAS payloads have been flown. The Hitchhiker payloads are the more complex of the smaller payloads, and provide opportunities for larger, more sophisticated experiments. The Hitchhiker system employs two carrier configurations: (1) a configuration on the orbiter payload bay side wall and (2) a configuration across the payload bay using a multi-purpose experiment support structure (MPESS). During the mission, the Hitchhiker payloads can be controlled and data can be received using the aft flight deck computer/standard switch panels or from the ground through the payload operations control center (POCC).

Payload analytical integration is the responsibility of the Payload Projects Office at the Marshall Space Flight Center (MSFC), and supported by a contract with Boeing. Physical payload integration and processing is the responsibility of the Payload Management and Operations Office at the KSC, and also supported by a contract with Boeing.

Another item funded in payload processing and support is the Flight Support System (FSS). The FSS consists of three standard cradles with berthing and pointing systems along with avionics. It is used for on-orbit maintenance, repair, and retrieval of spacecraft. The FSS is used on the Hubble Space Telescope (HST) repair/revisit missions.

SCHEDULE AND OUTPUTS

	FY 1998		FY 1999		FY 2000
Missions Supported	Plan	Actual	Plan	Revised	Plan
Space Shuttle Missions	6	4	8	6	8
Spacelab Payloads	1	1	--	--	--
Hitchhiker Experiments, includes CAP/SEM/HH Jr.	6+TBD	7	4+TBD	13	4-6
Get-Away Special Payloads	7+TBD	14	TBD	5	10-20
Spacehab/Mir Missions	2	2	1	2	--
Other Major Payloads	4	3	--	8	8
Other Secondary Payloads	21	22	TBD	34	0
Multi-Purpose Experiment Support Structure (MPESS)	--	1	--	--	--
Pallets	--	--	--	2	8
Expendable Launch Services	8	5	8	13	4
Number of Payload Facilities Operating at KSC	6	6	6	6	6
KSC Payload Ground Operations (PGOC) Workforce	366	366	312	341	334

ACCOMPLISHMENTS AND PLANS

The Hitchhiker, GAS, and FSS programs, as well as the Pallets and Multi-Purpose Experiment Support Structures (MPESS) from the Spacelab program, were transferred to the Payload Carriers and Support program in FY 1998.

The Payload Carriers and Support provided the payload carrier and integration activities for the USMP-4 mission. Launch and landing payload support activities encompass four Space Shuttle missions and payload processing support activities and facilities for nine manifested major payloads, including the last two Spacehab missions to Mir and one ISS flight (first element launch). Over 25 manifested major and secondary payloads were also supported. Reimbursable funds of $719,000 were received in FY 1998 to cover processing costs for GAS and Hitchhiker payloads.

In FY 1999, Payload Carriers and Support will provide the payload carriers and associated avionics for the Shuttle Radar Topography Mission (SRTM) and the HST Orbital Systems Test (HOST). Payload integration activities will also be provided for SRTM. Launch and landing payload support activities will be provided for six Space Shuttle missions, including the SRTM and a science transition mission for Spacehab (STS-95). Payload processing support activities and facilities will be provided for ten manifested major payloads, including four ISS flights. A number of secondary payloads will also be supported, including 4 payloads to be ejected from Hitchhiker carriers. Reimbursable funds of $759,000 are expected to be received in FY 1999 to cover processing costs of GAS and Hitchhiker payloads.

In FY 2000, Payload Carriers and Support will provide pallets for Hubble Space Telescope (HST) Servicing Mission 3 and for three ISS assembly flights. Launch and landing payload support activities will be provided for eight Space Shuttle missions,

encompassing payload processing support activities and facilities for 14 major payloads, including seven ISS assembly and utilization flights. A number of secondary payloads will also be supported. One of the FSS cradles will support the spacecraft and rocket motor for the Triana mission, scheduled to launch in FY 2001. Reimbursable funds of $786,000 are expected to be received in FY 2000 to cover processing costs for GAS and Hitchhiker payloads.

BASIS OF FY 2000 FUNDING REQUIREMENT

EXPENDABLE LAUNCH VEHICLE SUPPORT

	FY 1998	FY 1999	FY 2000
		(Thousands of Dollars)	
Expendable Launch Vehicle Support	--	31,500	28,600

PROGRAM GOALS

The goals of the Expendable Launch Vehicle (ELV) mission support program are to: (1) enhance probability of mission success and on-time cost effective launch services for NASA missions undertaken in support of NASA's strategic plan; (2) provide comprehensive advanced mission analysis and feasibility assessments for NASA payload customers; (3) increase efficiency in launch site operations and countdown management; and (4) provide low cost secondary payload opportunities.

STRATEGY FOR ACHIEVING GOALS

NASA has consolidated ELV management and acquisition of launch services at Kennedy Space Center (KSC). Effective in FY 1999, all funding for mission support will likewise be transitioned from the Office of Space Science and the Office of Mission to Planet Earth to the Office of Space Flight, consistent with assignment of responsibility for ELV management to OSF.

KSC is responsible for acquiring requisite launch services to meet all NASA requirements and for increasing the probability of mission success through focused technical insight of commercially provided launch services. A core team of civil servants located primarily at KSC performs technical management of this program supported by contractor personnel. KSC personnel are also resident at key launch sites, launch facilities and customer facilities. NASA personnel are resident at Vandenberg AFB in California where all launches into a polar orbit, such as those required by the Mission to Planet Earth Enterprise, are conducted. NASA resident office personnel are located in launch service contractor plants, specifically, the Lockheed Martin Corporation Atlas Centaur plant in Denver and the Boeing Corporation Delta plant in Huntington Beach, California. On-site customer offices are being established at the centers assigned program management responsibility for the majority of Space Science (JPL) and Mission to Planet Earth (GSFC) missions that require access to space via NASA-funded ELV services.

Advanced mission design/analysis and leading edge integration services are provided for the full range of NASA missions under consideration for launch on ELV's. Technical launch vehicle support is provided in the development and evaluation of spacecraft Announcement of Opportunities, to enable cost effective consideration of launch service options and technical compatibility. Early definition of vehicle requirements enables smooth transition to launch service and an excellent cost containment strategy.

Launch site operations and countdown management is being improved through the use of a consolidated launch team, efficient telemetry systems, and close partnership with the contractor and USAF to assure lowest cost launch complex operations.

NASA's ELV secondary payload program enables efficient use of excess vehicle performance on selected NASA, USAF and commercial missions through funding integration of small secondary payloads. The secondary payloads come from university

research institutions and often international cooperatives which can afford the constraints of this unique option, which is to take advantage of available limited excess space and performance from a primary payload and accept it's launch schedule and orbit. NASA has developed a standard Delta secondary launch vehicle capability and has similar discussions under way with other US ELV providers.

SCHEDULE AND OUTPUTS

	FY 1998		FY 1999		FY 2000
Missions Supported	Plan	Actual	Plan	Revised	Plan
ELV Missions	8	4	11	13	8
Secondary Payloads	3	1	0	3	3

ACCOMPLISHMENTS AND PLANS

During FY 1998, eight ELV launches and one secondary ELV mission were planned. The Cassini mission was successfully launched on October 15, 1997 using an USAF-provided Titan IV Centaur launch vehicle. Two Pegasus launches, SNOE and TRACE, were launched along with one Titan II provided by the USAF; and the pathfinder activity was accomplished for first launch of an Atlas-Centaur from a new launch site at Vandenberg. NASA has worked closely with the USAF and Lockheed Martin Corporation, provider of the Atlas IIAS launch services, to conduct pathfinder operations at the newly constructed West Coast Atlas launch pad. KSC also ran the SELV II SEB which resulted in the award of multiple Small ELV launch services (SELV II) contracts early in FY 1999 to assure access to space for NASA small explorer (SMEX) and earth system science probes (ESSP) class of payloads.

Support for 13 missions, including EOS AM-1, Landsat-7, and four planetary missions are planned for launch in FY 1999 and integration and technical management of 24 payloads planned for launch in FY 2000 and FY 2001 are supported in this request along with mission analysis and studies in support of Flight Planning Board Activities.

The ELV Sustaining effort will support launch site maintenance and sustaining operations at Vandenberg AFB and Cape Canaveral Air Station, technical insight across all launch vehicle classes (Small, Med-Lite, Medium, & Intermediate), and flight of 1-2 secondary payloads a year. Support for launch, integration and technical management of 24 payloads planned for launch in FY2000 and FY 2001 are supported in this request along with mission analysis & studies in support of Flight Planning Board activities.

BASIS OF FY 2000 FUNDING REQUIREMENT

ADVANCED PROJECTS

	FY 1998	FY 1999	FY 2000
		(Thousands of Dollars)	
Advanced projects	46,700	10,000	6,000

PROGRAM GOALS

In FY 1998, NASA reallocated most of the Advanced Projects funding to meet critical needs of the International Space Station (ISS), with the exception of the X-38 project which should be complete in FY 2000. Efforts have continued as a largely in-house activity to meet long-term Human Space Flight goals under the funding for the Engineering and Technical Base (ETB). These efforts will continue as reflected in the ETB section of the Launch Vehicles and Payloads Operations budget narrative.

STRATEGY FOR ACHIEVING GOALS

For safety reasons, a Crew Return Vehicle (CRV) is necessary for permanent human habitation of the International Space Station. The Russian Soyuz spacecraft will provide the crew-return vehicle capability while the three crewmembers are accommodated aboard the station. The U.S. is developing a CRV to meet crew return requirements when station capability grows beyond three crew memebrs. As an interim capability prior to the availability of the U.S. CRV, additional Soyuz vehicles could be used. The X-38 experimental vehicle program is specifically intended to demonstrate the technologies and processes required to produce a CRV in a "better, faster, cheaper" mode. Evaluations of the performance of the technologies of the X-38 systems are conducted through a series of ground, air, and space tests. The X-38 is based on the U.S. Air Force/Martin-Marietta X-24A lifting body research vehicle. Successful demonstration of the X-38 technologies is a precursor to the decision process to select a long-term CRV configuration for the International Space Station. Through cooperative arrangements that are under discussion with the European Space Agency, the DOD, and the Japanese Space Agency, NASA also seeks to identify opportunities for commonality among space vehicles being developed. An independent study was initiated in FY 1998 to assess the cost estimates and applicability of the X-38 design for the Space Station CRV. In addition, the study will assess options for a Crew Transfer Vehicle (CTV) and other options which meet the Space Station's crew rescue requirements. This study will augment the industry-led Future Launch studies described in the Aeronautics and Space Transportation Technology section. The decision on whether to start development of a crew return vehicle is planned for FY 2000, with a target of providing the first vehicle for deployment in FY 2004. The decision will be closely tied to progress on Space Station assembly and depend on X-38 progress, alternative design concepts, and the results of the Future Launch studies.

SCHEDULE AND OUTPUTS

The success of the Advanced Projects activities has been measured by the success of its projects. Over 100 projects have been supported in the past six years, most of which have been successful in delivering products that enhance the efficiency and reduce the cost of ground and flight operations. Many of the advanced technologies incorporated in the new integrated Shuttle/Station Mission Control Center were developed in this program. These technologies are contributing to a significant reduction of Office of

Space Flight mission operations costs. Modest investments in these activities will be continued under ETB.

In the Orbital Debris activity, accurate measurements have been made of the orbital debris environment. Models have been developed to predict the changes in the environment as a function of time. Utilizing these measurements, flight rules, operational procedures, and new orbital debris protection systems have been developed and/or modified to improve/enhance safety during Shuttle and Space Station operations. Space Station and Space Shuttle now provide financial support for this activity, as they are the programs directly benefiting from this effort.

The following events represent significant milestones in the successful completion of this program:

Advanced Space Systems

Orbital Debris Collector (ODC) Returned from Mir Plan: 4th Qtr FY 1997 Actual: 1st Qtr FY 1998	The ODC is an experiment to collect *in-situ* samples of the micro debris environment from the orbit of the International Space Station to understand the sources of this debris and thus enabling effective steps to mitigate it.
Students for the Exploration and Development of Space Satellite (SEDSAT) Launch Plan: 4th Qtr FY 1997 Actual: 3rd Qtr FY 1998	Deployment of SEDSAT as a DELTA II secondary payload. SEDSAT serves as an amateur radio relay system and collects multi-spectral remote sensing data. This deployment had been delayed because the payload was re-manifested from the Shuttle to a Delta expendable launch vehicle.

Telerobotics Research and Technology

Free-Flying Camera Robots for EVA Plan: 4th Qtr FY 1997 Actual: 1st Qtr FY 1998	Implement upgrades to the existing Supplemental Camera and Maneuvering Platform (SCAMP) system.

Advanced EVA Research and Development

Soft space suit configuration hardware delivery Plan: 2nd Qtr FY 1998 Actual: Defer	Delivery of new soft space suit for testing. Soft suits hold potential of being lighter weight and easier to stow. Deferred because of significant reductions in available funding.
Soft space suit configuration comparison test delivery Plan: 3rd Qtr FY 1998 Actual: Defer	Demonstrates the amount of mobility that can be incorporated into a soft suit configuration. Deferred because of significant reductions in available funding.

Radiator ready for test Plan: 3rd Qtr FY 1998 Actual: Defer	Demonstrates on-orbit cooling using a radiator instead of water sublimation in the real thermal environment. Deferred because of significant reductions in available funding.

X-38

Atmospheric Test Program Plan: 4th Qtr FY 1997 Revised: 4th Qtr FY 1998	Five atmospheric test flights of Vehicles 131 and 132 conducted to demonstrate full lifting body control and parafoil control systems. This milestone has been delayed due to difficulties in parafoil testing.
Award contract for de-orbit module Plan: 2nd Qtr FY 1998 Actual: 4th Qtr FY 1998	Purchase of de-orbit module for X-38 orbital flight test
CRV Formulation Study Plan: 3rd Qtr FY 1998 Actual: 1st Qtr FY 1999	Initiate independent assessment regarding the cost and applicability of the X-38 design for the CRV.
Flight test for the third atmospheric vehicle Plan: 4th Qtr FY 1999	Additional testing will be conducted to demonstrate full lifting body control, using the sub-scale vehicle with final shape.
Shuttle Space Flight Test for Vehicle 201 Plan: Under Review	

ACCOMPLISHMENTS AND PLANS

The X-38 experimental vehicle program is specifically intended to demonstrate the technologies and processes required to produce a human-rated spacecraft such as a Crew Return Vehicle (CRV) in a "better, faster, cheaper" mode. A CRV is necessary for permanent human habitation of the International Space Station to ensure crew safety. The Russian Soyuz spacecraft will provide crew return vehicle capability during the 3-crew member stage, and could provide an interim capability during the six crew member stage, until the CRV becomes operational in 2004.

Evaluations of the performance of the technologies of the X-38 systems are conducted through a series of ground, air, and space flight tests. The first atmospheric flight test was conducted on March 12, 1998 as the X-38 test vehicle (Vehicle 131; 24 ft. scale vs. 30 ft scale for operational CRVs) was dropped from under the wing of a NASA B-52, deployed its parafoil parachute and completed a guided descent from 23,000 feet altitude to a nominal landing. Additional atmospheric flight tests are scheduled to continue over the next two years using three increasingly complex test vehicles. A second flight for V131 is planned for early FY

1999. The tests will culminate in the year 2000 with the deployment of an unpiloted space test vehicle from the Space Shuttle and a controlled descent to landing. A third atmospheric test vehicle in full operational scale will be added to the X-38 program for atmospheric flight-testing.

A second atmospheric flight test vehicle (V132) in 24-ft. scale will demonstrate a lifting body flight control system using Electro Mechanical Actuators (EMAs) and advanced control software technology. In 1999 V132 will begin a series of at least six flight tests at the Dryden Flight Research Facility. A third atmospheric test vehicle (V133) is a modified shape in operational 30-ft. scale. It is scheduled to undergo flight tests in 2000 with the primary goal of aerodynamic verification of shape modifications and control laws. The X-38 space flight test vehicle (V201) is also 30-ft. operational scale and is scheduled for launch on the Space Shuttle in late 2000 to demonstrate the full range of CRV flight operations, including space flight, reentry and parafoil landing test.

The decision on whether to start development of a crew return vehicle is planned for FY 2000, with a target of providing the first vehicle for deployment in FY 2004. The decision will be closely tied to progress on Space Station assembly and depend on X-38 progress, alternative design concepts, and the results of the Future Launch studies.

Advanced technology development projects will focus on innovative, high-leverage technologies that will enable the development of new capabilities to meet future human space flight needs. The program will continue trade studies and mission analysis for the human exploration and development of space, with planned updates to key planning documents. Technology development for advanced EVA capability will focus on development of improved soft goods, gloves, multi-bearing shoulder joints, and a modular Primary Life Support System. As previously noted, Advanced Projects, other than the X-38 program, are being continued as a modest, largely in-house activity with funding requested for the Engineering and Technical Base (ETB).

BASIS OF FY 2000 FUNDING REQUIREMENT

ENGINEERING AND TECHNICAL BASE

	FY 1998	FY 1999	FY 2000
		(Thousands of Dollars)	
Engineering and technical base	102,900	96,300	85,200

PROGRAM GOALS

The focus of the Engineering and Technical Base (ETB) is to support the institutional capability in the operation of space flight laboratories, technical facilities, and testbeds; to conduct independent safety, and reliability assessments; and to stimulate science and technical competence in the United States. ETB activities are carried out at the Johnson Space Center (JSC) including White Sands Test Facility (WSTF), Kennedy Space Center (KSC), Marshall Space Flight Center (MSFC), and Stennis Space Center (SSC). ETB funds are used to: maintain the Centers' technical competence and ability to perform research; analysis and testing tasks; to solve present problems; and to reduce costs in developing programs, technologies, and materials. Beginning in FY 1998, a substantially de-scoped Advanced Projects activity was supported as a largely in-house effort to meet long-term Human Space Flight enterprise (HSF) requirements using modest amounts from this funding source. Efforts include system and mission analysis, integrated HSF Research and Technology (R&T) requirements definition and integration, modest R&T investments in a substantially de-scoped EVA technology demonstration project and limited investments in R&T required to support the integrated Office of Space Science/HEDS robotic efforts.

STRATEGY FOR ACHIEVING GOALS

The complex and technically challenging programs managed by the Office of Space Flight (OSF), now and in the future, are most effectively carried out by sustaining a NASA "core" institutional technical base. It is vital to preserve essential competency and excellence. Since FY 1994, the OSF centers have consolidated activities and have identified ways to economize the resources committed to ETB while maintaining ETB's benefits to the nation's human space flight program. Over the next few years, this consolidation will continue to generate savings through improved information resources management and contract streamlining. A prioritized core capability will include multi-program labs and test facilities, associated systems, equipment, and a full range of skills capable of meeting research, testing and simulation demands.

As the ETB budget is reduced, several activities will continue to refine current business practices. Mandatory equipment repair and replacement will be reassessed. Software applications for multi-program analytical tools will be implemented. The strategy to better manage the NASA investment in information processing resources includes aggressive actions to integrate and consolidate more ADP operations. ETB will ensure synergism among major NASA engineering programs. Awards for education and research tasks will be granted to support educational excellence and research learning opportunities in colleges and universities. A key challenge of the ETB strategy will be to provide a core capability for future human space flight endeavors with fewer resources. Future budget constraints dictate that new innovative processes be adopted to meet critical ETB core requirements, and that non-critical capabilities be streamlined or eliminated.

SCHEDULE AND OUTPUTS

Laboratories & facilities supported (KSC)	Maintains 11 science and engineering laboratories in support of 6 agency programs
Laboratories & facilities supported (JSC)	Maintains 156 science and engineering laboratories in support of 52 agency programs
Laboratories & facilities supported (MSFC)	Maintains science and engineering laboratories (7) and facilities (116) in support of 42 agency programs
Laboratories & facilities supported (SSC)	Maintains 3 science and engineering laboratories in support of 2 agency programs
NASA Minority University Research and Education Program at JSC, KSC, MSFC & SSC	Award education and research grants

ACCOMPLISHMENTS AND PLANS

The institutional technical base accomplished numerous activities in FY 1998. JSC used the majority of its ETB funding to maintain multi-program science and engineering laboratory capability. For example, ETB was used to complete the purchase and begin installation of a 5-axis milling machine, enabling JSC to meet fabrication requirements for the X-38 project as well as support other in-house engineering projects. ETB also supported the development of the Advanced Life Support Systems Integration Test Bed. This facility will serve as the Agency's focal point for development of closed-loop bio-regenerative life support system technologies, accommodate long-duration evaluations of regenerative biological and physicochemical life support systems with human test crews, and evaluate various aspects of human performance under isolated conditions. In addition, ETB was used to complete the lease-to-own-purchase of a mainframe processor through MSFC, ensuring adequate computing capability to support science and engineering analyses.

At KSC, ETB enables the Center's technical core capability to provide in-depth technical support for designs, development, and testing. The KSC laboratories perform activities for Shuttle, Space Station, Reusable Launch Vehicles, Payloads and Life Sciences programs. The KSC core laboratory environment provides customers with calibration and standards, non-destructive evaluation, component sampling and analysis, toxic vapor detection, sensor evaluation, radiological examination (computed topography), launch equipment and platform testing, and CAD/CAE. ETB also enables KSC to complete advanced planning studies including cost trade for future facility utilization; network security; and technology development tasks such as the cryogenic test bed. KSC also participates in programs to stimulate science and technical competence by participating in education and research grants with Historically Black Colleges and Universities (HBCU), Other Minority Universities (OMU), and Teacher/Faculty Enhancement programs.

The MSFC allocation of ETB funds supports 7 science and engineering laboratories and 166 facilities providing for a multitude of research activities. ETB funding enables the Center's technical core capability to provide in-depth technical support for design, development, testing, mission operations and evaluation of launch vehicles, space transportation systems, space stations, and payloads. ETB enables MSFC to conduct research and development efforts related to advanced propulsion systems and spacecraft, as well as engineering design, systems engineering, systems integration, material and process engineering, physical science research, test and evaluation, data analysis and system simulations. In FY 1999, MSFC will make the final lease payment on the Engineering Analysis Data System II (EADS II) Cray Triton. ETB funding will only be required to support operations and maintenance costs, which are reflected in the MSFC ETB budget. Beginning in FY 2000, all Supercomputing activities, currently provided by the EADS II, will be conducted at Ames Research Center. MSFC will also continue to evaluate the Center's ETB content for determination of how ETB funds will be distributed in a full cost budget environment. This includes developing and defining service pool rates for the Science and Engineering Service Pool and the Information Systems Service Pool. FY 2000 full cost simulation for ETB has been completed and lessons learned will be useful for POP 99 planning and preparation.

The SSC laboratories perform activities for NASA's Space Shuttle and Advanced Space Transportation Programs as well as for commercial propulsion test programs and resident governmental agencies. ETB funds maintain operability of the gas/materials analysis and calibration laboratories, provide for development of propulsion test technologies and maintain critical propulsion test engineering expertise in support of SSC's role as the agency's Lead Center for Propulsion Testing.

ETB funding includes the institutional Safety and Mission Assurance (S&MA) contractor workforce performing space flight activities at JSC, KSC and, MSFC. This workforce includes highly skilled personnel who are charged with responsibility to conduct Safety, Reliability & Quality Assurance assessments of conformance to reliability and quality standards. Surveillance of design, manufacturing and testing of hardware and software was conducted to ensure compliance with NASA safety and mission assurance requirements. The ETB resources will support independent assessments of flight and test equipment and testing operations, including product assurance tasks for the International Space Station program (ISS). However, product assurance tasks and funding for the ISS were transferred to the Office of Safety and Mission Assurance in FY 1998.

In FY 1998, JSC's SR&QA Directorate and the Shuttle Program began examining the base level of SR&QA competencies that benefited the Shuttle but were supported by ETB. Adequate support to the Shuttle SR&QA functions required some Shuttle SR&QA tasks to be funded by the Shuttle Program. All Shuttle SR&QA functions will be transferred to the Shuttle Program for management responsibility. The Shuttle Program and JSC's SR&QA Directorate will continue reviewing Shuttle SR&QA content with the goal of reducing, consolidating, or eliminating functions to lower costs while maintaining safety. In addition, responsibility for JSC's multi-program benefiting SR&QA functions is also transferring to the Shuttle and Station Programs. In addition, the FY 1999, budget constraints require JSC and WSTF to reduce support in the multi-program science and engineering laboratories and facilities. This will result in deferment of equipment replacements and upgrades and transfer of additional testing costs to programs and other customers.

ETB funding enables WSTF to maintain science and engineering core capabilities supporting testing and evaluations of spacecraft materials, components, and propulsion systems for safe human exploration and development of space. WSTF also employed these core capabilities to perform tasks for other Government agencies and the private sector on a reimbursable basis.

Marshall Space Flight Center also performed an analysis of SR&QA activities in an effort to properly align work content to the appropriate program, with the goal of reducing, consolidating, or eliminating functions to lower costs while maintaining safety.

This activity resulted in a shift of work content from the Center Institutional function to the Space Shuttle Program. The Shuttle Program and the SR&QA Directorate will continue reviewing Shuttle SR&QA content with the goal of reducing, consolidating, or eliminating functions to lower costs while maintaining safety.

The Engineering and Technical Base also supports Information Resource Management (IRM). IRM processing achieved efficiencies and improved economies of scale through the consolidation of IBM-compatible mainframes supporting administrative and programmatic automated data processing (ADP) services at the NASA ADP Consolidation Center (NACC) located at MSFC. Consolidation of user requirements and information technology plans were fully implemented in FY98; however, the NACC continues to seek new and innovative ways to achieve cost savings.

The NACC provides supercomputing capability for its customers for engineering and scientific computer-intensive applications seven days a week. The NACC supercomputing facility was established in FY 1994 and is managed through the MSFC NACC Project Office. The NACC supercomputing facility includes a mainframe located at MSFC and a smaller distributed system located at JSC, supporting customers at both Centers. The NACC supercomputer facilities include hardware and software to conduct thermal radiation analyses, computational fluid dynamics, structural dynamics and stress analyses for NASA programs such as the Space Shuttle, X-33, X-34, Space Station, and Reusable Launch Vehicle. The facilities also conduct certification and engineering performance evaluation of flight and test data.

In FY 1999, JSC will begin receiving workstation support through the Outsourcing Desktop Initiative for NASA (ODIN). JSC's Information Systems Directorate will work with the selected vendor to ensure adequate scientific, technical, and engineering computing capability is received at the lowest possible cost. In FY 2000, ETB will continue to provide vital support to JSC science and engineering lab infrastructure. FY 2000 contains many critical programmatic milestones that will require extensive support from our labs. NASA needs to perform many critical studies, tests, and analyses for many activities. These include: monitoring human life support and crew health as we begin to inhabit Station in FY 2000; and ensuring the Shuttle can safely operate and transport Station hardware and astronaut personnel; ensuring smooth and safe operations of personnel and equipment during the Station assembly EVAs. In addition, ETB will keep our labs operational to perform exploration and development studies.

In cooperation with the goals of the NASA Minority University Research and Education Program, ETB enables the Space Flight Centers to participate in programs to stimulate science and technical competence in the nation. The ETB program enabled the Centers to award education and research grants to Historically Black Colleges and Universities (HBCU). A total of 40 grants were awarded in FY 1998. Examples include: solution crystal growth in low gravity; organic fiber optic sensors; hydrology, soil climatology, and remote sensing; and cytogenic investigations into radiosensitivity, genetic instability and neoplasti. JSC will be awarding approximately $1.0 million in new research grants to Historically Black Colleges and Universities and Other Minority Universities. Both KSC and SSC also participate in programs to stimulate science and technical competence by participating in education and research grants with Historically Black Colleges and Universities (HBCU), Other Minority Universities (OMUs).

In FY 1999 and FY 2000 the ETB budget will continue to be reduced as the reductions resulting from the Agency's Zero-Base Review (ZBR) are implemented. These reductions include a reduced level of science and engineering lab support to human space flight programs, streamlined technical operations, additional ADP consolidation activities, and reduced education and research awards funding. These reductions will require that all Centers continue to assess their range of workforce skills, analytical tools and facilities dedicated to ensure their ability to provide space flight institutional engineering support for future human space flight programs and the existing customer base. Center assessments will focus on maintaining core support for design,

development, test and evaluations, independent assessments, simulation, operations support, anomaly resolution, and systems engineering activities.

In FY 1999, KSC will continue to achieve ZBR-recommended reductions in FY 1999 by reengineering CAD/CAE services including migration to PC platform and elimination of VAX mainframe/software and associated maintenance. MSFC and SSC will continue institutional support while continuing to strive for institutional efficiencies. In FY 1999 and FY 2000, KSC will continue to achieve cost efficiencies in the operation of existing core laboratories and associated technical ADP services which will enable necessary equipment/system upgrades and implementation of strategic core technical development initiatives that support our Center of Excellence assignment.

In FY 1999, ETB will continue to conduct business in the current mode, but will be preparing for implementation of the Agency's Full Cost budget structure. In FY 2001, all Space Flight Centers will transition to a Full Cost budget structure environment. At this time the ETB budget will be phased out. Under Full Cost budget structure, ETB activities will be planned, justified and budgeted for by the benefiting customer receiving the service. All Space Flight Centers previously providing these ETB services will define and establish service pools and usage costs in order to recover operating costs. Service pools will be established for testing services, science and engineering laboratory capability, and computer operations. Space Flight Centers will continue to provide the highest quality science and engineering analyses for NASA's programs and external customers during and following this transition, to the Full Cost budget structure.

In FY 2000, there will be an effort to include systems analysis and modest investments in research and technology to meet long-term HSF requirements included in the ETB budget. Systems Analysis will provide for overall planning and analysis for development of new technology, focusing on innovative, high-leverage technologies and approaches which will enable the development of new capabilities to meet future human space flight needs, and providing the opportunity for enhanced synergy between ongoing programs and future HEDS objectives. It includes the following activities:

- Overall technical integration and development of technical requirements, technology roadmaps, and investment strategies;
- Evaluation of alternative mission approaches and technologies;
- Development of advanced transportation system architectures and technology requirements;
- Definition of R&T for Advanced Power, Information Systems Technology, and Advanced Sensors;
- System & concept definition and identification of proof-of-concept tests/ demonstrations for key emerging HEDS technologies/systems;
- ISS evolution systems analysis to determine far-term mission requirements and concepts for cost reduction and performance enhancement; and
- Identification of candidate HEDS payloads for future Mars robotics missions providing low cost environmental data and technology demonstrations that are necessary to enable safe exploration missions in the future.

Intelligent Synthesis Environment (ISE) testbeds will be initiated in FY 1999 to provide NASA engineers and scientists with the tools and infrastructure to facilitate the development of new technology, analysis and modeling tools for mission architectures. The centers' ISE requirements are further addressed in the agency's FY 2000 ISE initiative for which funding is requested in the Research and Technology Base of the Aeronautics program with an increased focus on commercial space development initiatives.