HUMAN SPACE FLIGHT

FISCAL YEAR 2001 ESTIMATES

BUDGET SUMMARY

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

SUMMARY OF RESOURCES REQUIREMENTS

	FY 1999 OPLAN 12/23/99	FY 2000 OPLAN REVISED	FY 2001 PRES BUDGET	Page Number
	(Thousands of Dollars)			
Payload carriers and support	39,200	49,300	[57,000]	HSF 3-3
Expendable launch vehicle mission support	31,500	30,600	[33,200]	HSF 3-5
Advanced projects	15,000	--	--	HSF 3-8
Engineering and technical base	96,300	85,200	[81,500]	HSF 3-10
OSF Contributions to Academic Programs (in ETB)	(2,300)	(2,300)	(8,000)	
Total	182,000	165,100	[171,700]	
Distribution of Program Amount by Installation				
Johnson Space Center	44,261	20,731	[29,400]	
Kennedy Space Center	66,765	79,068	[90,000]	
Marshall Space Flight Center	51,039	43,600	[37,100]	
Stennis Space Center	1,650	1,600	[200]	
Ames Research Center	300	--	[--]	
Glenn Research Center	450	--	[--]	
Langley Research Center	1,885	--	[--]	
Goddard Space Flight Center	15,000	8,900	[10,200]	
Jet Propulsion Laboratory	500	35	[--]	
Headquarters	150	11,166	[4,800]	
Total	182,000	165,100	[171,700]	

Note -- Beginning in FY 2001, the Payload Utilization and Operations Budget Line Item (BLI) has been divided into two new budget line items - Payload and ELV Support and Investments and Support. Payload carriers and support and ELV Mission Support move to the Payload and ELV support BLI, while Engineering and Technical Base moves to the Investments and Support BLI.

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 Earth Science 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.

Beginning in FY 2001, the Payload Utilization and Operations Budget Line Item (BLI) has been divided into two new budget line items - Payload and ELV Support and Investments and Support. Payload carriers and support and ELV Mission Support move to the Payload and ELV support BLI, while Engineering and Technical Base moves to the Investments and Support BLI.

BASIS OF FY 2001 FUNDING REQUIREMENT

PAYLAOD CARRIERS AND SUPPORT

	FY 1999	FY 2000	FY 2001
		(Thousands of Dollars)	
Payload Carriers and Support	39,200	49,300	[57,000]

PROGRAM GOALS

The primary goal for Payload Carriers and Support is to safely and efficiently assemble, test, checkout, service, and integrate a wide variety of spacecraft and space experiments launched on the Space Shuttle.

STRATEGY FOR ACHIEVING GOALS

The Payload Carriers 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 launch vehicle; and integration and installation into the launch vehicle. 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.

Payload Carriers and Support also funds small 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 sidewall 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 sidewall 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 Paylaod Carriers 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.

SCHEDULES AND OUTPUTS

	FY 1999		FY 2000		FY 2001
Missions Supported	Plan	Actual	Plan	Revised	Plan
Space Shuttle Missions	6	4	8	6	[9]
Hitchhiker Experiments, includes CAP/SEM/HH Jr.	13	12	4-6	2	[7]
Get-Away Special Payloads	5	5	10-20	0	[2]
Spacehab Missions	2	2	0	1	[1]
Other Major Payloads	8	6	8	6	[13]
Other Secondary Payloads	34	26	0	7	[1]
Multi-Purpose Experiment Support Structure (MPESS)					
Pallets	2	0	8	3	[5]
Number of Payload Facilities Operating at KSC	6	6	6	5	[5]
KSC Payload Ground Operations (PGOC) Workforce	360	366	334	308	[334]

ACCOMPLISHMENTS AND PLANS

In FY 1999, the Payload Carriers and Support provided the payload carrier and integration activities for the HST Orbital Systems Test (HOST) mission. Launch and landing payload support activities encompassed four Space Shuttle missions, including the first American segment of the ISS, and Payload Carriers and Support activities and facilities for six manifested major payloads. Twenty-six secondary payloads were also supported. The program also began preparation and initial analyses for HST Servicing Mission 3A, scheduled for launch in December 1999, with no additional funding. Operational efficiencies have reduced cost and improved customer satisfaction as well as reduced processing time and error rate. However, recent budget reductions will require closure of ground processing facilities, which will erode much of the progress made in recent years. Reimbursable funds of $806,000 were received in FY 1999 to cover processing costs for GAS and Hitchhiker payloads.

In FY 2000, Payload Carriers and Support will provide pallets for Hubble Space Telescope (HST) Servicing Mission 3A and for three of the ISS assembly flights. Launch and landing payload support activities will be provided for six Space Shuttle missions, encompassing Payload Carriers and Support activities and facilities for nine major payloads, including four ISS assembly and utilization flights. A number of secondary payloads will also be supported. Funding will also include the planning and processing of horizontally installed payloads in support of the Space Shuttle and ELV manifests; and providing operations and maintenance of five Payload Facilities at KSC. In order to fund the requirements of payload processing for the HST Servicing Mission added in FY 2000, NASA has placed the Vertical Processing Facility (VPF) at the Kennedy Space Center in a stand-by mode. While there are no current requirements in the Shuttle manifest for the unique capabilities of the VPF -- the VPF is the only vertical integration facility for Shuttle as well as the only hazardous Cargo Integration Test Equipment (CITE) location -- this could have potential impact on processing some payloads due to conflicts in remaining facilities. Funding includes a Construction of Facility Project in the amount of $750,000 for modifications/upgrades to the Spacecraft Assembly and Encapsulation Facility (SAEF)-2. Reimbursable funds of $1,125,000 is expected to be received in FY 2000 to cover processing costs for GAS and Hitchhiker payloads

Beginning in FY 2001, the Payload Carriers and Support budget will be in a new budget line item called Payload and ELV Support.

Details on FY 2001 activity can be found in this section.

BASIS OF FY 2001 FUNDING REQUIREMENT

EXPENDABLE LAUNCH VEHICLE SUPPORT

	FY 1999	FY 2000	FY 2001
		(Thousands of Dollars)	
Expendable Launch Vehicle Support	31,500	30,600	[33,200]

PROGRAM GOALS

The goals of the Expendable Launch Vehicle (ELV) mission support program are: (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 was transitioned from the Office of Space Science and the Office of Earth Science 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 Enterprise requirements and for increasing the probability of mission success through focused technical oversight of commercially provided launch services. A core team of civil servants and contractors primarily located at KSC performs the technical management. 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 Earth Science Enterprise, are conducted. 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. KSC customer offices have been established at GSFC and JPL as the centers assigned program management responsibility for the majority of Space Science and Earth Science missions requiring access to space via NASA-provided launch 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 Boeing and the USAF to assure lowest cost west coast Delta 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. These payloads are sponsored by university research institutions and often international cooperatives which can take advantage of available limited excess space and performance on launch vehicles and accept the primary payload'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.

SCHEDULES AND OUTPUTS

	FY 1999		FY 2000		FY 2001
Missions Supported	Plan	Actual	Plan	Revised	Plan
ELV Missions	13	10	8	9	[11]
Secondary Payloads	3	1	3	5	[1]

ACCOMPLISHMENTS AND PLANS

During FY 1999, 13 ELV launches and 3 secondary ELV mission were planned. Ten were successfully launched (SWAS, Deepspace, Mars Orbiter, Mars Lander, Stardust, Landsat 7, FUSE, WIRE, Terriers, QuikScat) and three were delayed by contractor failure investigation activities until FY 2000 (TDRS-H, TERRA, and GOES-L). One secondary payload was launched (ORSTED/SUNSAT) and two secondaries (Munin/CE) were delayed due to the readiness of the primary spacecraft. Two contracts for launch services were signed under the Small ELV II acquisition effective December 1998. The ELV program negotiated launch of OES Vegetation Canopy Lidar payload using the Athena Launch Service residual from the cancelled Lewis mission and also supported NASA Wing Glove experiment launch and test on a commercial Pegasus mission. The modification/rehabilitation project of the Engineering and Operations Building located on Cape Canaveral Air Station, Florida, was started. Procurement and installation of a backup power supply system located at Vandenberg Launch Site Complex 2 (SLC-2) at Vandenberg Air Force Base (VAFB), California, was completed.

Support for 9 missions (Terra, GOES-L, HETE II, IMAGE, TDRS-H, EO-1, NOAA-L, HESS I, and VCL) and 5 secondaries (ACRIM, QUICKTOMS, MUNIN, Citizen Explorer, and ProSEDS) are planned for launch in FY 2000. Integration and technical management of 28 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 Gravity Probe-B mission moved from FY 2000 to FY 2001 due to spacecraft readiness. The JASON/TIMED mission also moved from FY 2000 to FY 2001.

Two launch services competitions are supported in this request. In FY 2000, the NASA Launch Services (NLS) procurement for purchasing launch services for future NASA missions – including potential Space Station re-supply missions– will be competed. This contract provides for awards to multiple contractors with vehicles with demonstrated flight history. Also, the Next Generation Launch Services (NGLS) contracts will be competed. NGLS will enable emerging launch services companies, with little or no flight history, to compete for offering launch services to NASA. The NLS NGLS procurements, in addition to the existing Small ELV (SELV) contracts will be used for the Alternative Access element of the Space Launch Initiative, for which funding begins in FY 2001 in the SAT account. Alternative Access funding is intended to enable NASA to establish and use alternative means of access to space – primarily to the International Space Station. These funds will be used to purchase services, however, in the near-term they may support technology development or operational technology demonstrations to help enable near term commercial launch systems that could service space station or launch NASA science payloads. Alternative access could provide important benefits, including contingency capability, operational flexibility, increased competition, near-term flight opportunities, and

development of capabilities to meet station-unique needs. The OSF ELV Program will work closely with OAST on Alternative Access and NASA envisions that funding for Alternative Access may be transferred from the SAT account to the HSF account in the future. This budget also supports two minor revitalization and Construction of Facilities at various locations.

Beginning in FY 2001, the ELV Mission Support budget will be in a new budget line item called Payload and ELV Support. Details on FY 2001 activity can be found in this section.

BASIS OF FY 2001 FUNDING REQUIREMENT

ADVANCED PROJECTS

	FY 1999	FY 2000	FY 2001
		(Thousands of Dollars)	
Advanced projects.....	15,000	--	--

PROGRAM GOALS

In FY 1999, NASA reallocated all of the Advanced Projects funding to meet critical needs for the International Space Station (ISS) with the exception of the X-38 project. The X-38 project was merged into the Crew Return Vehicle (CRV) Program starting in FY 2000.

STRATEGY FOR ACHIEVING GOALS

The X-38 experimental vehicle program is specifically intended to demonstrate the technologies and processes required reducing the risks of developing 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 develop a long-term crew return capability 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 the 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. Continuing studies will assess options for a Crew Transfer Vehicle (CTV) and other options which meet the Space Station's crew rescue requirements and will augment the industry-led Future Launch studies described in the Aeronautics and Space Transportation Technology section. The decision on whether to proceed with an X-38 based CRV design will be made in two years, in the context of broader decisions that NASA and the Administration will make regarding future space transportation architectures. Funding for Phase 2 of CRV development resides in the SAT account, pending these decisions.

SCHEDULES AND OUTPUTS

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 Actual: Under review	Additional testing will be conducted to demonstrate full lifting body control, using the sub-scale vehicle with final shape.
Shuttle Space Flight Test for	Currently manifested for February 2002

Vehicle 201
Plan: 2nd Qtr FY 2002

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 crew return capability 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 6-crew member stage, until an U.S. system becomes operational in 2005. 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. The X-38 test vehicle (Vehicle 131; 24 ft. scale vs. 30 ft scale for operational CRVs) was dropped under the wing of a NASA B-52. It successfully 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 using three increasingly complex test vehicles. The second flight for Vehicle 131 was successfully completed on February 6, 1999. In FY 1999, Vehicle 132 also underwent flight testing at the Dryden Flight Research Center. Vehicle 132 completed two lifting body flight control system flight tests using Electro Mechanical Actuators (EMAs) for aero-surface control. The X-38 space flight test vehicle (Vehicle 201) is full 30-ft. operational scale and is scheduled for launch on the Space Shuttle in early 2002 (currently manifested for February 2002) to demonstrate the full range of CRV flight operations, including space flight, reentry and parafoil landing test. The primary structure for Vehicle 201 (Space Test Vehicle) was completed in FY 1999, the initial wiring was installed, and the cabin pressure testing was successfully completed. The X-38 program completed a 9-month Independent Assessment (IA) in which 110 maturity gate action items were identified to ensure costs savings are realized -- 57 of these actions were completed in FY 1999, including construction of a full scale (7500 sq. ft) parafoil. FY 1999 accomplishments also include completed modifications to X-38 Vehicle 131 (to 131R) into an operational aerodynamic configuration for future flight testing; improvements to parafoil deployment dynamics; first use of neural net based flush air data system; flight readiness of dynamic inversion (MACH) flight control system (V132); completion of Deorbit Propulsion Stage CDR; and completion of electromagnetic docking/berthing testbed.

Since the scope of the X-38 project objectives were significantly expanded to include early development of technologies directly usable on an operational CRV, the X-38 project will be merged into the CRV project as a part of the ISS Program. X-38 milestones and program costs, including completion of CRV operational technology developments and the Vehicle 201 space flight test will be tracked as an element of the CRV project budget within Space Station.

BASIS OF FY 2001 FUNDING REQUIREMENT

ENGINEERING AND TECHNICAL BASE

	FY 1999	FY 2000	FY 2001
		(Thousands of Dollars)	
Engineering and technical base	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. Efforts include system and mission analysis, integrated HSF Research and Technology (R&T) requirements definition and integration, modest R&T investments in an EVA technology demonstration project and investments in R&T required supporting 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. Adoption of new innovative processes to meet critical ETB core requirements and streamlining or eliminating non-critical capabilities will enable future savings.

In the President's FY 2001 budget request, funding for Engineering and Technical Base is moved from the Payload Utilization and Operations budget line item to a new budget line item, Investments and Support.

SCHEDULES 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 123 science and engineering laboratories and facilities 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

In FY 1999, KSC implemented the Outsourcing and Desktop Initiative NASA (ODIN) contract to consolidate basic information technology (i.e., desktop maintenance, network administration, intra-network connections) for JSC, KSC, MSFC, and SSC. These Centers transitioned applicable ETB-funded IT support to ODIN as part of this consolidation effort.

In FY 1999, JSC received 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.

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. 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 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). 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. MSFC, 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) and Other Minority Universities (OMUs).

In FY 1999, KSC continued 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 2000 the ETB budget will continue to implement the Agency's Zero-Base Review (ZBR) recommendations. These 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 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. The In-House HEDS Studies for FY2000 will address systems definition and analysis, and technology road map definition for a wide variety of potential options for future HEDS programs to improve safety and reduce costs; to promote space commercialization and technology transfer; and to enable future missions. These studies will be closely integrated with agency next decade planning activities and the HEDS Technology/Commercialization initiative. ISS and Space Shuttle may be addressed as supporting infrastructure aspects of the in-house studies, if appropriate, but are not planned to be the principal focus of these efforts. 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. Studies will include 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.

ETB will support implementation of HEDS experiments for the Office of Space Science Mars's missions, as appropriate.