FUSION ENERGY SCIENCES

PROGRAM MISSION

The Fusion Energy Sciences program has changed from an energy technology development program to a program focused on the scientific foundations that underpin the fusion process. The mission of the Fusion Energy Sciences Program is to:

"Acquire the knowledge base needed for an economically and environmentally attractive fusion energy source."

Crucial to this mission is understanding how to limit the turbulent transport of particles and energy across the magnetic fields that are typically used to confine fusion energy fuels. Dramatic progress in this area has emerged in just the last two years after decades of research on this extremely difficult scientific problem which challenges the frontiers of both experimental investigation and theoretical description.

The GOAL of the Fusion Energy Sciences program is to work collaboratively within the international community to develop the scientific basis for a fusion energy development program. In pursuing this goal, the fusion program will also foster the advancement of plasma science which has applications in other fields of science and near-term industrial uses.

Specific OBJECTIVES related to the above goal are to:

Understand the physics of plasmas, the fourth state of matter. Plasmas comprise most of the universe, both stellar and interstellar, and have many practical applications;

Identify and explore innovative and cost-effective development paths to fusion energy . Practical fusion power will require an optimized toroidal approach building on the considerable tokamak experience, or a quite different approach, such as inertial fusion energy;

PROGRAM MISSION - FUSION ENERGY SCIENCES (Cont'd)

Explore the science and technology of energy producing plasmas, the next frontier in fusion research, as a partner in an international effort. Understanding the physics of self-heated plasmas and developing the technologies essential for fusion energy are linked goals that are achievable through the cooperative efforts of the world community.

PERFORMANCE MEASURES:

The scientific excellence of the fusion program is continually assessed by expert panels, by merit review with peer evaluations, by publications in scientific journals, by issuance of patents and citations, and by international standing. Also important are the contributions to other departmental and administration goals, such as supporting the science and technology infrastructure, strengthening science education, and enabling science and technology spin-offs. Performance measures for FY 1998 are:

1. Improve the understanding of the physics of plasmas.

2. Achieve new scientific discoveries and technological innovations that contribute to the scientific basis for a fusion power source.

3. Develop new simulation and computational tools that advance the ability to predictively model complex plasma phenomena.

4. Construct, on cost and schedule, and operate unique experimental facilities at the forefront of fusion energy science.

5. Progress on the International Thermonuclear Experimental Reactor (ITER) Engineering Design Activities (EDA). ITER would investigate the physics and technology of an energy-producing plasma source when built and operated.

6. Careful and effective management of the physical and human assets required to carry out the fusion research effort.

PROGRAM MISSION - FUSION ENERGY SCIENCES (Cont'd)

SIGNIFICANT ACCOMPLISHMENTS AND PROGRAM SHIFTS:

- Fundamental discovery and analysis have led to a remarkable new understanding of how to reduce loss of energy from the core of a tokamak. Unique diagnostic probes and improved theoretical analyses have contributed to much improved performance of the tokamak facilities needed for high temperature plasma experiments. Experiments on Tokamak Fusion Test Reactor (TFTR) and Doublet III-D (DIII-D) have established thermal barriers that reduced the loss of plasma energy and particles to unprecedented levels. These results have demonstrated considerable progress in the scientific understanding needed for the ultimate objective of developing simpler, more economical fusion power systems.

- The world's first opportunity to study the detailed science associated with the production of fusion power using deuterium-tritium (D-T) fuel occurred over the past few years on TFTR at Princeton Plasma Physics Laboratory (PPPL). This device achieved over 10,000,000 watts of fusion power and provided numerous refined measurements of the fusion heating process. The research efforts on TFTR focused on completing the scientific objectives uniquely attainable in that device before shutting down to permit increased efforts on tokamak improvements and alternative concepts using other facilities. The process of shutting down TFTR and placing it in a mothball condition will be initiated in mid FY 1997.

- In FY 1998, funds previously used for the TFTR program in FY 1997 will be redirected to support construction of the National Spherical Torus Experiment at PPPL, national and international collaborative efforts involving PPPL physicists, enhancement of the DIII-D scientific mission and maintenance of the mothballed TFTR facility.

PROGRAM MISSION - FUSION ENERGY SCIENCES (Cont'd)

- The following table displays how the savings resulting from the shut down of TFTR will be redirected to allow the program to move forward with the implementation of the restructured program.

Reallocation of TFTR Program Funding
(B/A in thousands)

	FY 1997-98 Change
TFTR Shutdown	-24,836
NSTX Increase	7,600
PPPL Collaboration Abroad	1,965
Increase for DIII-D Research and Operations	7,464
Increase for Alcator C-MOD Research and Operations	2,464
Increase for Alternative Concepts Research	4,110
Increase for General Plasma Science	1,000
Increase for small scale plasma experiments	233

- In FY 1997 the Fusion Energy Sciences program continued on the course set in FY 1996, toward an international program aimed at studying the scientific aspects of energy producing plasmas with U.S. support for the ITER EDA sustained at the FY 1996 level. Also, the planning assumption for U.S. involvement in any future ITER construction was changed from significantly increased participation to participation at the current level. In FY 1997, the ITER EDA Detailed Design Report, including a cost estimate and a safety assessment, will be reviewed domestically, as well as with our international partners, to establish whether there is a technical basis for proceeding with ITER construction. The four ITER Parties are now engaged in pre-negotiations, i.e., non-committal discussions called Explorations, to determine whether acceptable construction arrangements can be established consistent with the limitations of each Party. If these Explorations are successful and if the Detailed Design Report is technically acceptable, then we would expect to join negotiations on a construction agreement. If these latter negotiations are successful, and if there is a successful technical conclusion to the ITER EDA, then we would expect to enter into a construction agreement within projected U.S. fusion program financial limitations.

- A principal Fusion Energy Sciences Advisory Committee (FESAC) recommendation was to increase the U.S. effort in innovative concepts research. This budget includes funds to continue work on an innovative new spherical torus experiment, the NSTX, as well as a new initiative for small-scale innovative concepts.

PROGRAM MISSION - FUSION ENERGY SCIENCES (Cont'd)

- A new initiative in general plasma science and engineering began in FY 1997, including a joint program with NSF targeted at university programs and a young investigators program providing research opportunities for tenure-track faculty in plasma science. In FY 1998, the plasma science initiative will be increased. This broad plasma research program will support not only fusion but other elements of the Department's energy and defense missions.

FUSION ENERGY SCIENCES
PROGRAM FUNDING PROFILE
(Dollars in thousands)

Subprogram	FY 1996 Enacted Appropriation	FY 1997 Original Appropriation	FY 1997 Adjustments	FY 1997 Current Appropriation	FY 1998 Budget Request
Science	$88,552	$101,529	$0	$101,529	$103,281
Facility Operations	68,067	58,171	0	58,171	47,519
Technology	73,587	64,400	0	64,400	67,300
Program Direction	8,734	8,400	0	8,400	6,900
Subtotal, Fusion Energy Sciences	238,940	232,500	0	232,500	225,000
Adjustment	0	-2,069 a/	0	-2,069 a/	0
TOTAL, FES	$238,940 b/	$230,431	$0	$230,431	$225,000
Full-Time Equivalents	70	62		62	49

a/ Share of Energy Supply, Research and Development general reduction for use of prior year balances assigned to this program. The total general reduction is applied at the appropriation level.

b/ Excludes $4,491,000 which was transferred to the SBIR program and $342,000 which was transferred to the STTR program.

Public Law Authorization:

Pub. Law 95-91, DOE Organization Act

FUSION ENERGY SCIENCES
(Dollars in thousands)

PROGRAM FUNDING BY SITE

Field Offices/Sites	FY 1996 Current Appropriation	FY 1997 Original Appropriation	FY 1997 Adjustments	FY 1997 Current Appropriation	FY 1998 Budget Request
Albuquerque Operations Office					
Los Alamos National Laboratory	$4,610	$3,456	$0	$3,456	$3,356
Sandia National Laboratories	5,675	5,245	0	5,245	5,555
Chicago Operations Office					
Argonne National Laboratory	5,307	1,915	0	1,915	2,560
Brookhaven National Laboratory	97	60	0	60	50
Princeton Plasma Physics Laboratory	60,057	55,873	0	55,873	47,623
Idaho Operations Office					
Idaho National Engineering Laboratory	2,494	2,360	0	2,360	2,360
Oakland Operations Office					
Lawrence Berkeley National Laboratory	5,182	11,650	0	11,650	4,240
Lawrence Livermore National Laboratory	17,094	9,272	0	9,272	8,910
Stanford Linear Accelerator Center	50	50	0	50	50
Oak Ridge Operations Office					
Oak Ridge Institute for Science & Education	1,111	867	0	867	0
Oak Ridge National Laboratory	19,415	16,244	0	16,244	16,740
Thomas Jefferson National Accelerator Facility	5	0	0	0	0
Richland Operations Office					
Pacific Northwest Laboratory	1,472	1,190	0	1,190	1,230
Savannah River Operations Office					
Savannah River Tech Center	218	270	0	270	270
All Other Sites	116,153	124,048	0	124,048	132,056
Subtotal	238,940	232,500	0	232,500	225,000
Adjustment	0	-2,069 a/	0	-2,069 a/	0
TOTAL	$238,940 b/	$230,431	$0	$230,431	$225,000

a/ Share of Energy Supply, Research and Development general reduction for use of prior year balances assigned to this program. The total general reduction is applied at the appropriation level.

b/ Excludes $4,491,000 which was transferred to the SBIR program and $342,000 which was transferred to the STTR program.

FUSION ENERGY SCIENCES

SCIENCE

I. Mission Supporting Goals and Objectives: This subprogram provides funding for scientists and support staff at universities and laboratories that carry out research in fusion plasma science. The experimental and theoretical research activities include planning, design, fabrication, and installation of diagnostics and small experiments, conduct of experiments, analysis of data, computation and publication of results.

Plasma science is the study of the behavior of ionized states of matter -- ranging from fluorescent lights to stars -- that make up 99 percent of the visible universe. It contributes not only to fusion energy research, which has driven the intellectual development of plasma science, but also to many national science and technology goals, ranging from astrophysics to industrial processing and national security. One of the objectives of the Science Subprogram is to broaden the intellectual and institutional base in fundamental plasma physics, preferably in partnership with other agencies. A joint DOE/National Science Foundation plasma science partnership, begun in FY 1997, addresses important research topics in plasma science and engineering.

Fusion plasma science advances through a balance of large- and small-scale experimentation, theory, and modeling. The largest experimental component is the tokamak experimental research activity which is focused on gaining a predictive understanding of the behavior of hot confined plasmas using existing U.S. research facilities (e.g., Alcator C-MOD, and DIII-D) and through international collaborations on state-of-the-art foreign experimental facilities. The central scientific issue is that of improving plasma energy confinement, (or, conversely, reducing energy transport) which is the subject of intensive study using a variety of theoretical models developed and refined from an ever growing worldwide experimental data base. In addition, this effort contributes to resolving physics issues for the design of ITER and the development of fusion as an energy source for the future.

Research on alternative confinement concepts (magnetic and inertial) will be pursued to identify approaches which may improve the economical and environmental attractiveness of fusion energy. This research will be carried out at levels appropriate to the state of advancement of the approach. This includes small scale exploratory programs primarily at universities as well as more advanced physics experiments as exemplified by the National Spherical Torus Experiment (NSTX) which is currently being fabricated at PPPL. Efforts in inertial fusion energy (IFE) will focus on development and assessment of the most efficient methods that provide a heating process for the inertial fusion energy concept.

A particularly critical component for progress in fusion science is the development and use of theoretical and computational tools to provide and verify detailed scientific understanding of the physical phenomena that govern the confinement of high temperature plasmas.

II. Funding Schedule:

Activity	FY 1996	FY 1997	FY 1998	$ Change	% Change
Tokamak Experimental Research	$47,721	$54,027	$58,928	$+ 4,901	+ 9.1 %
Alternative Concept Experimental Research	14,357	15,350	19,460	+ 4,110	+26.8%
Theory	26,244	25,300	17,500	- 7,800	-30.8%
General Plasma Science	230	3,000	4,000	+ 1,000	+33.3%
SBIR/STTR	0	3,852	3,393	- 459	- 11.9 %
Total Science	$88,552	$101,529	$103,281	$ +1,752	+ 1.7%

III. Performance Summary - Accomplishments

	FY 1996	FY 1997	FY 1998
TOKAMAK EXPERIMENTAL RESEARCH	$47,721	$54,027	$58,928

Tokamak Experimental Research provides support for physicists and engineers to carry out the scientific research program on domestic tokamak facilities, as well as for U.S. collaborations with European, Japanese, and Russian scientists on major fusion experiments abroad. These foreign collaborative programs have enhanced the productivity of the U.S. Program, and will expand somewhat in FY 1998 with the shift of some PPPL scientific personnel to collaborations on major facilities in Japan and Europe. PPPL will also have a major collaborative effort on DIII-D and Alcator C-Modified.

Tokamak experiments are aimed at investigating a wide range of scientific issues, particularly the causes of plasma energy loss relevant to the design of future advanced tokamaks (e.g., ITER). Results have demonstrated record-breaking fusion power using D-T plasmas and that the confinement of plasma

III. Performance Summary- Accomplishments

	FY 1996	FY 1997	FY 1998
energy and particles can be dramatically improved by modifying the magnetic field to create an energy barrier within the plasma. Other key research topics which are important for future tokamaks include development of efficient heat removal systems and advanced operating techniques to support long pulse operation.			
In addition to experiments on large tokamaks, the program supports small scale experiments, advanced diagnostic development, and atomic data for fusion. These small scale experiments permit cost-effective initial exploration of promising improvements in the tokamak confinement concept and are conducted primarily at universities.			
ALTERNATIVE CONCEPT EXPERIMENTAL RESEARCH	14,357	15,350	19,460
The alternative concepts development program studies magnetic confinement configurations other than the conventional tokamak, both for their scientific value and as reactor concepts that may have advantages compared to the conventional tokamak. Approximately 15 experimental programs, located primarily at universities, are supported with these funds. Noteworthy, among many recent successes, is the completion of the experimental data base upon which a favorable decision to proceed with a proof-of-principle spherical torus experiment (NSTX) has been based.			
The National Spherical Torus Experiment (NSTX) will address the fundamental plasma and fusion science issues, such as current drive by radio frequency waves, very intense levels of fusion power and nearly total self-generation of current to produce fusion plasma confinement in an ultra-			

	FY 1996	FY 1997	FY 1998
compact tokamak. Plans will be developed starting in FY 1997 to establish a national NSTX research program with broad participation by scientists at U.S. universities, industries, and laboratories. The scientific research program on NSTX is scheduled to commence in mid FY 1999.			
In the area of Inertial Fusion Energy, research will continue on the ion beam drive methods and supporting critical technology issues.			
THEORY	26,244 a/	25,300 a/	17,500
The theory program provides broadly based support for the fusion energy sciences program in three areas; basic theory of plasma behavior, development of techniques and codes to model plasmas of fusion interest, and support of experimental programs. The Fusion Energy Sciences program has proposed to the DOE 2000 initiative, a program to develop new application codes and a code library for use by fusion researchers, and advanced, widely applicable, methods of remote participation in experiments.			
GENERAL PLASMA SCIENCE	230	3,000	4,000
The general plasma science program is directed toward enhancing basic plasma science research, primarily in the university community; through initiatives for young investigators and announcements of research opportunities coordinated with other government agencies, e.g. NSF. Advances in plasma physics will support the fusion energy sciences program as well as other multi-disciplinary fields of importance to science and technology.			

a/ Includes $7,740,000 in FY 1996 and $7,370,000 in FY 1997 for Computational support at the NERSC. In FY 1998 all funds for NERSC operations are budgeted in the Computational and Technology Research program.

SBIR/STTR FUNDING	FY 1996	FY 1997	FY 1998
In FY 1996 $2,882,000 and $220,000 were transferred to the SBIR and STTR programs respectively. The FY 1997 estimate is for both SBIR and STTR. The FY 1998 estimate is for SBIR only since Part D, Section 110 of P.L. 104-208, making Omnibus Consolidated Appropriations for FY 1997 reauthorized STTR for FY 1997 only.	0	3,852	3,393
TOTAL SCIENCE	$88,552	$101,529	$103,281

EXPLANATION OF FUNDING CHANGES FY 1997 TO FY 1998:

Funding for TFTR is reduced by $2,915,000 primarily from further reductions in staff, resulting from permanently shutting down the facility in mid FY 1997 and placing it in a mothball status. Further reductions for TFTR are accounted for under the Facilities Operation subprogram. The shut down of TFTR will enable the two remaining major tokamaks, DIII-D and Alcator C-MOD, to be operated at a more scientifically productive rate in FY 1998 and permit increasing effort on alternative concepts, such as fabrication of the NSTX.	-$2,915,000
Increases in funding for DIII-D of $4,425,000, Alcator C-Mod of $1,674,000 and International $2,015,000 reflect increased efforts resulting from collaborations by PPPL staff on these facilities as well as European and Japanese devices (following the shutdown of the TFTR experiment).	+$8,114,000
Smaller scale plasma experiments and diagnostic development are increased $536,000.	+$536,000
Reductions of $834,000 are primarily associated with reduction for traineeships.	-$834,000
The FY 1998 level for theory is essentially comparable with the FY 1997 level, except for funding to support National Energy Research Scientific Computing Center, that is budgeted for in the Computational and Technology Research program in FY 1998.	-$7,800,000

EXPLANATION OF FUNDING CHANGES FY 1997 TO FY 1998 (Cont'd):

An additional $1,000,000 is provided for increasing the breadth of participation in the basic plasma science initiative which began in FY 1997.	+$1,000,000
An increase of $4,110,000 is provided to enhance operations of existing alternative concept experiments and to support an innovative concepts initiative.	+$4,110,000
SBIR/STTR funding requirements are decreased $459,000 primarily associated with the termination of STTR.	-$459,000
Total Funding Change, Science	$+1,752,000

FUSION ENERGY SCIENCES

FACILITY OPERATIONS

I. Mission Supporting Goals and Objectives: This activity provides for the operation of major experimental facilities which are the essential tools that enable scientists in university, industry and laboratory based research groups to perform experimental research in fusion energy sciences. This subprogram includes funding for the operation and maintenance of the three major fusion research facilities: TFTR at the Princeton Plasma Physics Laboratory (PPPL), DIII-D at General Atomics (GA), and Alcator C-Mod at the Massachusetts Institute of Technology (MIT). These facilities consist of magnetic plasma confinement devices, plasma heating and current drive systems, diagnostics and instrumentation, experimental areas, computing and computer networking facilities, and other auxiliary systems. It includes the cost of operating personnel, electric power, expendable supplies, replacement parts and subsystems, and inventories. In the case of PPPL, this funding also supports the safe shutdown and mothballing of TFTR. General plant projects (GPP) funding for PPPL will be provided to support minor new construction, other capital alterations and additions, and for buildings and utility systems. Capital equipment (CE) funding for upgrading the research capability of DIII-D is also included, as are funds for design, fabrication and installation of NSTX.

The ultimate measure of success in this activity is whether the research scientists have data of sufficient quantity and quality to carry out their planned experiments or to discover new phenomena. The quality of data is dependent on the confinement device capabilities, and those of the plasma diagnostic and data processing equipment, and the degree to which those capabilities are achieved during a particular operating period. The quantity of data relates primarily to the operational availability of the facility and its data acquisition systems.

The principal objective of the Facility Operations Subprogram is to maximize the quantity and quality of data collected for approved experiments being conducted at FES facilities.

The following table summarizes the scheduled weeks of operations for DIII-D, Alcator C-Mod and TFTR. This table illustrates how the redirection of TFTR funds allows for increased operations of C-Mod and DIII-D.

Facility Utilization
(Weeks of Operation)

	FY 1996	FY 1997	FY 1998
TFTR	22	6-8	0
DIII-D	16	8	16
Alcator C-Mod	15	6-8	10-12

FUSION ENERGY SCIENCES
FACILITY OPERATIONS

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	% Change
Princeton Plasma Physics Laboratory .	$43,492	$30,971	$16,490	- 14,481	- 46.8%
General Atomics	18,575	19,100	22,139	+ 3,039	+15.9%
Massachusetts Institute of Technology	6,000	8,100	8,890	+ 790	+ 9.8%
Total Facility Operations	$68,067	$58,171	$47,519	- 10,652	- 18.3%

III. Performance Summary - Accomplishments

	FY 1996	FY 1997	FY 1998
Princeton Plasma Physics Laboratory	$43,492	$30,971	$16,490

TFTR will complete the highest priority D-T experiments by mid-FY 1997 and then enter into a process of safe and orderly shutdown. These funds provide for operation, maintenance, safe shutdown and caretaking of the TFTR facility, as well as for design, fabrication, and installation of the NSTX using existing equipment and facilities at the PPPL site. The maintenance of the laboratory physical plant is also supported.

- TFTR
  - -- FY 1996 - plasma operation using deuterium and D-T fuel for 22 weeks; followed by a maintenance and upgrade outage.
  - -- FY 1997 - plasma operation using deuterium and D-T fuel for 6-8 weeks; followed by safe shutdown and mothballing.
  - -- FY 1998 - maintained in mothball condition.

III. Performance Summary - Accomplishments	FY 1996	FY 1997	FY 1998
• NSTX Design, Fabrication, Installation			
-- FY 1996 - completed and reviewed engineering design, schedule, and cost estimates.			
-- FY 1997 - complete final design and start fabrication of components.			
-- FY 1998 - complete component fabrication and start assembly/installation.			
General Atomics	18,575	19,100	22,139

Provides support for operation, maintenance, improvement and enhancement of the DIII-D facility and supporting equipment at the GA site. A planned equipment enhancement of DIII-D includes increasing the microwave heating power and upgrading power supplies and other systems needed to extend the maximum operating pulse length.

- DIII-D
  - -- FY 1996 - plasma operation using hydrogen and deuterium fuel for 16 weeks; followed by a maintenance and upgrade outage.
  - -- FY 1997 - plasma operation using hydrogen and deuterium fuel for 8 weeks; plus down time for upgrades and maintenance.
  - -- FY 1998 - plasma operation using hydrogen and deuterium fuel for 16 weeks; plus down time for upgrades and maintenance.

FUSION ENERGY SCIENCES
FACILITY OPERATIONS

III. Performance Summary - Accomplishments

	FY 1996	FY 1997	FY 1998
MIT	6,000	8,100	8,890

Provides support for operation, maintenance, improvement and enhancement of the Alcator C-Mod facility and supporting equipment at the MIT site.

- Alcator C-Mod
  - -- FY 1996 - plasma operation using hydrogen and deuterium fuel for 15 weeks plus down time for maintenance.
  - -- FY 1997 - plasma operation using hydrogen and deuterium fuel for 6-8 weeks plus down time for maintenance.
  - -- FY 1998 - plasma operation using hydrogen and deuterium fuel for 10-12 weeks plus down time for maintenance.

TOTAL FACILITY OPERATIONS	$68,067	$58,171	$47,519

EXPLANATION OF FUNDING CHANGES FY 1997 TO FY 1998:

A decrease of $21,621,000 results from shutting down the TFTR at PPPL. This is partially offset by an increase of $7,140,000 in funding for fabrication and installation of NSTX.	-$14,481,000
The increase of $3,039,000 at GA supports more DIII-D experimental run time and continuing the upgrade of the DIII-D heat removal system.	+$3,039,000
The increase of $790,000 at MIT supports more Alcator C-Modified experimental run time.	+$790,000
Total Funding Change, Facility Operation	-$10,652,000

FUSION ENERGY SCIENCES

TECHNOLOGY

I. Mission Supporting Goals and Objectives: The Technology Subprogram provides the technological foundation for current fusion science as well as the research and engineering required to advance fusion science in future fusion experiments. Research will be performed in the areas of superconducting magnets, plasma heating and fueling, safety, plasma control, fuel processing and breeding, heat removal and high performance materials. Research and engineering design in support of the International Thermonuclear Experimental Reactor (ITER) Engineering Design Activities (EDA) is included in this Subprogram. At present, the four ITER parties are now engaged in pre-negotiations, i.e., non-committal discussions called "Explorations", to determine whether acceptable construction arrangements can be established consistent with the limitations of each party. It also includes the technology research necessary to establish the knowledge base needed for an economically and environmentally attractive fusion energy source, as well as assessments of critical aspects of integrated fusion systems. Research on low-activation materials will be focused on high performance fusion system materials capable of withstanding long-term exposure to energetic particles and electromagnetic radiation from fusion plasma reactions.

II. Funding Schedule:

Program Activity	FY 1996	FY 1997	FY 1998	$ Change	% Change
Engineering Research	$65,721	$56,536	$59,725	$+3,189	+ 5.6%
Materials Research	7,866	6,000	5,900	- 100	- 1.7%
SBIR	0	1,864	1,675	- 189	-10.1%
Total Technology	$73,587	$64,400	$67,300	$+2,900	+ 4.5%

III. Performance Summary - Accomplishments

	FY 1996	FY 1997	FY 1998
ENGINEERING RESEARCH	$65,721	$56,536	$59,725

The ITER EDA is the principal activity within Engineering Research and will be completed by the four ITER parties in FY 1998. The culmination of 6 years of design and supporting R&D, including preparation of a construction cost estimate and schedule, will be documented in the Final Design Report. This

III. Performance Summary - Accomplishments

report will serve as the technical basis for decisions on whether and where to build the ITER facility and whether and how to transition from the current working arrangements to a construction activity. In FY 1997, the Detailed Design Report will be completed and a review is underway.

The following table summarizes ITER EDA funding:

		B/A ($000)			
FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
51,936	62,731	69,349	54,438	54,736	54,500

Research on fusion plasma technologies of superconducting magnets, plasma facing components, and heating and fueling systems will continue at laboratories and universities. This work is needed in order to provide advanced technology components and systems required for the conduct of fusion plasma research. In addition, research on fusion safety, fuel breeding and processing systems will continue. This work is needed in order to provide a technical basis for future decisions on how and when to initiate larger scale development of these systems.

System studies of current as well as advanced fusion concepts and configurations will continue. This work is needed in order to provide guidance and direction for future program activities.

The FY 1998 work is essential in order to reach a decision on construction and also to complete satisfactorily the ITER design and R&D activities for future generic use within the U.S. domestic fusion program.

III. Performance Summary - Accomplishments

	FY 1996	FY 1997	FY 1998
MATERIALS RESEARCH	7,866	6,000	5,900

Development and testing of vanadium alloys, silicon carbide composite materials and advanced ferritic steels for structural service in the high power zones of fusion power systems will continue. Conceptual design of a fusion materials neutron source facility was completed in FY 1997 by an international team under the auspices of the International Energy Agency (IEA). U.S. involvement in the follow-on design and planning work will continue at a low level in FY 1998, in parallel with discussions among the IEA partners on their possible interest in constructing such a facility. If they decide to proceed toward construction, it is anticipated that the U.S. could also decide to participate, albeit at a very modest level. This work is a key element in developing safe, reliable and environmentally attractive fusion systems.

SBIR/STTR FUNDING	0	1,864	1,675

In FY 1996, $1,609,000 and $122,000 were transferred to the SBIR and STTR programs respectively. The FY 1997 estimate is for both SBIR and STTR. The FY 1998 estimate is for SBIR only since Part D, Section 110 of P.L. 104-208, making Omnibus Consolidated Appropriations for FY 1997 reauthorized STTR for FY 1997 only.

TOTAL TECHNOLOGY	$73,587	$64,400	$67,300

FUSION ENERGY SCIENCES
TECHNOLOGY

EXPLANATION OF FUNDING CHANGES FY 1997 TO FY 1998:

Program elements continue at essentially the FY 1997 level with modest increases in system studies and in research for advanced technologies in the areas of heating, blankets, and safety. The total increase of $2,900,000 provides for comparative studies of the alternative physics concepts and research on advanced plasma heating methods for use in current fusion experiments and on fusion blanket techniques that would have broad applicability to any fusion concept. In addition, safety evaluations will be conducted on the various alternate concepts.	$2,900,000
Total Funding Change, Technology	+$2,900,000

Major Issue

After the completion of the ITER EDA, the U.S. will determine whether it should continue to participate with the other ITER parties in the ITER construction, operation, and experimental activities in some limited form, if international construction proceeds.

FUSION ENERGY SCIENCES

PROGRAM DIRECTION

I. Mission Supporting Goals and Objectives: This subprogram provides the Federal staffing resources and associated funding needed to plan, direct, manage, and administer the highly complex scientific and technical research and development program in fusion energy. The Fusion Energy Sciences program is developing the magnetic and inertial approaches to attaining fusion energy as two separate and distinct programs, coordinating, on inertial fusion, with the Office of Defense Programs. International collaboration is an essential element of the program strategy and requires extensive coordination efforts.

Beginning in FY 1997, program organizations are contributing to a Working Capital Fund to cover the costs of centrally provided goods and services such as supplies, housing, utilities, audit services, etc., which previously were budgeted in Departmental Administration. In the FY 1998 request for Fusion Energy Sciences Program Direction, $500,000 has been included for the Working Capital Fund.

II. Funding Table:

	FY 1996 Current Appropriation	FY 1997 Original Appropriation	FY 1997 Adjustments	FY 1997 Current Appropriation	FY 1998 Budget Request
Chicago					
Salary and Benefits	$1,055	$1,028	$0	$1,028	$910
Travel	120	120	0	120	74
Support Services	0	0	0	0	0
Other Related Expenses ..	215	200	0	200	190
Total	$1,390	$1,348	$0	$1,348	$1,174
Full-Time Equivalents ...	17	12	0	12	10
Oakland					
Salary and Benefits	$167	$174	$0	$174	$184
Travel	17	14	0	14	14
Support Services	0	0	0	0	0
Other Related Expenses ..	2	2	0	2	2
Total	$186	$190	0	$190	$200
Full-Time Equivalents ...	2	2	0	2	2

II. Funding Table (cont'd):

	FY 1996 Current Appropriation	FY 1997 Original Appropriation	FY 1997 Adjustments	FY 1997 Current Appropriation	FY 1998 Budget Request
Headquarters					
Salary and Benefits	5,499	4,776	0	4,776	4,001
Travel	285	250	0	250	225
Support Services	1,000	980	0	980	600
Other Related Expenses a/	374	856	0	856	700
Total	$7,158	$6,862	$0	$6,862	$5,526
Full Time Equivalents ...	51	48	0	48	37
Total Fusion Energy Sciences					
Salary and Benefits	6,721	5,978	0	5,978	5,095
Travel	422	384	0	384	313
Support Services	1,000	980	0	980	600
Other Related Expenses .	591	1,058	0	1,058	892
Grand Total	$8,734	$8,400	$0	$8,400	$6,900
Full-Time Equivalents ...	70	62	0	62	49
Adjustment	0	-80 b/	0	-80 b/	0
Budget Authority	$8,734	$8,320	$0	$8,320	$6,900

a/ Other Related Expenses line in Headquarters includes Working Capital Fund estimates starting in FY 1997 and FY 1998.
b/ Share of Energy Supply, Research and Development general reduction for use of prior year balances assigned to this program. The total general reduction is applied at the appropriation level.

III. Performance Summary:	FY 1996	FY 1997	FY 1998
Salaries and Benefits: Reductions of 5 FTEs in FY 1997 and 2 in FY 1998 in Chicago result from cutbacks in the Fusion Energy Sciences Program at Princeton. Reductions of 3 FTEs in FY 1997 and 11 in FY 1998 at Headquarters result from streamlining and reorganization of the Office of Fusion Energy Sciences in response to direction from Congress and the recommendations of the Fusion Energy Sciences Advisory Committee regarding reorientation of the Fusion Energy Sciences Program.	$6,721	$5,978	$5,095
Travel: The reductions in travel in FY 1997 and FY 1998 are due to decreases in the number of travelers, as well as increased use of alternatives to travel, such as teleconferencing.	422	384	313
Support Services: Reductions in support services in both years result from the decrease in the size of the Fusion Energy Sciences Program. Support services provide for the program's mailroom, travel processing, technical support and computer systems development needs. Energy Research has the best record in the Department for judicious use of support services.	1,000	980	600
Other Related Expenses: The estimates for FY 1997 and FY 1998 include $600,000 and $500,000, respectively, for the new Headquarters Working Capital Fund. The remaining funds cover hardware and software for information architecture as well as rent and utilities for field staff.	591	1,058	892
TOTAL PROGRAM DIRECTION	$8,734	$8,400	$6,900

EXPLANATION OF FUNDING CHANGES FROM FY 1997 TO FY 1998:

Decrease of $883,000 in salaries and benefits resulting from the impact of the decrease in FTEs which is partially offset by general pay increases and promotions.	-$883,000
Decrease of $71,000 in travel is due to fewer travelers because of staffing reductions and increased use of alternatives to travel.	-$71,000
Decrease of $380,000 in support services is due to the decreases in the staff to be supported and in the size of the Fusion Energy Sciences program.	-$380,000
Decrease of $166,000 for other related expenses is due to reductions of $100,000 in the Working Capital Fund as a result of fewer staff to support and $66,000 in information infrastructure costs and rent and utilities in the field, also due to staffing reductions.	-$166,000
Total	-$1,500,000

Support Services	FY 1996 ($000)	FY 1997 ($000)	FY 1998 ($000)	FY 1998/ FY 1997 Change ($000)
Technical Support Service				
Feasibility of Design Considerations				
Economic and Environmental Analysis				
Test and Evaluation Studies				
Subtotal	0	0	0	0
Management Support Services				
Management Studies				
Training and Education	10	10	5	-5
ADP Support	530	520	245	-275
Administrative Support Services	460	450	350	-100
Subtotal	1,000	980	600	-380
Total Support Services	1,000	980	600	-380
Use of Prior Year Balances				

Other Related Expenses	FY 1996 ($000)	FY 1997 ($000)	FY 1998 ($000)	FY 1998/ FY 1997 Change ($000)
Training				
Working Capital Fund	0	600	500	-100
Printing and Reproduction				
Rental Space	35	30	26	-4
Software Procurement/Maintenance Activities/Capital Acquisitions	556	428	366	-62
Other				
Total Obligational Authority	591	1,058	892	-166
Use of Prior-Year Balances				
Total Budget Authority	591	1,058	892	-166

FUSION ENERGY SCIENCES CAPITAL OPERATING EXPENSES & CONSTRUCTION SUMMARY
(Tabular dollars in thousands, narrative in whole dollars)

	FY 1996	FY 1997	FY 1998	$ Change	% Change
Capital Operating Expenses					
General Plant Projects (total)	$ 500	$ 300	$ 600	$+ 300	+100.0%
Capital Equipment (total)	3,670	5,917	14,790	+ 8,873	+150.0%

Major Items of Equipment (CE $2 Million and Above)

	TEC	Previous Approp.	FY 1996 Approp.	FY 1997 Approp.	FY 1998 Request	Acceptance Date
1. DIII-D Upgrade	$32,400	$14,300	$ 1,675	$ 1,500	2,440	FY 2000
2. NSTX	18,500 a/	0	0	3,450	11,300	FY 1999

a/ The preliminary TEC for NSTX is $18,500,000, plus $2,700,000 of associated operating funding to provide for conceptual design, physics support and R&D. A revised cost estimate, now under review, will be based on the detailed engineering design and will account for installing the experiment at the TFTR site rather than the originally planned location. The TEC will increase modestly, but the TFTR site will provide much greater research capability by allowing the use of TFTR's neutral beams and power systems.