DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
GENERAL SCIENCE AND RESEARCH

OVERVIEW

SUPERCONDUCTING SUPER COLLIDER (SSC)

Research in high energy physics is directed at understanding the nature of matter and energy at the most fundamental level and the basic forces which govern all processes in nature. Experimental research in high energy physics most often requires the use of large particle accelerators, colliding beam devices, and large particle detectors. The ability to carry out forefront exploratory research on the physics frontier is critically dependent on the experimental capabilities of the accelerators, colliding beam and detector facilities. The Stanford Linear Collider (SLC) and the Fermilab Tevatron, together with the other high energy physics facilities, will keep the U.S. program highly competitive and at the cutting edge for the next several years.

Although the present model for understanding the subnuclear world has been very successful, we know that it is not complete and cannot provide answers to a number of very fundamental questions. After extensive studies and careful review it has been determined that exploration of the TeV mass region is essential to advance understanding of the fundamental nature of matter and energy and to enable the U.S. High Energy Physics program to remain at the research frontier in the late 1990's and beyond. To explore this region a new, more powerful particle accelerator is required. The SSC is a proton-proton collider having an energy of up to 20 TeV per beam that will permit exploration of this new domain of physics research in which major breakthroughs in understanding are anticipated and which cannot be reached by any other facility either in existence or planned. The SSC holds the potential for new breakthroughs in science, technology and education. While the primary purpose of the SSC is to provide new fundamental knowledge and insights, history has clearly demonstrated that major advances in fundamental understanding lead subsequently to developments in technology and practical products which profoundly affect the quality of life for all Americans and enhance the economic competitiveness of our nation.

The SSC is a critical part of the Administration's initiative to strengthen the position of the nation as a world leader in science and technology. It will be both a symbol of the nation's commitment to scientific leadership in this century and the next, and an instrument by which U.S. leadership can be maintained. It will produce discoveries, innovations and spin-offs that could profoundly touch every American.

The design of the SSC is based firmly on principles and engineering concepts used in previous accelerators. It is backed by an R&D program specifically related to the SSC which has been in progress since FY 1984, by prior efforts in the High Energy Physics program to develop accelerator-quality superconducting magnets and by the experience gained in the successful operation of the Tevatron. A preliminary design and cost estimate developed in the 1986 Conceptual Design Report and supporting documentation have served as a baseline for the project. In January 1989, the Department selected the site for the SSC and awarded a contract to Universities Research Association, Inc., to serve as the Management and Operating Contractor for the SSC. A revised conceptual design has been prepared to reflect the characteristics of the Texas site and R&D achievements since 1986. This forms the basis for the technical, cost and schedule baseline for the SSC developed by the Department in September of 1990. The baseline TPC is $8.249 billion (as-spent), with completion projected by the end of FY 1999.

There has been substantial progress on the Superconducting Super Collider (SSC) in 1990. The management of the SSC Laboratory has recently been substantially strengthened, and we now have a very strong management team with a combination of major construction and technical project experience. The Department has established an On-Site Project Office, with sufficient resources and the appropriate delegation of authority and responsibilities to the Project Director to ensure that the SSC is built to the cost and schedule baseline. A major step forward in the collider superconducting dipole magnet program was taken recently with the selection of the leader and follower contractors for the engineering development and demonstration of manufacturability phase of this program. The architect-engineer/construction management firm for the project has been selected and is under contract. Additionally, even in the current climate of budget and economic restraint, we have obtained a commitment from the State of Texas for a total contribution of $149 million for FY 1991. The support from Texas is key to maintaining the project's momentum in FY 1991 and is in concert with a Memorandum of Understanding signed with the Texas National Research Laboratory Commission, outlining principles of agreement between the Department and the State of Texas.

The request for Federal funds in FY 1992 includes $103,593,000 in operating funds for continued R&D on superconducting magnets, R&D on other accelerator technical systems, R&D on detector subsystems, and DOE program direction costs; $56,340,000 in capital equipment funds for detector subsystem prototypes, accelerator component and system prototypes, apparatus in support of on-site accelerator system and magnet tests, laboratory computing equipment, and a variety of general laboratory equipment and instrumentation essential to establishing a new research laboratory; and, $373,767,000 in federal construction funds for detailed design of technical systems and conventional facilities, the magnet industrialization program, fabrication of injector and collider technical systems and components, on-site construction of conventional facilities and project management and administration. In addition to the Federally-funded activities described above, construction of on-site facilities and work on technical systems is expected with funds contributed by the State of Texas. The contribution of Texas funds will be in accordance with the Memorandum of Understanding between the Department and the State of Texas which outlines principles of agreements for contributions to the SSC and support of the project. Exact funding contributions for each

fiscal year will be agreed upon annually. Some international contributions to accelerator construction and detectors may become available in FY 1992 in the form of design work on subsystems and components. Advanced teams and delegations led by the Deputy Secretary have visited Japan, Korea, Western Europe and Canada. Negotiations with India have begun and discussions with the Soviets are beginning.

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
GENERAL SCIENCE AND RESEARCH
(dollars in thousands)
LEAD TABLE
Superconducting Super Collider (SSC)

Activity	FY 1990 Actual	FY 1991 Estimate	FY 1992 Base	FY 1992 Request	Program Change Request vs Base	
					Dollar	Percent
Operating Expenses.....	$69,587 a/b/	$116,000	$116,620	$103,593	$- 13,027	- 11%
Capital Equipment.....	20,706	33,000	33,000	56,340	+ 23,340	+ 71%
Construction.....	126,592	93,866	93,866	373,767	+279,901	+ 298%
Total.....	$216,885 c/	$242,866 c/	$243,486	$533,700 c/	$+290,214	+ 119%
Operating Expenses.....	($69,587)	($116,000)	($116,620)	($103,593)	- 13,027	+ 11%
Capital Equipment.....	(20,706)	(33,000)	(33,000)	(56,340)	+ 23,340	+ 71%
Construction.....	(126,592)	(93,866)	(93,866)	(373,767)	+ 279,901	+ 298%
Total Program.....	($216,885)	($242,866)	($243,486)	($533,700)	$+290,214	+ 119%
Staffing (FTEs).....	15	58	70	89		

Authorization: Section 209, P.L. 95-91.

a/ Includes $2,400,000 reprogrammed from SSC Construction for 18 additional FTEs. Does not include $838,000 in in FY 1990 General Science Program Direction support.
b/ Total has been reduced by $847,000 reprogrammed to Energy Supply for SBIR.
c/ Includes funding provided through appropriation process only. Non-federal contributions will permit additional activities. The size and scope of these contributions will be known after firm agreements with the State of Texas and foreign partners are completed.

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
GENERAL SCIENCE AND RESEARCH
(dollars in thousands)

SUMMARY OF CHANGES

Superconducting Super Colllider (SSC)

FY 1991 Appropriation	$ 242,866
Adjustments - Increased personnel costs	+ 620
FY 1992 Base	$ 243,486
SSC R&D and Operations	
- R&D to concentrate on design of superconducting magnets and development of designs for the injectors, other collider technical systems and detectors	- 16,307
- Additional personnel and support costs	+ 3,280
Capital Equipment	
- Equipment in support of SSC accelerator and detector R&D programs and for general purpose equipment essential to set up a new laboratory	+ 23,340
Construction	
- Enhanced level of SSC construction for major efforts on both technical components and conventional facilities	+279,901
FY 1992 Congressional Budget Request	$ 533,700

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
GENERAL SCIENCE AND RESEARCH
(dollars in thousands)

KEY ACTIVITY SUMMARY

SUPERCONDUCTING SUPER COLLIDER (SSC)

I. Preface: SSC Research, Development and Operations

The SSC R&D program provides support for the studies that develop the conceptual design and technological foundation for the SSC and its technical systems. The program currently has a strong focus on superconducting magnet development but also includes R&D on detectors and other accelerator systems which are also critical elements of the SSC.

This subprogram also provides the Federal staffing resources and associated funding required to plan, direct, and administer a highly complex program to plan, design, construct, and operate the multibillion dollar SSC. The magnitude and complexity of the project resulted in approval of the Office of Superconducting Super Collider (OSSC) which reports directly to the Director of Energy Research. An SSC On-Site Project Office (SSCPO) at the SSC site in Texas has also been established which reports directly to OSSC.

II. A. Summary Table: SSC Research, Development and Operations

Program Activity	FY 1990 Enacted	FY 1991 Enacted	FY 1992 Request	% Change
SSC R&D	$ 67,187	$ 108,900	$ 92,593	- 15
SSC Program Direction	2,400	7,100	11,000	+ 55
Total, SSC Research, Development and Operations	$ 69,587	$ 116,000	$ 103,593	- 11

III. Activity Descriptions: (New BA in thousands of dollars)

Program Activity	FY 1990	FY 1991	FY 1992
SSC Research, Development and Operations			
SSC R&D	The three major emphases of the FY 1990 R&D program were superconducting dipole magnet R&D, the development of the site-specific conceptual design and cost estimate, and detector R&D. The superconducting magnet R&D program under the guidance of the SSC Laboratory continues to be pursued largely at Fermilab, BNL, and LBL pending establishment of on-site facilities in Texas. The program of fabrication and testing of full-length 4cm magnets has been highly successful. The development of the new 5cm aperture design is now underway. Accelerator R&D includes developing design specifications and technical systems requirements for injector and collider technical systems, integration of technical systems, establishing primary beam parameters, beam dynamics and particle tracking studies, and the fabrication and testing of prototypes of accelerator components and systems. The detector R&D program includes continuation of the generic detector R&D program and the initiation of a program of detector subsystems R&D.	In FY 1991 the superconducting magnet R&D program will continue fabricating and testing 40mm magnets, further refine and develop the design of the 50mm magnets and test that design with short model magnets, fabricate and prepare for testing the first full-length 50mm magnets, continue R&D on superconductor, work with the industrial vendors to prepare for producing the first dozen test magnets, and begin preparations for the magnet string test scheduled for late in FY 1992. A significant portion of the work is conducted at other laboratories. Accelerator R&D will include refinement of the design of the injector accelerators & collider technical systems, the fabrication and testing of prototypes of components, the development of specifications for long lead procurements, and preparation of the accelerator systems required for the magnet string tests. The detector R&D will focus on an enhanced program of detector subsystem R&D and the development of detailed proposals for specific detectors.	A major feature of the FY 1992 R&D program will be final preparation for and implementation of the magnet string test to take place late in the fiscal year. Superconducting magnet R&D will continue to further refine the superconducting dipole design and to pursue development of the superconducting quadrupole and high energy booster superconducting dipole magnets ($31,800). Accelerator R&D will focus on testing and evaluation of prototypes of components and systems refinements of the design of the injectors and collider, and the development of final specifications for procurement of these systems ($30,100). Detector subsystem R&D will continue at a reduced level and the emphasis will progressively shift toward specific approved detectors after first stage approval of experiments early in FY 1992 ($4,600). The remainder of the request is needed to support general laboratory operations such as laboratory management and administration, and the laboratory's, technical and experimental support groups ($26,093).
	$ 67,187	$ 108,900	$ 92,593

III. SSC Research, Development and Operations (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
SSC Program Direction	Provided funds for salaries, benefits, and travel for 15 full-time equivalents (FTEs) in the Office of Superconducting Super Collider (OSSC) and at the on-site Chicago Support Office. ($1,423)	Provide funds for salaries, benefits, and travel for 58 FTEs for OSSC, including 6 additional FTEs above the FY 1991 budget. ($5,910)	Provide funds for salaries, benefits, and travel for 83 FTEs for the Office of SSC and 6 FTEs for Energy Research support personnel, including 5 FTEs transferred from other Energy Research programs. Provide for 31 additional FTEs above the revised FY 1991 level and for normal increased personnel costs resulting, for example, from general pay raises and within-grade and merit increases. ($8,950)
	The OSSC-HQ provided program direction and management oversight of the DOE SSC program totaling $217 million as well as the non-Federal funding contributions. R&D focused on magnet industrialization, detectors, engineering and fabrication of injectors, accelerator R&D, physics, and theoretical analyses. External relations increased, particularly with Texas regarding land acquisition and funding contributions. State and international agreements for cost-sharing arrangements were being negotiated. Workload related to project management plans, briefings, reviews, and documentation continued to be heavy. OSSC-HQ staff has primary responsibility for project control activities as well as policy and technical direction to the on-site SSC Project Office (SSCPO).	Provide 22 FTEs to staff the OSSC-HQ to manage an SSC program with a total FY 1991 budget of $392 million which includes non-Federal contributions. Significant staff time will be expended on negotiation and implementation of cost-sharing arrangements with Texas and foreign partners. Continue to manage the expanded scientific R&D program and provide guidance and oversight from HQ on detailed design and civil construction activities. Manage the project baseline at the HQ level and meet the heavy demand for project reviews, briefings and information requests from the Congress, public and media. Provide ES&H support to ensure safe and efficient project implementation, including completion of the Supplemental Environmental Impact Statement and the associated Record of Decision.	Provide 28 FTEs to continue to staff the OSSC-HQ to manage the DOE SSC program and additional non-Federal contributions. Continue negotiation and implementation of detailed cost-sharing arrangements with Texas and foreign countries. Continue accelerator R&D programs to finalize conceptual designs of superconducting magnets, injector accelerators and other technical systems, and fabricate and test models of components. Manage increased workload related to detailed detector design and prototyping activities. Continue to manage project control at the HQ level and meet demands for project reviews, briefings, information requests, ES&H, and other program support requirements of the SSC project.

III. SSC Research, Development and Operations (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
SSC Program Direction (Cont'd)	Began to staff the SSCPO to provide technical guidance and support activities at the site, with the State of Texas, and with the M&O contractor; provide guidance and oversight on the scientific program and monitor technical progress; provide engineering and construction support; maintain project control at the field level; and ensure ES&H and quality assurance control and compliance. Provided on-site contract administration, industrial relations, personnel, and administrative services. Provided OSSC-HQ assistance as required.	Provide 36 FTEs to staff the SSCPO, including the addition of 6 FTEs above the FY 1991 budget base to ensure that the appropriate oversight and management are available at the on-site office to ensure that cost and schedule baselines are met and to implement recent delegations of personnel and procurement authority. Provide project oversight and guidance and manage on-site systems engineering and civil construction activities including site preparation, campus buildings, and injector facilities. Oversee development of technical systems such as the collider dipole magnets. Interact daily with M&O contractor staff and State of Texas representatives. Assist OSSC-HQ as required.	Provide 55 FTEs to continue to staff the SSCPO to provide effective day-to-day DOE oversight and management of this large, complex project which is one of the Department's and Administration's major science initiatives. Continue to provide project oversight of construction activities at the site, monitor the many design and development efforts for technical systems, oversee the laboratory's procurement and business activities, administer the M&O contract, and provide administrative support at the site. Serve as focal point for daily interactions with M&O contractor staff, State of Texas representatives, and OSSC-HQ and others as required. TRANSFER: Provide six FTEs for ER program and management support to the SSC in the areas of budget and finance, personnel administration, acquisition and assistance, policy review and coordination, and construction management support. Five FTEs were transferred from other ER programs. The additional FTE is required for increased support to the complex SSC project.
	Provided a variety of program support to the OSSC-HQ and SSCPO such as printing and binding, supplies and materials, and contractual support such as relocation services, telecommunications and rents. ($977)	Provide for a variety of program support as in FY 1990 at an increased level to support the additional staff. Provide for rents at the site, employee relocations, and other services at the SSCPO. ($1,190)	Continue a variety of program support as in FY 1990 and FY 1991. Increased funding will provide support for additional staff, primarily at the site. ($2,050)
	$ 2,400	$ 7,100	$ 11,000

III. SSC Research, Development and Operations (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
SSC Research, Development and Operations	$ 69,587	$ 116,000	$ 103,593

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(dollars in thousands)

KEY ACTIVITY SUMMARY

SUPERCONDUCTING SUPER COLLIDER (SSC)

I. Preface: SSC Capital Equipment

The SSC has significant capital equipment requirements for procurements in support of R&D efforts on the many accelerator technical system and components and for initial procurement of detector components and systems. Also included are the equipment needs for establishing a major new research laboratory, including in-house computing capability, acquisition of general purpose scientific instrumentation and general laboratory support equipment.

II. A. Summary Table: SSC Capital Equipment

Program Activity	FY 1990 Enacted	FY 1991 Enacted	FY 1992 Request	% Change
SSC Capital Equipment.....	$ 20,706	$ 33,000	$ 56,340	+ 71
Total, SSC Capital Equipment	$ 20,706	$ 33,000	$ 56,340	+ 71

III. Activity Descriptions: (New BA in thousands of dollars)

Program Activity	FY 1990	FY 1991	FY 1992
SSC Capital Equipment	Provides capital equipment in support of the SSC R&D programs and for establishing an effective research laboratory. The FY 1990 equipment acquisitions include prototypes of detector subsystems and accelerator technical components and systems for the four injectors and the collider; computing equipment; equipment needed to establish on-site magnet testing and development capabilities, and a variety of power supplies, electronics, test instrumentation, and other equipment needed when establishing a major new research laboratory.	In FY 1991 there will be an enhancement in the level of prototypes of detector subsystems and components, an increase in accelerator component and systems prototyping and an enhanced level of equipment required to establish a new laboratory.	Provides for fabrication of prototypes for detector subsystems and components ($29,540); prototypes of accelerator components and systems for the four injector accelerators and the collider and equipment for on-site testing ($14,900); equipment in support of the magnet R&D effort ($5,300), a variety of items of general laboratory technical support equipment that are essential when establishing a new research laboratory ($6,600).
	$ 20,706	$ 33,000	$ 56,340
SSC Capital Equipment	$ 20,706	$ 33,000	$ 56,340

III. Activity Descriptions: (New BA in thousands of dollars)

Program Activity	FY 1990	FY 1991	FY 1992
SSC Research, Development and Operations			
SSC R&D	The three major emphases of the FY 1990 R&D program were superconducting dipole magnet R&D, the development of the site-specific conceptual design and cost estimate, and detector R&D. The superconducting magnet R&D program under the guidance of the SSC Laboratory continues to be pursued largely at Fermilab, BNL, and LBL pending establishment of on-site facilities in Texas. The program of fabrication and testing of full-length 4cm magnets has been highly successful. The development of the new 5cm aperture design is now underway. Accelerator R&D includes developing design specifications and technical systems requirements for injector and collider technical systems, integration of technical systems, establishing primary beam parameters, beam dynamics and particle tracking studies, and the fabrication and testing of prototypes of accelerator components and systems. The detector R&D program includes continuation of the generic detector R&D program and the initiation of a program of detector subsystems R&D.	In FY 1991 the superconducting magnet R&D program will continue fabricating and testing 40mm magnets, further refine and develop the design of the 50mm magnets and test that design with short model magnets, fabricate and prepare for testing the first full-length 50mm magnets, continue R&D on superconductor, work with the industrial vendors to prepare for producing the first dozen test magnets, and begin preparations for the magnet string test scheduled for late in FY 1992. A significant portion of the work is conducted at other laboratories. Accelerator R&D will include refinement of the design of the injector accelerators & collider technical systems, the fabrication and testing of prototypes of components, the development of specifications for long lead procurements, and preparation of the accelerator systems required for the magnet string tests. The detector R&D will focus on an enhanced program of detector subsystem R&D and the development of detailed proposals for specific detectors.	A major feature of the FY 1992 R&D program will be final preparation for and implementation of the magnet string test to take place late in the fiscal year. Superconducting magnet R&D will continue to further refine the superconducting dipole design and to pursue development of the superconducting quadrupole and high energy booster superconducting dipole magnets ($31,800). Accelerator R&D will focus on testing and evaluation of prototypes of components and systems refinements of the design of the injectors and collider, and the development of final specifications for procurement of these systems ($30,100). Detector subsystem R&D will continue at a reduced level and the emphasis will progressively shift toward specific approved detectors after first stage approval of experiments early in FY 1992 ($4,600). The remainder of the request is needed to support general laboratory operations such as laboratory management and administration, and the laboratory's, technical and experimental support groups ($26,093).
	$ 67,187	$ 108,900	$ 92,593

III. Activity Descriptions: (New BA in thousands of dollars)

Program Activity	FY 1990	FY 1991	FY 1992
Construction	Provides initial construction funding for the SSC. Permits a significant program of detailed design of technical components and conventional facilities, initiation of the magnet industrialization program, selected long lead procurements for the injectors, and build-up of the laboratory staff and support capabilities.	Provides for detailed design of technical systems and conventional facilities, including the AE/CM contractor. Technical systems construction includes procurement of linac components (RFQ and klystrons), cryogenics and control systems. The magnet program includes the dipole industrial contract, initiation of the quadrupole contract and procurement of components for the magnet development and test laboratories. Conventional construction includes the award of the first collider, three buildings in the magnet facility, the linac enclosure, the Accelerator System String Test (ASST), cryogenics and support facilities in the E-1 area, the accelerator shop and warehouse, and some utilities and infrastructure.	Provides $194,000 for the magnet program, including the Collider Dipole Magnet Industrialization Program which includes the development and acquisition of tooling, the fabrication of 15 prototype magnets by industry and the procurement of materials and components for the 70 preproduction magnets to be manufactured in FY 1993. The remainder of the magnet program includes the collider quadrupole contract, the high energy booster dipole and quadrupole contract, procurement of equipment and tooling for the on-site magnet facilities, and advance procurement of superconducting wire and cable. Also provides $43,000 for detailed design of conventional facilities (collider tunnel, injector enclosures, campus buildings, and other surface facilities); $44,000 for collider system technical components other than the superconducting magnets; and $41,000 for injector technical systems for the linac, Low Energy Booster (LEB) and Medium Energy Booster (MEB); Conventional facilities construction includes the award of the first collider tunnel sector and initiation of construction in the fourth quarter of FY 1992 ($59,000); onsite utilities and roads for the west east campuses, and the administration building at the west interaction region ($106,000), and the LEB enclosure is constructed in total and construction of the MEB enclosure is initiated ($20,000). Also provides $17,000 for project management and administration. Of the total construction requirement of $524,000 described above it is expected that approximately $150,000 will be met with expected non-Federal

III. Construction (Cont'd):

Program Activity	FY 1990	FY 1991	FY 1992
Construction (Cont'd)			contributions, primarily from the state of Texas ($130,000). It is expected that their funds would primarily be used for the conventional construction activities in the areas of collider facilities and injector facilities. The Federal construction funding requirement is therefore estimated to be $373,767.
	$ 126,592	$ 93,866	$ 373,767
Construction	$ 126,592	$ 93,866	$ 373,767

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
OFFICE OF ENERGY RESEARCH
GENERAL SCIENCE AND RESEARCH
(dollars in thousands)

KEY ACTIVITY SUMMARY

CONSTRUCTION PROJECTS

Superconducting Super Collider

IV. A. Construction Project Summary

Project No.	Project Title	Total Prior Year Obligations	FY 1991 Request	FY 1992 Request	Unappropriated Balance	TEC
90-R-106	Superconducting Super Collider	$ 126,592	$ 234,844	$ 523,767	$5,466,000	$6,351,203
	Less Estimated Non-Federal Contributions	(0)	(140,978)	(150,000)	(2,301,000)	(2,591,978)*
Total, Federal Superconducting Super Collider Construction		$ 126,592	$ 93,866	$ 373,767	$3,165,000	$3,759,225

* Estimate based on DOE goal for non-Federal participation in SSC. Firm agreements are yet to be negotiated.

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GENERAL SCIENCE AND RESEARCH
(dollars in thousands)

KEY ACTIVITY CONSTRUCTION PROJECT SUMMARY

Superconducting Super Collider (SSC)

IV. B. Plant Funded Construction Project

Project TEC: $6,351,203a/

1. Project title and location: 90-R-106
Superconducting Super Collider (SSC)
Ellis County, Texas

Start Date: 1st Qtr. FY 1990
Completion
Date: 4th Qtr. FY 1999a/

2. Financial schedule:

Fiscal Year	Appropriated[a/]	Obligations	Costs
1990	126,592	102,704	84,995
1991	234,844	258,732	185,900
1992b/	523,767	523,767	390,300
1993	710,688	710,688	673,900
1994	972,757	972,757	938,400
1995	1,010,321	1,010,321	1,021,100
1996	1,092,829	1,092,829	1,114,100
1997	875,481	875,481	998,200
1998	686,510	686,510	801,900
1999	117,414	117,414	142,408

3. Narrative:

- The Superconducting Super Collider is a high luminosity proton-proton collider with beam energy of up to 20 trillion electron volts (TeV). The collider itself consists of two rings of superconducting magnets and associated systems in a common tunnel, about 54 miles in circumference. Up to four interaction regions will be outfitted with collision halls and support areas for experiments. The project includes a series of injector accelerators which provide the input beam for acceleration and circulation in the collider rings. The associated office and laboratory facilities (buildings, structures, and utilities) required to support the technical systems are also included.

a/ Total construction project funding indicated. Funding required through appropriation process will be less as a result of anticipated non-federal contributions. The Department is seeking non-Federal participation in the SSC to share the benefit and the responsibility of the construction and operational phases of the SSC program. The data presented are estimates based on obtaining one-third of the Total Project Cost from non-Federal contributions. Identification of the details of the non-Federal contributions will depend upon completion of negotiation of agreements with foreign partners and on cost-sharing agreements with Texas.

b/ Reflects savings of $6.3 million BA and $4.7 million BO due to proposed David Bacon Amendment.

- The SSC will ensure forefront experimental capability for continued progress in advancing the frontier of knowledge of matter and energy at its most fundamental level, with resulting impacts on the Nation's science and technology base. The collider will cause oppositely directed bunches of protons to collide, basically head-on, making available a total of up to 40 TeV of energy within an extremely small volume. These energies are expected to produce new types of matter and new forms of energy. Internal structure, and even more basic building blocks of matter, may be revealed. Large detectors will be used in the interaction regions to detect and record interactions of interest. The SSC, through its investigation of fundamental physical processes, will provide new insights into questions of great significance to other sciences as well as high energy physics, and to our knowledge and understanding of the world in which we live. It will be a powerful and unique tool for extending those investigations of matter and energy that have led us to an understanding of the atom, the nucleus, and on to their smallest components.

- Construction activities will proceed at a significantly enhanced pace in FY 1992. The request for appropriated funds includes: $43 million for conventional facilities design, $185 million for conventional facility construction, $41 million for injector technical systems fabrication, $194 million for superconducting magnet program, $44 million for collider technical system fabrication (other than the superconducting magnets); and $17 million for project management, support equipment, and rental space of the $524 million requirement for construction, it is estimated that $150 million will be provided from non-Federal funds, resulting in a requirement for $374 million of Federal funds. No tunnel construction will occur before the 4th quarter of FY 1992.

- Total BA funding for the project including construction, detectors and R&D and preoperational costs in escalated dollars are:

(Dollars in Millions)

	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY1999	Total
Total Project Funding	$ 33.0	$ 97.6	$ 214.5	$ 384.8	$ 672.7	$871.1	$1,137.6	$1,194.1	$1,302.7	$1,101.7	$915.9	$323.4	$8,249.1
Estimated Non-Federal Contributions	0	0	0	149.0	150.0	233.0	427.0	466.0	570.0	250.0	250.0	105.0	2,600.0
Federal Share[c/]	$ 33.0	$ 97.6	$ 214.5	$ 235.8	$ 522.7	$638.1	$ 710.6	$ 728.1	$ 732.7	$ 851.7	$665.9	$218.4	$5,649.1

c/ Excludes direct Federal management and on-site administrative costs shown below. (BA in Thousands)

	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996
Program Direction.....	$ 2,400	$ 7,100	$11,000	$11,900	$12,400	$13,000	$13,700
FTE's.....	15	58	89	96	96	96	96

4. Total Project Funding (BA in Thousands): (Federal Share - excludes Program Direction)

	Prior Years	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996
Construction.....	$ 0	$126,592	$ 93,866	$373,767	$477,688	$545,757	$544,321	$522,829
Operating Expenses & Capital Equipment.....	130,585	87,893	141,900	148,933	$160,412	$164,843	$183,779	$209,871

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET REQUEST
CONSTRUCTION PROJECT DATA SHEETS
PLANT AND CAPITAL EQUIPMENT
SUPERCONDUCTING SUPER COLLIDER (SSC)

(Tabular dollars in thousands. Narrative material in whole dollars.)

1. Title and location of project: Superconducting Super Collider (SSC)
Ellis County, Texas

2. Project No.: 90-R-106

3. Date A-E work initiated: 3rd Qtr. FY 1989

3.a Date physical construction starts: 1st Qtr. FY 1990

4. Date construction ends: 4th Qtr. FY 1999

5. Previous cost estimate: $4,300,000
Less amount for PE&D: 0
Net cost estimate: $4,300,000
Date: December 1988

6. Current cost estimate: $6,351,203
Less amount for PE&D: 0
Net cost estimate: $6,351,203
Date: December 1990

7. Financial Schedule:

Fiscal Year	Authorization*	Appropriations*	Obligations*	Costs
1990	$ 126,592	$ 126,592	$ 102,704	$ 84,995
1991	234,844**	234,844**	258,732	185,900
1992***	523,767	523,767	523,767	390,300
1993	710,688	710,688	710,688	673,900
1994	972,757	972,757	972,757	938,400
1995	1,010,321	1,010,321	1,010,321	1,021,100
1996	1,092,829	1,092,829	1,092,829	1,114,100
1997	875,481	875,481	875,481	998,200
1998	686,510	686,510	686,510	801,900
1999	117,414	117,414	117,414	142,408

* Total project construction funding indicated. Funding required through appropriation process will be less as a result of anticipated non-Federal contributions. The Department is seeking non-Federal participation in the SSC to share the benefit and responsibility of the construction and operational phases of the SSC program. The data presented are estimates based on obtaining non-federal contributions at a level of up to one-third of the TPC. The exact timing and magnitude of the non-Federal contributions will depend upon completion of agreements with non-Federal partners that specify which SSC systems are to be provided by others and how these systems fit into the project schedule. Improved firm estimates will be available after completion of definitive cost-sharing agreements with the State of Texas and foreign partners.

** Includes $93,866,000 of Federal funds and an estimated portion of the $149,000,000 Texas contribution in FY 1991.

*** Reflects savings of $6.3 million BA and $4.7 million BO due to proposed Davis Bacon Amendment.

1. Title and location of project: Superconducting Super Collider (SSC)
Ellis County, Texas

2. Project No.: 90-R-106

8. Brief Physical Description of Project

The Superconducting Super Collider (SSC) consists of a superconducting storage ring system in which beams of protons traveling in opposite directions in two rings of superconducting magnets are made to collide at certain interaction points, producing ultra-high energy reactions for physics studies. The project includes a series of injector accelerators which provide the input beam for acceleration and circulation in the collider rings. The associated laboratory facilities (buildings, structures, and utilities) required to support the technical systems are included.

Proposed SSC Design Objectives

Proton beam energy up to 20 TeV

Luminosity $10^{33}cm^{-2}s^{-1}$

Number of interaction regions 4 (plus 4 potential)

In the collider, oppositely directed bunches of protons, each with an energy of up to 20 TeV (20 trillion electron volts), are caused to collide with each other, almost head-on, making available a total of 40 TeV of energy in each proton-proton collision. Since the probability of interaction per proton is comparatively low, the beams can be recirculated to collide repetitively for many hours without significant attenuation. Thus the SSC is constructed as a pair of storage rings capable of holding tightly confined, counter-rotating proton beams. The rings are made to cross at up to eight locations where the collision reactions take place and where detectors that observe and measure the reaction products for physics study can be located. Four interaction regions are to be provided in the base project. The design can accommodate future beam bypass tunnels where an additional four interaction regions could be added for future expansion of experimental capabilities.

1. Title and location of project: Superconducting Super Collider (SSC)
Ellis County, Texas

2. Project No.: 90-R-106

8. Brief Physical Description of Project (continued)

The two collider rings confining the proton beams are housed one above the other in a common underground tunnel. The beams are guided around the desired path through an evacuated tube by a system of superconducting electromagnets. This magnetic confinement system consists of a periodic array of bending and focusing magnets. The circumference of the rings is approximately 87 km (54 miles), a size governed by the maximum magnetic field and the maximum energy. The operating cycle of the SSC begins with the collider magnets maintained at low field for about seventy minutes while the proton beams are loaded into both collider rings. With injection complete, the acceleration system is activated. The increase in the beam energy is accompanied by a corresponding increase in the confining magnet strength thus keeping fixed the position of the beam orbit. This synchronous acceleration is complete in about twenty five minutes when the beams reach their collision energy of up to 20 TeV, about twenty times the injection energy. Then the beams are steered into collision at the interaction points. The resulting reactions can take place for about a day before the beams are depleted sufficiently so that the refill and acceleration cycle must be repeated. The design luminosity, a measure of the effectiveness of a collider in producing useful collisions, is 10^{33} cm $^{-2}s^{-1}$.

The injector system consists of a source and a linear accelerator (which accelerates the protons to 600MeV), a Low Energy Booster (LEB) (11GeV), a Medium Energy Booster (MEB) (200GeV) and a High Energy Booster (HEB) (2TeV). The MEB also provides test beams for use in testing detector components and systems.

By far the largest and most costly of the SSC technical systems are the main ring magnets -- some 8500 dipoles and nearly 2000 quadrupoles. An extensive cryogenic system is required to maintain the magnets at the operating temperature.

The SSC conventional facilities structures can be classified into four major categories -- the Collider Tunnel, the Collision Halls, the Campus-Injector Complex, and Cryogenic and Surface Support Facilities. The underground Collider Tunnel is approximately 54 miles in circumference. The tunnel is composed of arc sections of uniform periodicity, interrupted by two special sections called clusters. Within these clustered areas are the utility sections needed for specialized accelerator functions (such as injection, radio frequency acceleration, and the beam abort/dump facilities) and the collision halls containing the detectors. Four collision halls are to be constructed. For future flexibility, space has been left for four more collision halls.

The Campus-Injector Complex has a very different character. In this location, and to a lesser extent at the Interaction Hall Cluster on the other side of the ring, there are groups of laboratory, shop and office buildings with associated grounds, roads, parking lots, utilities yards, etc. The utilities and services for the entire SSC, as well as all of the operating staff, largely are concentrated in these two laboratory areas. The campus complex will consist of buildings arranged in four major groups -- laboratory, industrial, warehouses, and support buildings.

1. Title and location of project: Superconducting Super Collider (SSC) Ellis County, Texas

2. Project No.: 90-R-106

8. Brief Physical Description of Project (continued)

At the surface and distributed at a number of points around the ring are service areas which house refrigerator facilities with large helium compressors, power supplies and other support functions for the collider tunnel. These areas also have vertical shafts which provide tunnel access and egress for personnel and equipment. At two or more locations around the large ring are located major electrical sub-stations connecting the accelerator complex to the power grid. The entire facility requires a reliable and stable source of electric power with peak demands up to about 200 MW and a domestic water supply averaging 234,000 gallons per day.

The laboratory staff during regular operation will consist of about 2700 people, of whom 2200 are resident staff and workers and 500 are visiting scientists on short-term stays of days to months. During construction, the population will fluctuate. In addition to the basic buildings, roads and parking areas, appropriate environmental and support systems are needed for this population, including items such as heating and ventilation of buildings and work areas, provision for sewage and solid waste disposal, provision of police and fire protection, emergency medical aid and other standard considerations.

Construction activities will proceed at a significantly enhanced pace in FY 1992. The request for appropriated funds includes: $43 million for conventional facilities design; $185 million for conventional facility construction, $41 million for injector technical systems fabrication, $194 million for superconducting magnet program, $44 million for collider technical system fabrication (other than the superconducting magnets); and $17 million for project management, support equipment, and rental space. Of the $524 million requirement for construction, it is estimated that $150 million will be provided from non-federal funds, resulting in a request for $374 million of federal construction funds.

9. Purpose, Justification of Need, and Scope of Project

The purpose of the SSC is to ensure forefront experimental capability for continued progress in advancing the frontier of knowledge of matter and energy at the most fundamental level, with resulting impacts on the Nation's science and technology base. The scientific work of the laboratory will be focused on the study of reactions among the elementary constituents of matter at the highest energies.

1. Title and location of project: Superconducting Super Collider (SSC)
Ellis County, Texas

2. Project No.: 90-R-106

9. Purpose, Justification of Need, and Scope of Project (continued)

The SSC will build on the experience of earlier hadron-hadron colliders, especially the Fermilab Tevatron Collider, which has been in operation for a number of years with its superconducting magnets. The SSC represents an enormous step in both energy and luminosity over existing machines. In the energy regime of interest only a proton-proton machine is today capable of the high luminosity necessary to gather information on the rarest and possibly most interesting phenomena. The very high energy of the SSC will take it to a completely unexplored domain, providing answers to some of the most fundamental questions concerning the nature of matter and the forces acting on it, as well as uncovering new, unanticipated phenomena.

The recent progress of particle physics has brought astounding results. A distinct level of matter below the proton has been identified. Three generations of that matter have been found, and the basic forces between these particles have been identified. The present understanding of matter and forces is extensive and extraordinarily successful, but is not complete. Many crucial questions need to be answered. Are there more quarks and leptons? Are there additional levels of matter beneath the quarks and leptons? What is the origin of mass? Are there new, undiscovered forces in nature? New energy sources? These are some of the challenges in particle physics for which the SSC will play a major role.

Facilities in operation, or soon to be, will explore the near frontier but will be unable to extend the energy frontier to the extent necessary to address many important questions. The only currently feasible way to reach the energies of interest is by a high-luminosity, multi-TeV proton collider. The SSC will have impressive potential for discovery in the following areas:

New quarks and leptons

The SSC will search for new quarks and leptons up to masses of a few TeV, a factor of 40 beyond the present limit.

1. Title and location of project: Superconducting Super Collider (SSC) Ellis County, Texas

2. Project No.: 90-R-106

9. Purpose, Justification of Need, and Scope of Project (continued)

New force particles

The SSC will search for new force particles, like the W and Z of the weak force, up to masses of 7 TeV, a factor of 20 beyond the present 0.3 TeV.

New hypothetical particles

The SSC will search for hypothetical new "supersymmetric" particles up to masses of 1.5 TeV, a factor of about 20 beyond today's limit.

Mass generation

The SSC will explore the mass-generating phenomenon at energies more than an order of magnitude beyond today's limits.

Internal structure

The SSC will search for internal structure (even more basic building blocks) in quarks and leptons to distances 40 times smaller than the present limits.

These examples serve only to illustrate the power of the SSC relative to other high energy facilities. Nature is usually more subtle and intricate than the projection of the human mind. Surprises will surely occur and a rich and diverse research and discovery program will develop, including in directions not now even contemplated. The basic strength of the SSC is its long reach up in energy and its high luminosity.

The SSC, through its investigation of fundamental physical processes, will provide new insights into questions of great significance to other sciences as well as particle physics, and to our general knowledge and understanding of the world in which we live. It will be a powerful tool for extending those investigations of matter and energy that have led us to an understanding of the atom, the nucleus, and on to their smallest components.

1. Title and location of project: Superconducting Super Collider (SSC)
Ellis County, Texas

2. Project No.: 90-R-106

10. Details of Cost Estimate*

		Item Cost	Total Cost
a.	Engineering, Design, Inspection, and Administration @ approximately 20% of item b		$ 899,145
b.	Construction Costs		4,609,061
	1. Conventional Systems	$1,164,393	
	(a) Improvements to Land (site preparations, utilities, roads, fencing and landscaping) $ 148,168		
	(b) Campus Buildings 77,749		
	(c) Accelerator Facilities (structures & underground enclosures) 775,623		
	(d) Experimental Facilities (structures & underground enclosures) 162,853		
	2. Technical Systems	3,444,668	
	(a) Injector Systems 400,784		
	(b) Collider Systems		
	(1) Superconducting Magnets 2,207,477		
	(2) Other Systems 836,407		
c.	Contingency @ 15% of above costs (exclusive of a reduction for estimated contingency on the production of expected foreign in-kind contributions)		842,997
	Total Estimated Cost		$6,351,203

11. Method of Performance

Design, construction, and inspection of the facility will be the responsibility of the Operating Contractor. The design and construction of the conventional facilities will be subcontracted to architectural/engineering and construction/management firms. It is anticipated that the vast majority of the hardware and technical components will be procured from industry using fixed-price contracts awarded on the basis of competitive bidding. The private sector will be utilized to the maximum extent possible while meeting the SSC requirements in a cost effective manner.

CONSTRUCTION PROJECT DATA SHEETS

1. Title and location of project: Superconducting Super Collider (SSC) Ellis County, Texas — 2. Project No.: 90-R-106

12. Funding Schedule of Project Funding and Other Related Funding Requirements (dollars in millions)

	Prior[a/] Years	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97	FY 98	FY 99	Total
a. Total project cost												
1. Total facility cost												
(a) Construction line item.....	$ 0	$ 85.0	$185.9	$390.3	$673.9	$ 938.4	$1021.1	$1114.1	$998.2	$801.9	$142.4	$6351.2[b/]
2. Other project costs												
(a) R&D and Laboratory Support.....	123.1	51.4	114.5	107.7	89.9	66.6	53.8	53.3	56.4	66.0	74.0	856.7
(b) Pre-operations..	0	0	0	0	0	6.5	13.6	21.8	30.7	33.7	24.5	130.8
(c) Initial Complement of Detectors and Computers.....	7.5	25.5	33.7	39.9	72.4	91.2	116.5	133.9	138.0	133.2	118.6	910.4[c/]
Total other project costs.....	130.6	76.9	148.2	147.6	162.3	164.3	183.9	209.0	225.1	232.9	217.1	1897.9
Total project cost.....	$130.6	$161.9	$334.1	$537.9	$ 836.2	$1102.7	$1205.0	$1323.1	$1223.3	$1034.8	$359.5	$8249.1[d/]
Estimated Non-Federal Contribution.....	$ 0	$ 0	$149.0	$150.0	$ 233.0	$ 427.0	$ 466.0	$ 570.0	$ 250.0	$ 250.0	$105.0	$2600.0
Estimated Federal Costs.	130.6	161.9	185.1	387.9	603.2	675.7	739.0	753.1	973.3	784.8	254.5	$5649.1

a/ FY 1988 and FY 1989.
b/ Assumes site provided at no cost to DOE. Total construction cost including anticipated international, state, and other non-Federal contributions.
c/ Includes detector fabrication, as well as detector R&D and computers.
d/ Total project cost including a preliminary estimate of non-Federal contributions to the SSC. The exact magnitude and timing of the non-Federal contributions will depend on which SSC systems are provided by others and how these systems fit into the project schedule. Improved firm estimates will be available after completion of definitive agreements with the State of Texas and foreign contributors. The Department's goal is to achieve non-Federal participation up to one-third of the TPC.

1. Title and location of project: Superconducting Super Collider (SSC)
Ellis County, Texas

2. Project No.: 90-R-106

12. Funding Schedule of Project Funding and Other Related Funding Requirements (dollars in millions) (continued)

b. Annual Funding Requirements After Completion* (FY 1992 dollars)

1. Annual facility operating costs	$ 224.0
2. Capital equipment	66.0
3. General Plant Projects (GPP)	35.0
4. Accelerator Improvement Projects (AIP)	55.0
Total other related annual funding requirements	$ 380.0

*Cost levels estimated for normal operation in the first full year of operation after completion of construction.

13. Narrative Explanation of Total Project Funding and Other Related Funding Requirements

a. Total project cost

1. Total facility cost

Explained in items 8, 9, and 10

2. Other project costs

(a) R&D and Laboratory Support

This will provide further design and cost optimization of components. In addition to the Technical Accelerator systems, this program will also address the issues of Safety, Quality Assurance, Operations, Reliability, and Maintainability. Optimization of the facility for experimental High Energy Physics research potential will also be made. Also includes costs of laboratory technical support, administrator services and management costs.

1. Title and location of project: Superconducting Super Collider (SSC) Ellis County, Texas

2. Project No.: 90-R-106

13. Narrative Explanation of Total Project Funding and Other Related Funding Requirements (continued)

2. Other Project Costs (continued)

(b) Pre-Operation Costs

Pre-Operations costs are projected for the operations of each injector accelerator system and collider sector until commissioning of that element is completed. The successive completion of the Linac, LEB, MEB, and HEB injectors is forecast beginning in FY 1994. The costs for pre-operations include manpower, materials, power, and utilities associated with the commissioning of each accelerator system. Operating costs of technical systems beyond the completion of commissioning are to be covered outside of the TPC, as are general laboratory operating costs not directly related to the construction project.

(c) Initial Complement of Detectors

The baseline provides an allowance of $910 million for the initial complement of detector systems for the SSC, for detector R&D and for computing requirements.

b. Other Related Funding Requirements

Total costs are estimated for the operation of the SSC laboratory facility in the first full year of operation after construction completion. The projected costs for laboratory operations, capital equipment, GPP, and accelerator improvements are included.

DEPARTMENT OF ENERGY
FY 1992 CONGRESSIONAL BUDGET SUBMISSION
CONSTRUCTION PROJECT DATA SHEETS
GENERAL SCIENCE AND RESEARCH - PLANT AND CAPITAL EQUIPMENT
NUCLEAR PHYSICS
(Tabular dollars in thousands. Narrative material in whole dollars.)

1. Title and location of project: General plant projects
various locations

2. Project No. GPE-300

3. Date A-E work initiated: 1st Qtr. FY 1992

3a. Date physical construction starts: 2nd Qtr. FY 1992

4. Date construction ends: 2nd Qtr. FY 1994

5. Previous cost estimate: None
Less amount for PE&D: None
Net cost estimate: None
Date: None

6. Current cost estimate: $3,949
Less amount for PE&D: 0
Net cost estimate: $3,949
Date: May 1990

7. Financial Schedule:

Fiscal Year	Authorization	Appropriations	Obligations	Costs
1992	$ 3,949	$ 3,949	$ 3,949	$ 1,200
1993	0	0	0	2,000
1994	0	0	0	749

8. Brief Physical Description of Project

This project provides for minor new construction, other capital alterations and additions, and for improvements to land, buildings, and utility systems. Where applicable, the request also includes the cost of installed capital equipment integral to a subproject. No significant R&D program is anticipated as a prerequisite for design and construction.

Lawrence Berkeley Laboratory.....$ 3,050

Requirements include: rehabilitation of Building 58 substation and power distribution system, upgrade of fume exhaust system of Building 77 Plating Shop, cooling tower addition and upgrade for Building 62 and 66, roof replacement for Building 62, and renovation of Building 62 and 74 elevators.