DEPARTMENT OF ENERGY
FY 1990 CONGRESSIONAL BUDGET REQUEST
OFFICE OF ENERGY 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. Two recent major upgrades of U.S. high energy physics facilities, the Stanford Linear Collider (SLC) and the Fermilab Tevatron Collider, are now in operation for research. These facilities will keep the U.S. program highly competitive and at the cutting edge for the next several years.

After careful study it has been determined that a new, more powerful particle accelerator capable of exploring 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 mid 1990's and beyond. The SSC is a proton-proton collider having an energy of 20 Tev per beam. The SSC will permit exploration of this new domain of physics research which cannot be reached by any facility either in existence or planned. The SSC holds the potential for new breakthroughs in science, technology and education. It will produce discoveries, innovations and spin-offs that will profoundly touch every American.

The project is ready for construction. The SSC design, cost estimates and schedule have been carefully documented and reviewed. The project is backed by an R&D program specifically related to the SSC which began in 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. The design of the SSC is based firmly on principles and engineering concepts used previously and is backed by a thorough conceptual design report and cost estimate which have been carefully reviewed by the Department and by outside experts.

The SSC is a critical part of the Administration's initiative to strengthen the scientific and technological position of the nation and to keep this nation on the cutting edge of world leadership and effectiveness. 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.

Significant funding ($98,613,000) for the SSC project was provided in FY 1989 for R&D, preliminary design and site selection activities. Major R&D achievements are expected in FY 1989; with definitive progress on refining and optimizing the design of the superconducting magnets, completion of Phase I of the magnet industrialization program, initiation of Phase II of the magnet industrialization and initial work on the injectors. Following designation of the site in January 1989, site geotechnical studies and initial site specific design activities will begin. First construction funding is being requested in FY 1990. R&D on SSC technical systems will continue at a strong level in FY 1990.

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LEAD TABLE

Superconducting Super Collider (SSC)

Activity	FY 1988 Actual	FY 1989 Estimate	FY 1990 Base	FY 1990 Request	Program Change Request vs Base	
					Dollar	Percent
Operating Expenses.....	$33,000	$82,613	$82,613	$69,000	$- 13,613	- 16%
Capital Equipment.....	0	16,000	16,000	21,000	+ 5,000	+ 31%
Construction.....	0	0	0	160,000	+ 160,000	-
Total.....	33,000	$98,613	$98,613	$250,000	$+ 151,387	+ 154%
Operating Expenses.....	(33,000)	(82,613)	(82,613)	(69,000)	- 13,613	- 16%
Capital Equipment.....	0	(16,000)	(16,000)	(21,000)	+ 5,000	+ 31%
Construction.....	0	0	0	(160,000)	+ 160,000	-
Total Program.....	($33,000)a/	($98,613)b/	($98,613)	($250,000)c/	$+ 151,387	+ 154%
Staffing (FTEs).....	(Reference General Science Program Direction)					

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

a/ Includes $8,000,000 transfer of appropriation.
b/ Excludes $1,387,000 which represents applicable portion of $12,000,000 General Reduction contained in FY 1989 appropriation.
c/ Includes funding provided through appropriation process only. Non-federal contributions will permit additional activities. The size and scope of state contributions will be known after the final site is selected.

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SUMMARY OF CHANGES

Superconducting Super Colllider (SSC)

FY 1989 Appropriation	$ 98,613
Adjustments - Increased personnel costs	0
FY 1990 Base	98,613
SSC R&D	
- Reduced level of SSC preliminary engineering and design and site selection activities, with beginning of construction	- 13,613
Capital Equipment	
- Equipment in support of SSC accelerator and detector R&D programs	+ 5,000
Construction	
- Initiate SSC construction	+ 160,000
FY 1990 Congressional Budget Request	$ 250,000

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KEY ACTIVITY SUMMARY

SUPERCONDUCTING SUPER COLLIDER (SSC)

I. Preface: Superconducting Super Collider R&D

In FY 1990 a continued significant level in SSC R&D is required to finalize the design of the superconducting dipole magnets, to expand a program of industrialization for magnet fabrication, to complete the design of the injector, quadrupole and correction magnets, and other technical systems (such as refrigeration, vacuum and controls), to refine the design of conventional facilities, and to proceed with detector R&D for specific SSC detectors.

II. A. Summary Table

Program Activity	FY 1988	FY 1989	FY 1990	% Change
Superconducting Super Collider R&D.....	$ 33,000	$ 82,613	$ 69,000	- 16

III. Superconducting Super Collider R&D

Program Activity	FY 1988	FY 1989	FY 1990
SSC R&D	The purpose of the SSC R&D program is to ensure that the designs of technical systems components are capable of meeting the necessary quality and reliability standards and to ensure that the designs are ready and tested in a timely fashion to meet performance cost and schedule requirements. The major focus of the FY 1988 R&D is on the superconducting magnet program. This program will	This program will focus on R&D to insure that designs of technical systems and components meet the necessary quality and reliability standards and on fabrication of prototypes and testing of components. The superconducting magnet program will include: further fabrication and testing of full-scale dipoles of advanced design, incorporating results from the tests	The FY 1990 program will continue to have a strong focus on the long superconducting dipole magnets, with the fabrication and testing of the final set of long magnets built in the HEP laboratories to finalize the design ($45,000); extensive design, prototyping and testing on other collider technical systems, including the focusing and correction magnets, RF, vacuum, etc. ($9,500); final

III. BRUF - Superconducting Super Collider (Cont'd)

Program Activity	FY 1988	FY 1989	FY 1990
SSC R&D (Cont'd)	concentrate on producing full-size dipole magnets that meet field strength, field uniformity, and reproducibility requirements. We have had a successful test of a long dipole which went to its short-sample limit on the first quench. A program of magnet industrialization will be initiated with the selection of industrial participants for Phase I of the program to transfer laboratory developed magnet technology to industry. Also includes work on other systems as well as major SSC site selection activities. ($33,000)	in FY 1988; completion of Phase I of the magnet industrialization program; initiation of Phase II of the magnet industrialization program; preparation for fabrication of pre-production full-scale magnets by industry; prototyping and testing of quadrupoles, correction magnets, and IR quadrupoles; accelerated lifetime tests and magnet systems tests; and development of quality control specifications. Detailed designs of the four injector accelerators will be initiated and components developed and tested. Also includes funding for the SSC detector development program. Also includes preliminary engineering design and final site selection activities. ($82,613)	design for the four injector accelerators ($3,500); conventional system development ($1,000); and, a significant program of detector R&D as this program moves from the generic phase to focus on specific SSC detectors ($10,000). ($69,000)
Total	$ 33,000	$ 82,613	$69,000

I. Preface: Capital Equipment

In FY 1990, SSC will have significant capital equipment requirements in support of the R&D program on the many accelerator components and systems and in connection with the SSC detector R&D program.

II. A. Summary Table

Program Activity	FY 1988	FY 1989	FY 1990	% Change
Capital Equipment.....	$ 0	$ 16,000	$ 21,000	+ 31
Total, Capital Equipment.....	$ 0	$ 16,000	$ 21,000	+ 31

II. B. Major Laboratory and Facility Funding

Program Activity	FY 1988	FY 1989	FY 1990	% Change
Superconducting Super Collider.	$ -	$ 16,000	$ 21,000	+ 31

III. Activity Descriptions

Program Activity	FY 1988	FY 1989	FY 1990
Capital Equipment SSC	Not applicable.	Provide equipment in support of SSC R&D and for detector development and prototyping: the major item is a helium refrigerator for the SSC on-site magnet test facility ($7,000); other items include development tooling for fabrication of special magnets; power supply systems; test, control and measurement equipment; components for detector development and prototyping ($9,000). ($16,000)	Provides capital equipment in support of the SSC R&D program, including tooling for prototyping the many technical systems and components of the collider and its four injector accelerators, power supplies, test and control instrumentation, and components for the magnet test facility ($12,000). Also provides for extensive prototypes of detector components, as SSC experiments and detectors begin to be defined ($9,000). ($21,000)
Total	$ 0	$ 16,000	$ 21,000
Construction Superconducting Super Collider	No activity.	No activity.	Authorization and initial construction funding for SSC. Permit significant progress in detailed design of technical components and conventional facilities, selected long lead procurements for the injectors and for collider magnets, the contracts for the first tunnel section and on-site buildings. TEC - $4,300,000. ($160,000)
Total	$ 0	$ 0	$160,000

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KEY ACTIVITY CONSTRUCTION PROJECT SUMMARY

Superconducting Super Collider (SSC)

IV. B. Plant Funded Construction Project

1. Project title and location: 90-R-106
Superconducting Super Collider (SSC)
Site to be selected by DOE*

Project TEC: $ 4,300,000**
Start Date: 1st Qtr. FY 1990
Completion
Date: 2nd Qtr. FY 1998

2. Financial schedule:

Fiscal Year	Appropriated***	Obligations	Costs
1990	188,300	188,300	120,000
1991	455,000	455,000	365,000
1992	575,000	575,000	540,000
1993	625,000	625,000	610,000
1994	628,000	628,000	625,000
1995	640,000	640,000	625,000
1996	640,000	640,000	625,000
1997	548,700	548,700	550,000
1998	--	--	240,000

3. Narrative:

(a) The Superconducting Super Collider is a high luminosity proton-proton collider with beam energy of 20 trillion electron volts (TeV). The collider itself consists of two rings of superconducting magnets and associated systems in a common tunnel, 53 miles in circumference. Four interaction regions will be outfitted with collision halls and support areas for experiments and are in the base project. 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. The TEC is the full construction cost and does not take into account any anticipated international or state contributions and assumes that the site will be provided at no cost to DOE. This estimate was verified by independent experts.

(b) 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 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.

(c) Initial construction activities will proceed on a broad front in FY 1990. The request includes $29 million for detailed design of technical systems, $29 million for conventional facilities design, $8 million for power and utilities distribution systems, $8 million for site preparations required to expedite the overall construction project, $20 million for injector technical components which are early critical path items, $30 million for long lead, critical path procurements for collider components (including magnet tooling, superconducting materials, and magnet steel), $28 million for project management, support equipment and rental space and $8 million for the first on-site shop and support buildings.

(d) The outyear BA projections for the project including construction, detectors, R&D, and preoperations 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	Total
Total Project Funding	$ 33.0	$98.6	$278.3	$593.0	$694.0	$750.0	$760.0	$832.0	$882.0	$832.7	$140.0	$5893.6
Estimated Non-Federal Contributions****	0	0	28.3	200.0	200.0	300.0	300.0	300.0	300.0	171.7	-	1800.0
Federal Share	$ 33.0	$98.6	$250.0	$393.0	$494.0	$450.0	$460.0	$532.0	$582.0	$661.0	$140.0	$4093.6

These projections assume the above schedule of appropriations. If yearly appropriations or inflation rates experienced are different than those assumed, these projections may require modification.

* DOE announced Texas as the preferred site on November 10, 1988. Final site selection will be announed in January 1989 upon completion of the EIS process.

** Revised cost estimate reflects updated inflation indices and the inflationary costs due to slippage in funding profile. The technical basis of the cost estimate is still the 1986 Conceptual Design Report.

*** Total project construction funding indicated. Funding required through appropriation process will be less as a result of anticipated non-federal contributions presently estimated to total $1.8 billion.

**** The projection of a total non-federal contribution to the SSC of $1.8 billion and the year-by-year spread of the estimated contributions are preliminary estimates. The exact 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 final site selection and completion of definitive cost-sharing agreements for foreign contributions.