United States General Accounting Office

GAO

Report to the Honorable
John W. Warner, U.S. Senate

May 1993

FEDERAL RESEARCH

Super Collider—National Security Benefits, Similar Projects, and Cost

GAO/RCED-93-158

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-227295

May 14, 1993

The Honorable John W. Warner
United States Senate

Dear Senator Warner:

The Department of Energy's (DOE) Superconducting Super Collider (SSC) is intended to be the world's largest particle accelerator—a basic research tool for seeking fundamental knowledge about matter and energy. DOE's cost estimate to build the SSC grew from $5.3 billion in 1987 to $8.25 billion in 1991. The 1991 baseline cost estimate included an annual funding profile through the proposed 1999 completion date.

In February 1993, we reported that the SSC project was over budget and behind schedule and that DOE's prime contractor had not yet implemented a fully functioning system for managing the project.[1] Concerned about these cost increases and delays, you requested in a March 5, 1993, letter that we examine (1) the direct national security benefits, if any, of the SSC; (2) the extent to which similar programs are being developed by other countries or consortia; and (3) the total cost for completing the SSC project.

Results in Brief

The principal result of high energy physics is fundamental knowledge about matter and energy; therefore, the SSC will not produce any direct national security benefits. Additional benefits of high energy physics can be categorized as the physics' cultural value to society, the potential practical applications of research discoveries, and spin-off benefits. Although specific national security benefits cannot be predicted or directly tied to high energy physics research, national security may indirectly benefit from the potential but unpredictable practical applications of research discoveries or from technological spin-offs.

Although the United States and other countries have smaller accelerators operating, no existing or planned accelerator is or will be exactly the same as the SSC. If built, the project most similar to the SSC would be the Large Hadron Collider (LHC), proposed by the European Organization for Nuclear Research, commonly called CERN. Although research and development has begun on the LHC, its construction has not yet been approved. Considered

[1]Federal Research: Super Collider Is Over Budget and Behind Schedule (GAO/RCED-93-87, Feb. 12, 1993).

to be complementary to the SSC, the LHC is expected to be about one-third the size, and to collide particles at about one-third the energy, of the SSC. If built, the LHC is expected to be capable of conducting physics experiments that might be done at the lower energy range of the SSC.

Although the total cost for constructing the SSC cannot be reliably estimated, known cost increases show that the total cost will exceed $11 billion. As we reported in February 1993, DOE does not yet have in place a system for managing the project that will enable managers to reliably estimate the SSC's total cost and schedule. However, we also reported that the total cost will exceed the $8.25 billion estimate DOE made in January 1991 because (1) the estimate did not include $1.2 billion in costs that are to be funded by other sources and (2) the project was over budget and behind schedule. Since that report, the administration has proposed to stretch out the project's completion schedule and reduce the project's planned annual funding. Although the precise impact of this proposal has not been fully analyzed, stretching out the project will further increase the total cost of constructing the SSC by at least another $1.6 billion. Therefore, the project's total cost will exceed $11 billion.

To preclude the cost and schedule from continuing to increase beyond $11 billion, annual funding levels would need to increase dramatically over that projected in the President's budget. In fact, DOE is assuming in its projections that there will be no funding constraints after fiscal year 1998—an assumption that could prove unrealistic unless the budget deficit improves markedly. Conversely, continued funding constraints after 1998 would further increase the project's cost and schedule. For example, continued funding at the level projected for fiscal years 1995 through 1997 could lead to inflation and overhead costs consuming all available funding, thereby impacting on the ability to complete construction.

Background

High energy physics facilities with colliding beam accelerators exist throughout the world in countries such as Germany, Japan, Russia, Switzerland, and the United States. The world's largest existing proton accelerator is the Tevatron, a 2-trillion-electron-volts (TeV) collider located at DOE's Fermi National Accelerator Laboratory (Fermilab), in Batavia, Illinois. However, a higher energy accelerator is needed to examine smaller particles and further the understanding of physics. Thus, the SSC is designed to accelerate two beams of protons to nearly the speed of light before they collide with an energy of 40 TeV. The principal components of the collider are superconducting magnets, which will be used to steer and focus the beams of protons through a 54-mile oval tunnel. By colliding two beams of protons at energies 20 times more powerful than can be created today, the SSC is expected to create particles that have never been seen before. Sensitive instruments will detect and record the results of the collisions for physicists to study.

The SSC facility will consist of (1) a series of four injector accelerators to accelerate the proton beams from rest to 2 TeV; (2) a 54-mile tunnel that will house the magnets and into which the beams will be injected and accelerated in opposite directions; (3) four underground interaction halls housing the detectors, where experiments will be conducted by colliding the beams; (4) conventional buildings such as a central laboratory building, industrial buildings, warehouses, and auxiliary support buildings; and (5) an infrastructure of roads and utilities.

At the end of fiscal year 1993, the SSC will have received about $1.6 billion in federal funding.

The SSC Will Not Provide Direct National Security Benefits

The high energy physics research that is proposed for the SSC will not directly lead to national security benefits. The primary result of high energy physics is fundamental knowledge that may ultimately benefit mankind in ways that cannot yet be predicted or even imagined. However, results from basic research have historically been applied to other research. Assuming that the knowledge gained from high energy physics research will be similarly applied, indirect benefits—which may include national security applications—could result. Similarly, technological spin-offs could also result in indirect national security benefits. Such indirect benefits, however, cannot be predicted with any degree of certainty. Nonetheless, DOE and SSC Laboratory officials furnished us with the following views on the potential benefits that the SSC may provide to national security.

The SSC's relationship to national security is illustrated in the response by Dr. Robert R. Wilson—the founding Director of Fermilab—to a similar question during a Joint Committee on Atomic Energy hearing in April 1969:

> . . . this new knowledge has all to do with honor and country but has nothing to do directly with defending our country except to help make it worth defending.[2]

[2]AEC [Atomic Energy Commission] Authorizing Legislation, Fiscal Year 1970, Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, 91st Cong., 1st Sess., Apr. 17 and 18, 1969, part I.

DOE officials said that this response is just as applicable today to the national security benefits of the SSC. By helping scientists explore and codify the basic laws of nature, the SSC will provide a deeper understanding of the universe and man's place in it.

DOE officials also pointed out that the fundamental knowledge gained from basic research ultimately results in a wide range of applications, including national security applications. According to a Fermilab study, a significant part of this country's gross national product could be attributed to activities that stemmed from the investigation of the atom at the turn of the century.[3]

According to DOE officials, the means and methods used to conduct high energy physics research can also provide benefits. For example, a two-part CERN study found that every Swiss franc spent on accelerator construction resulted in 3 Swiss francs of economic activity.[4] DOE officials did not know of any similar study conducted in regard to the SSC's benefits. However, CERN's policy is to make its purchases in Europe, while the SSC Laboratory is seeking foreign participation throughout the world and has made contracts for components to be built in countries such as China and Russia. Therefore, the economic benefits from funding the SSC that would remain in the United States would probably be less than what Europe gained from CERN's accelerator.

The indirect benefits of the SSC, if applied to military purposes, could assist national security. For example, one DOE official told us that producing the superconducting wire that is used in making the superconducting magnets would improve the industry's capability to produce such wire, and this could have national security benefits if the wire is used for national security purposes. In regard to such benefits, a report by the Congressional Budget Office noted that because the SSC will represent the bulk of the market for superconducting magnets during its construction, the SSC may be important to the development of the superconducting magnet industry.[5] However, the report concluded that outside of

[3]Leon M. Lederman and Richard A. Carrigan, Jr., "What Fraction of the U.S. GNP Makes Use of Devices Invented as a Result of the Success of the Quantum Theory of the Atom?" Fermilab Industrial Affiliates Roundtable on Research Technology in the Twenty-First Century (May 1987), pp. 173-79.

[4]H. Schmied, A Study of Economic Utility Resulting From CERN Contracts, European Organization for Nuclear Research (Geneva, 1975); and M. Bianchi-Streit, N. Blackburne, R. Budde, H. Reitz, B. Sagnell, H. Schmied, and B. Schorr, Economic Utility Resulting From CERN Contracts (Second Study), European Organization for Nuclear Research (Geneva, 1984).

[5]Risks and Benefits of Building the Superconducting Super Collider, Congressional Budget Office (Oct. 1988).

developing the magnet industry, the SSC is no more or less likely to produce an important advance than any other major laboratory.

Finally, another indirect benefit to national security cited by DOE officials was that the SSC provides work for defense-oriented industrial firms—such as General Dynamics, Babcock and Wilcox, and Westinghouse—that are developing the SSC's superconducting magnets. The officials pointed out that in the wake of the Cold War, the SSC is helping those firms make a transition to a stronger civilian industrial base.

Large Hadron Collider Is Most Similar to the SSC

Although many countries have particle physics programs, the proposed LHC at CERN, based in Geneva, Switzerland, is the most similar to the SSC. The LHC and the SSC are both proton colliders, but the LHC is expected to be about one-third the size, and to collide particles at about one-third the energy, of the SSC.

CERN, founded in the early 1950s, is made up of 17 member states that contribute to its operation and maintenance.[6] CERN's objective is to provide for collaboration among European states in particle physics research of a pure scientific and fundamental character and to make the results of its experimental and theoretical work generally available. The CERN facility consists of a series of accelerators, the largest and latest of which is the Large Electron Positron (LEP) Collider, which began operating in 1989.

Key Characteristics of the LHC and SSC

In 1985, CERN included the LHC in its long-range planning. In 1988, CERN began research and development on the LHC. In December 1991, the CERN Council unanimously adopted a resolution stating that the LHC was the right machine for the advance of particle physics and for the future of CERN. As of April 1993, however, the Council had not approved the construction of the LHC. CERN officials expect approval by December 1994. Meanwhile, research and development on the LHC's magnets is under way.

Because the proposed LHC will use CERN's existing facilities—which are smaller than SSC's—the LHC's circumference is smaller than the SSC's, and its collision energy is lower. To make up for this smaller size and energy, the field strength of the LHC's superconducting magnets is higher. Table 1 describes some of the characteristics of the LHC and the SSC.

[6]CERN member states are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

Table 1: Characteristics of the LHC and SSC

Characteristic	LHC	SSC
Circumference	17 miles	54 miles
Particles to be collided	Proton-proton Proton-electron Heavy ions	Proton-proton
Proton beam collision energy	15.4 TeV	40 TeV
Number of superconducting magnets	About 2,000 twin bore	About 10,000 single bore
Operating temperature	1.9 Kelvin[a]	4.35 Kelvin
Magnet field strength	9.5 Tesla[b]	6.6 Tesla
Currently estimated completion	1999/2000	2002

[a]0 Kelvin equals –273 Celsius.

[b]A measure of magnetic field (1 Tesla is about 10,000 times the earth's magnetic field).

Source: Prepared by GAO from information provided by CERN and DOE.

Because the LHC will use existing facilities, CERN believes it can build the LHC at a lower cost and faster than the SSC can be built. A CERN official told us that the cost of the LHC's material is estimated at about 2,000 million Swiss francs (about $1.3 billion), without contingency and excluding labor costs. CERN will use its existing accelerators to accelerate and inject the particles into the LHC. The LHC will be built in the existing tunnel that houses the LEP. Although work on the SSC has already begun, it is being constructed on a site with no existing accelerators or facilities. The four accelerators needed to accelerate the particles and inject them into the SSC's collider must still be constructed.

Nonetheless, SSC Laboratory officials told us that they question whether the LHC can be completed before the SSC because (1) the LHC has not yet been approved for construction and (2) the superconducting magnets, key components of the LHC, are more complex than the SSC's magnets and have not yet been technically proven.

Magnet Technology Challenges for the LHC

Because the LHC is proposed to be built in the tunnel housing the LEP, the space for the LHC's magnets is limited. To overcome this limitation, these magnets will have two beam tubes and coils within the same mechanical structure and vacuum vessel. CERN officials have stated that the superconducting magnets are the most technologically challenging components of the LHC. Industries in four European countries—Italy, Austria, Netherlands, and France—are involved in the research and development program for the magnets. CERN placed orders with each industry for short 1-meter magnets in 1988. In order to test different ideas, the magnets were built with technical variations. The magnets required many "cool-downs" to reach their highest magnetic field of 10 Tesla. CERN placed orders for full-length prototype 10-meter magnets at four European companies at the end of 1990. CERN expects delivery of the first complete magnet in the second half of 1993.

Both LHC and SSC Will Be Trying to Find Elementary Particles

A CERN official told us that the LHC is complementary to the SSC. Both the SSC and the LHC will be trying to find elementary particles that are included in the Standard Model of physics but have not yet been found at the energies of the existing accelerators—that is, theorized particles.[7] Two primary factors—beam energy and beam intensity, known as luminosity—will influence whether these particles will be found. The higher energy of the SSC would give it the potential to find things that the LHC at its lower energy would not be able to find. The higher luminosity of the LHC would increase the rate of particle collisions and thus increase the chance of finding the theorized particles.

CERN officials believe that the LHC would operate at an energy that would make it a plentiful source of one of the theorized particles. The officials also believe that the LHC would have an advantage over the SSC in this regard because the LHC could begin its research several years before the SSC and because the theorized particle might be found at the LHC's lower energy. According to CERN, the LHC is designed to have a higher luminosity than the SSC. CERN officials have stated that if interesting effects occur only rarely in the new energy range, the LHC could discover them despite its lower energy. DOE officials acknowledged that the LHC may discover the theorized particles, but they told us that because of the SSC's design, the SSC is a superior machine and thus has a greater chance of finding the theorized particles.

In addition, SSC Laboratory officials questioned whether general purpose detectors needed to carry out experiments at the LHC's higher luminosity will be available. They also pointed to a 1990 DOE High Energy Physics Advisory Panel (HEPAP) report that concluded that there is no significant

[7]The Standard Model of physics lists the known basic constituents of matter—leptons and quarks—and the forces that govern how they behave, together with the carrier particles—gluons, photons, and bosons—that communicate the forces.

difference in the potential luminosities of the LHC and the SSC.[8] The HEPAP report noted that the SSC's design specifications are set at a luminosity level at which currently conceived general purpose detectors are expected to operate. The report also noted, however, that with more limited, special purpose detectors, the SSC could do some experiments at the higher luminosity being discussed for the LHC.

SSC'S Total Cost to Exceed $11 Billion

While the total estimated cost for constructing the SSC is not yet known, it is expected to exceed $11 billion. As we reported in February 1993, DOE does not yet have in place a system for managing the project that will provide a reliable projection of the SSC's total cost and schedule. However, it is known that the project has exceeded its budget and is behind schedule. We also reported that DOE's January 1991 estimated total project cost of $8.25 billion did not include about $1.2 billion in costs that is expected to be funded by other sources. Since our report, the administration has proposed to stretch out the project's completion and reduce the project's planned annual funding. Although the precise impact of this action has not been fully analyzed, stretching out the project will further increase the total cost of constructing the SSC by at least another $1.6 billion. Therefore, the total estimated project cost would exceed $11 billion. If the annual funding continues to be constrained after fiscal year 1997 to the level projected in the President's budget for fiscal years 1995 through 1997, costs might increase indefinitely, and the project may never be completed.

Some Known Costs Excluded From $8.25 Billion Estimate

Our February 1993 report pointed out that DOE's January 1991 cost estimate of $8.25 billion excluded some costs that were expected to be funded by sources other than DOE's appropriation for construction. The baseline cost estimate does not include (1) about $500 million for the detectors, for which the SSC project is seeking primarily nonfederal funding; (2) about $400 million for laboratory preoperations costs not associated with commissioning the four injector accelerators or the collider, which are to be funded by DOE's High Energy Physics Program; (3) about $118 million through fiscal year 1999 for DOE program direction costs; and (4) about $60 million in land costs and $125 million in infrastructure and general support, which the state of Texas is contributing. Therefore, DOE excluded a total of over $1.2 billion in costs from its January 1991 estimate.

[8]Report of the 1990 HEPAP Subpanel on SSC Physics, DOE, Office of Energy Research (DOE/ER-0434, Jan. 1990).

In commenting on this issue, DOE officials told us that their agency has historically omitted such costs from the estimated cost of the agency's accelerator projects. Therefore, the omission of such costs from the SSC's cost estimate is consistent with DOE's historical practice. We have reported on this practice in the past, pointing out that the practice makes it difficult for the Congress to assess the affordability of such projects; consequently, we have recommended that DOE furnish the complete costs of projects to the Congress.[9] DOE officials noted that, although the $1.2 billion is not included in the project's cost estimate, the costs have been disclosed to the Congress.

Work in Progress Is Over Budget and Behind Schedule

As of August 1992—according to the latest available data at the time we conducted our work for our February 1993 report—work in progress on the SSC was over budget and behind schedule. At our request, DOE analyzed the cost performance reports for the architect and engineering/conventional construction contractor and the superconducting magnet subcontractors. DOE's analyses showed that each subcontractor was running over cost and behind schedule. DOE also provided trend analyses that showed that unless management corrections were made, the subcontractors would incur substantial cost overruns when completed—$630 million, for example, for one of the subcontracts. SSC Laboratory officials advised us that they subsequently took some mitigating actions to ensure that such cost increases do not occur.[10]

In providing the trend projections, DOE asserted that it was too early to produce quality trend analyses. We noted that as of August 1992—the date of the data analyzed—each subcontract had incurred 11, 16, and 21 percent of its total subcontract costs, respectively. While we agree that the subcontracts are in relatively early phases, we believe that the large projected cost increases are of concern. Although it examined defense contracts, a 1990 Department of Defense study indicated that contractor cost performance does not improve after 15 percent of total contract costs are incurred.[11] This study was based on the Defense Department's experiences in more than 400 programs since 1977. The study found

[9] Nuclear Science: Information on DOE Accelerators Should Be Better Disclosed in the Budget (GAO/RCED-86-79, Apr. 9, 1986).

[10] At the request of the Chairman, Subcommittee on Oversight and Investigations, House Committee on Energy and Commerce, we are currently examining the effect of the SSC Laboratory's mitigating actions on the project's cost and schedule.

[11] A-12 Navy Aircraft: System Review and Recommendations, Twenty-First Report by the Committee on Government Operations, H.R. Rep. No. 102-853, 2nd Sess., Aug. 27, 1992, pp. 31-69.

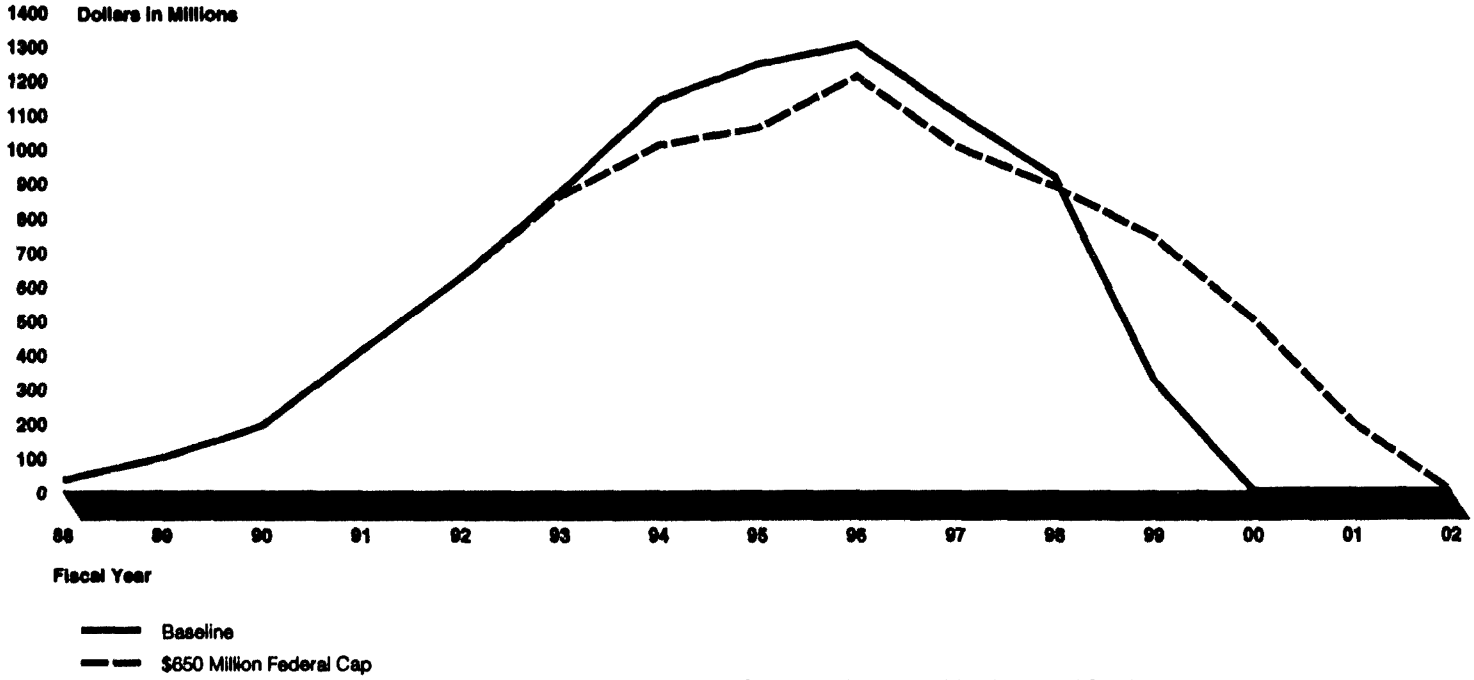
without exception that between 15 percent and 85 percent of contract performance, cumulative cost performance does not improve, but tends to decline.

Reduced Federal Funding Will Stretch Out the Schedule and Increase Costs

DOE's January 1991 cost estimate of $8.25 billion assumes that the project will be completed in 1999 and that funding will be provided to DOE on a timely construction schedule. As noted in our February report, the DOE Project Director stated that reduced fiscal year 1993 funding had already increased the total cost by $50 million to $200 million, depending on whether past funding shortfalls are restored in fiscal year 1994.

Our report also cautioned that with the peak project funding period approaching, DOE's funding profile will need to be met or closely approximated if the project is to be completed within the estimated cost and schedule period. As an example, we referred to an SSC Laboratory study that found that at an annual federal funding level of $650 million, the SSC project would require an additional 18 months to complete, with a cost increase of about $570 million. In preparing this projection, the SSC Laboratory assumed that all other constraints, other than the level of federal funding received, would remain the same as those used in preparing the January 1991 baseline. The January 1991 funding profile, compared with the projection of the $650 million federal funding cap, is shown in figure 1.

Figure 1: Baseline Funding Profile Compared With a $650 Million Federal Funding Cap



Source: Prepared by GAO from analyses provided by the SSC Laboratory.

At our request, the SSC Laboratory also prepared a profile using a $550 million funding cap. The SSC Laboratory's analysis showed that the project could not be completed at a $550 million federal funding level. This is because at the $550 million funding level, reduced buying power and overhead costs would consume most of the available funds after fiscal year 2000. A DOE official pointed out that this analysis, as well as the analysis for a $650 million funding cap, assumed that the approach for building the SSC would not be changed. The official explained that if it is known that less funding will be available, management can restructure the work to fit the available funding.

In April 1993, the President included $640 million for the SSC in his fiscal year 1994 budget request. The federal funding requested for fiscal year 1994 and projected for fiscal years 1995 through 1998 is shown in table 2.

Table 2: Federal Funding for Fiscal Years 1994-98

Dollars in millions

Fiscal year	Federal funding amount
1994	$640
1995	$551
1996	$570
1997	$591
1998[a]	$812

[a]Federal funding levels beyond fiscal year 1998 are yet to be determined.

Source: President's Fiscal Year 1994 Budget Request.

The reduced funding will further increase the project's cost because it will take longer to complete the project, resulting in inflation and overhead costs that would consume a larger amount of funds. However, the impact of the reduced funding has not yet been fully analyzed and will depend on what assumptions are made. According to a DOE official, as stated in the President's budget request, DOE's initial look at the impact of funding that is below the planning assumptions for fiscal years 1994 through 1998 indicated that the total cost would increase by about $2 billion, plus or minus 20 percent ($1.6 billion to $2.4 billion), and that there would be a 3-year delay in the project's completion.

The DOE Project Director has requested the SSC Laboratory to prepare a revised baseline budget and schedule by July 1, 1993. Three planning assumptions included in his guidance to the laboratory were that (1) inflation at the rates of 1.000 in fiscal year 1992, 1.030 in fiscal year 1993, 1.070 in fiscal year 1994, 1.114 in fiscal year 1995, 1.163 in fiscal year 1996, 1.215 in fiscal year 1997, and 1.269 in fiscal year 1998;[12] (2) a program will be put in place to minimize fixed indirect costs; and (3) make-or-buy decisions will be reviewed to minimize impacts on laboratory employment levels.

The guidance further advised the laboratory to assume that funding beyond fiscal year 1998 as necessary to complete the SSC in fiscal year 2003.[13] This last assumption will ensure that the SSC Laboratory's analyses will show that the project can be completed with the federal funding levels included in the President's Fiscal Year 1994 Budget Request. Using the

[12]These are actually inflation adjustment factors, not inflation rates.

[13]According to a DOE official, the SSC Laboratory is to assume that the project will be completed at the end of calendar year 2002 (the end of the first quarter of fiscal year 2003).

more optimistic analysis included in the budget request, the SSC project cost will increase by at least $1.6 billion.

Conclusions

Since the SSC was first proposed to the Congress in 1987, costs have more than doubled—from $5.3 billion to the more than $11 billion identified in this report. However, the total cost to construct the SSC is still not known. Depending on the assumptions made, this cost could increase significantly. For example, if the projected subcontractor cost increases we have previously identified are not fully mitigated, the total project cost may increase.

Furthermore, to preclude the cost and schedule from continuing to increase beyond $11 billion, future annual funding levels would need to increase dramatically over that projected in the President's budget. Following DOE's guidance, the SSC Laboratory, in its current study of the effect of the President's proposed project funding, assumes that funding will increase in fiscal year 1998 and will not be constrained from fiscal year 1999 through the completion of the project at the end of calendar year 2002. Unless the budget deficit improves markedly, such an assumption could prove unrealistic. Funding constraints will further increase the cost of the project and delay its schedule. For example, continued funding at the level projected for fiscal years 1995 through 1997 could lead to inflation and overhead costs consuming all available funding, thereby impacting on the ability to complete construction.

To respond to your request, we interviewed officials at DOE, the SSC Laboratory, and CERN and reviewed pertinent documents, including reports provided by these officials and our past reports on these issues. With respect to the project's total cost, we relied primarily on our report issued last February and our workpapers supporting the report; we supplemented that work with the views of DOE and SSC Laboratory officials on the impact of the funding levels proposed in the President's Fiscal Year 1994 Budget Request.

We discussed the facts presented in this report with DOE and SSC Laboratory officials, including the Director of DOE's Office of Energy Research and the Director of the SSC Laboratory. We revised the report as needed to reflect their views on how the LHC complements the SSC, and we updated information on the potential cost increases. As requested, we did not obtain written agency comments. We performed our work from

March to April 1993 in accordance with generally accepted government auditing standards.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies of the report to the Secretary of Energy and make copies available to others on request.

Please contact me at (202) 512-3841 if you or your staff have any questions. Major contributors to this report are listed in appendix I.

Sincerely yours,

Victor S. Rezendes
Director, Energy and Science Issues

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Related GAO Products

Federal Research: Super Collider Is Over Budget and Behind Schedule (GAO/RCED-93-87, Feb. 12, 1993)

Federal Research: Foreign Contributions to the Superconducting Super Collider (GAO/RCED-93-75, Dec. 30, 1992)

Federal Research: Implementation of the Super Collider's Cost and Schedule Control System (GAO/RCED-92-242, July 21, 1992)

Federal Research: Concerns About the Superconducting Super Collider (GAO/T-RCED-92-48, Apr. 9, 1992)

Energy Reports and Testimony: 1991 (GAO/RCED-92-120, Mar. 1992)

Federal Research: Concerns About Developing and Producing Magnets for the Superconducting Super Collider (GAO/T-RCED-91-51, May 9, 1991)

Federal Research: Status of DOE's Superconducting Super Collider (GAO/RCED-91-116, Apr. 15, 1991)

Federal Research: Super Collider Estimates and Germany's Industrially Produced Magnets (GAO/RCED-91-94FS, Feb. 12, 1991)

Energy Reports and Testimony: 1990 (GAO/RCED-91-84, Jan. 1991)

Energy: Bibliography of GAO Documents January 1986 — December 1989 (GAO/RCED-90-179, July 1990)

Federal Research: Information on Site Selection Process for DOE's Super Collider (GAO/RCED-90-33BR, Oct. 4, 1989)

Federal Research: Final Site Selection Process for DOE's Super Collider (GAO/RCED-89-129BR, June 16, 1989)

Federal Research: Determination of the Best Qualified Sites for DOE's Super Collider (GAO/RCED-89-18, Jan. 30, 1989)

Nuclear Science: DOE Should Provide More Control in Its Accelerator Selection Process (GAO/RCED-86-108, Apr. 4, 1986)

Nuclear Science: Information on DOE Accelerators Should Be Better Disclosed in the Budget (GAO/RCED-86-79, Apr. 9, 1986)

DOE's Physics Accelerators: Their Costs And Benefits (GAO/RCED-85-96, Apr. 1, 1985)

Increasing Costs, Competition May Hinder U.S. Position Of Leadership In High Energy Physics (EMD-80-58, Sept. 16, 1980)

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