

# CRS Report for Congress

Received through the CRS Web

## Department of Energy FY1999 Research and Development Budget: Description and Analysis

Updated July 8, 1998

Richard E. Rowberg  
Senior Specialist in Science and Technology  
Science, Technology, and Medicine Division

### **ABSTRACT**

For FY1999, the Department of Energy (DOE) is requesting \$7.73 billion for its extensive array of research and development programs, an 11.3% increase over the FY1998 appropriation. This report briefly describes the content and objective of the DOE civilian and defense R&D programs, the FY1999 budget request for each of those programs, and appropriations and authorization actions to date. It then discusses several specific budget-related issues about the Climate Change Technology Initiative, the nuclear energy research initiative, the fusion energy sciences program, the spallation neutron source, and the stockpile stewardship program. An important general issue concerns the constraints imposed on the large budget increase by the discretionary budget spending caps. This report should be useful for tracking appropriations and authorization actions on the DOE R&D programs, and the potential implications of those actions. It will be updated in response to congressional action on the budget.

# Department of Energy FY1999 Research and Development Budget: Description and Analysis

## Summary

For FY1999, the Department of Energy (DOE) has requested \$7.73 billion for civilian and defense research and development (R&D) funding. This is an increase of \$786 million, or 11.3%, over the FY1998 appropriation. For civilian programs, the request is \$4.44 billion — an increase of \$525.3 million over FY1998, and for defense programs the request is \$3.28 billion — an increase of \$260.7 million.

Large increases were requested for Solar and Renewable Energy, and Conservation R&D to support the Climate Change Technology Initiative (CCTI), a program of tax credits and R&D to help meet greenhouse gas reduction goals agreed to by the Administration at the December 1997 Kyoto conference. An increase of \$167.9 million was sought in the Basic Energy Sciences program primarily for construction of the spallation neutron source (SNS), a research facility expected to cost about \$1.3 billion when completed in 2005. Finally, DoE requested an additional \$321.2 million for the Stockpile Stewardship program to enhance development of computational and scientific capability to maintain the safety, reliability, and performance of the nation's nuclear weapon stockpile.

Several issues are emerging as Congress acts on the FY1999 request. These include the large increases being requested by Solar and Renewable Energy and Conservation R&D programs as part of the CCTI, the potential policy implications of the CCTI, the future of the International Thermonuclear Experimental Reactor (ITER) project within the Fusion Energy Sciences program, the future of nuclear energy R&D, the large increase requested for the Stockpile Stewardship program, and the extent of unobligated carryover funds from the prior fiscal year.

For FY1999, the Senate approved \$6.61 billion for DOE R&D programs within the Energy and Water Development Appropriations Bill, 1999. The House approved \$6.51 billion for those programs. The comparable DOE request was \$6.73 billion. The Senate Appropriations Committee has recommended \$889.8 million for DOE programs within the Department of Interior and Related Agencies Appropriation Bill, 1999, while the House Appropriations Committee recommended \$825.7 million for those programs. The comparable DOE request was \$1,000.8 million. Action by the Senate on the FY1999 defense authorization bill would authorize \$3.01 billion for DOE national security programs compared to a request of \$3.07 billion. The House-passed version would authorize \$3.03 million.

## Contents

Overview . . . . .	1
Background . . . . .	1
Congressional Action Overview . . . . .	3
R&D Programs — Descriptions and Budgets . . . . .	5
Energy Resources R&D . . . . .	5
Energy Conservation . . . . .	5
Fossil Energy R&D and Clean Coal Technology . . . . .	7
Nuclear Energy R&D . . . . .	8
Solar and Renewable Energy R&D . . . . .	9
Fusion Energy Science . . . . .	11
Science . . . . .	12
High Energy Physics . . . . .	13
Nuclear Physics . . . . .	14
Basic Energy Sciences . . . . .	14
Biological and Environmental Research . . . . .	16
Other . . . . .	16
National Security and Environmental Management . . . . .	17
Stockpile Stewardship . . . . .	18
Nonproliferation and Verification R&D . . . . .	20
Naval Reactor R&D . . . . .	21
Environmental Quality R&D . . . . .	21
Budget Issues . . . . .	23
Climate Change Technology Initiative . . . . .	23
Nuclear Energy . . . . .	24
Fusion Energy Science and the International Thermonuclear Experimental Reactor (ITER) . . . . .	25
Basic Energy Sciences and the Spallation Neutron Source . . . . .	26
Stockpile Stewardship . . . . .	26
Concluding Comments . . . . .	28

## List of Tables

Table 1. Total R&D Funding . . . . .	2
Table 2. Energy Resources R&D . . . . .	5
Table 3. Science . . . . .	13
Table 4. National Security and Environmental Management . . . . .	18

# Department of Energy FY1999 Research and Development Budget: Description and Analysis

## Overview

### Background

The Department of Energy (DOE) was created in 1977 as part of the nation's attempt to deal with the oil price shocks of the 1970s. The Department was formed from a number of agencies with energy-related missions. These agencies included the Energy Research and Development Administration (ERDA, which itself descended from the former Atomic Energy Commission (AEC)), the Federal Power Commission (now the Federal Energy Regulatory Commission), the Federal Energy Administration, and several programs in the Department of Interior. Because of the nuclear weapons and naval reactor programs absorbed from the AEC, the new DOE gained a sizable defense component. The DOE also became home for 22 field laboratories including the nine multipurpose national labs formed under the AEC.

The DOE covers a wide range of activities. It is responsible for the nation's nuclear weapons capability. It has the five federal power marketing administrations, some energy regulatory and information functions, civilian nuclear waste responsibilities, and the strategic and naval petroleum reserves. Over the last decade, DOE has developed a major environmental component to clean up its weapons production and related facilities. Finally, DOE has a large research and development (R&D) component in both civilian and defense areas.

This report focuses on the R&D programs. It divides the programs into four categories: energy resources R&D, science, national security R&D, and environmental quality R&D. Those categories, which approximate the way DOE has divided up its programs, are set up to keep similar research activities together.<sup>1</sup> R&D

---

<sup>1</sup>The major difference between these categories and those used by DOE is that DOE does not include the Energy Conservation, Fossil Energy, and Clean Coal Technology programs within its energy supply category, all of which are included in the energy resources R&D category in this report. DOE makes that distinction because those three programs fall within the jurisdiction of the Interior and Related Agencies Subcommittee of the Appropriations Committees, while all other DOE R&D programs fall within the jurisdiction of the Energy and Water Development Subcommittee. DOE also includes the Environment, Safety, and Health program in its energy supply category while this report includes it in the environmental quality category. In addition, R&D funding amounts given in the report for the FY1999 request are those given in the DOE budget request for R&D with the exception of nuclear energy, which is described in the text. Finally, the R&D  
(continued...)

funding is concentrated in the first three. Table 1 shows the FY1998 appropriations, the FY1999 budget request, and the FY1999 congressional appropriations action to date. All amounts in this and subsequent tables are for budget authority and are in current dollars.<sup>2</sup>

**Table 1. Total R&D Funding**  
(millions of dollars)

<b>Activity</b>	<b>FY1998 (App.)</b>	<b>FY1999 (Request)</b>	<b>FY1999 (Senate)</b>	<b>FY1999 (House)</b>
Energy Resources R&D	1,565.0	1,877.4	1,513.7	1,541.9
Science	2,287.1	2,490.0	2,673.2	2,420.6
National Security R&D	2,747.7	3,063.9	3,038.9	3,014.6
Environmental Quality R&D	341.0	295.5	278.5	336.0
<b>Total</b>	<b>6,940.8</b>	<b>7,726.8</b>	<b>7,504.3</b>	<b>7,313.1</b>

For all R&D programs for FY1999, DOE has requested an 11.3% increase over the FY1998 appropriation.<sup>3</sup> For civilian R&D, the request was \$4,493.4 million compared to \$3,918.1 million for FY1998, a 13.4% increase. For the defense R&D programs, DOE has requested \$3,283.4 million compared to \$3,022.7 million for FY1998, an increase of 8.6%. The total DOE budget request for FY1999 was \$18,034.6 million compared to \$16,560.6 million appropriated for FY1998, an increase 8.9%. For FY1999, R&D constituted 43% of the DOE request.

The increase requested for DOE R&D funding was one of the largest, in percentage terms, for any of the federal R&D funding agencies. It was also considerably greater than increases requested by DOE in the last few years. In its budget justification for FY1999, DOE cited as an important reason for the increase a report by the President's Committee of Advisors on Science and Technology (PCAST), which recommended substantial increases in energy resources R&D funding to meet the challenges of growing oil import dependence, increasing

<sup>1</sup>(...continued)

funding amounts given for previous years are the congressional appropriations as printed in the conference reports. For a detailed tracking of congressional action on the FY1998 request, see CRS Report 97-233.

<sup>2</sup>Some of the FY1998 appropriations have been adjusted to reflect changes DOE has made in the content of those programs at the direction of Congress. As a result, the numbers for FY1998 appropriations in this report may not agree in all cases with those reported in the last update of CRS Report 97-233.

<sup>3</sup>U.S. Department of Energy, Office of the Chief Financial Officer, *Department of Energy: FY1999 Congressional Budget Request*, DOE/CR-0051 (Washington: February 1998).

greenhouse gas emissions, and maintaining affordable, reliable energy supplies.<sup>4</sup> The report noted that current energy resources R&D funding was particularly inadequate for providing the energy technologies needed to meet, cost-effectively, the potential global warming dangers of increased emissions of carbon dioxide.<sup>5</sup> In addition to recommending increased R&D funding, the study recommended better coordination between the basic research activities of the Basic Energy Sciences program and the applied energy R&D programs, and more effective efforts to make energy resources R&D results commercially available. Finally the study urged that energy resources R&D be given greater “prominence” within the Department of Energy.<sup>6</sup>

DOE also noted that a significant portion of the increase it requested for R&D funds for FY1999 was part of the Climate Change Technology Initiative (CCTI), aimed at developing technologies to reduce emissions of carbon dioxide from energy use. At the same time, DOE argued that such reduction was only one of the potential benefits from increased energy resources R&D as stated in the PCAST study.

For the Science programs, DOE justified its request increase on the importance of science for economic growth, particularly as the global economy becomes more and more competitive. Finally, for the National Security R&D programs, DOE cited the Comprehensive Test Ban Treaty as providing additional incentive to develop the capabilities to maintain the safety and reliability of the nation’s nuclear weapon stockpile in the absence of nuclear testing.

This report will describe the programs within each category including their research objectives and the activities where significant budget changes were requested for FY1999. It then describes the request, and congressional appropriation and authorization action to date. There follows a discussion of issues about the FY1999 request that are emerging during congressional consideration of the budget.

## **Congressional Action Overview**

The Senate appropriated \$6,614.5 million for programs within the Energy and Water Development Appropriations Bill (S. 2138, S.RPT. 105-206) for FY1999 is 2.6% below the request but 7% above the FY1998 level. For the House, the comparable appropriation is \$6,512.9 million, 3.2% below the request but 6.4% above the FY1998 level (H.R. 4060, H.Rept. 105-581). Both bills provide nearly all of the requested increase from FY1998 for the Science programs. The House and Senate each noted its strong support for basic research in taking that action. Most of the increase requested for the National Security program requests were also met,

---

<sup>4</sup>Executive Office of the President, President’s Committee of Advisors on Science and Technology, *Report to the President on Federal Energy Research and Development for the Challenges of the Twenty-First Century*, (Washington: November, 1997).

<sup>5</sup>U.S. Library of Congress, Congressional Research Service, *Global Climate Change*, by John Justus and Wayne Morrissey, CRS Issue Brief IB89005 (Washington: continually updated).

<sup>6</sup>*Report to the President on Federal Energy Research and Development for the Challenges of the Twenty-First Century*, ES-2.

although the House and Senate each expressed some concern about the Stockpile Stewardship program as described below.

For those DOE programs within the Department of Interior and Related Agencies Appropriations Bill, 1999, Energy Conservation and Fossil Energy R&D, the Senate Appropriations Committee recommended a total of \$889.8 million, 11.1% below the request but 8.6% above the FY1998 level (S.2237/S.Rpt.105-227). The House Appropriations Committee recommended a total of \$825.7 million for these programs, 17.5% below the request but 0.8% above the FY1998 level. Both Committee's expressed concern about the relationship between DOE's request and the Kyoto agreement to reduce greenhouse gas emissions. The Senate Appropriations Committee directed DOE to submit a plan including measurable goals on how it intends to implement the Administration's proposal, made prior to Kyoto, to reduce greenhouse gas emissions. The House Appropriations Committee directed that no funds in its recommendation for the two programs are to be used to implement the Kyoto agreement.

A thread running through nearly all appropriations actions thus far is concern about the high level of unobligated carryover obligations. The four reports accompanying the appropriations recommendations from the Committees all noted the question of carryover balances. In addition, in making the recommendations, varying amounts of carryover balances were assigned to supply a portion of the appropriation. On the House side, approximately \$208 million of the DOE R&D funds is to come from carry over balances. Of that, about \$49 million is assigned to Energy Resource programs, \$145 million to Defense programs (all to Stockpile Stewardship), \$7.6 million to Science, and \$6 million to Environmental R&D. The Senate directed that about \$187 million of the R&D funds come from carry over balances. Of that, about \$110 is assigned to Energy Resource programs, \$39.6 million to Science programs, and \$34 million to Defense programs.<sup>7</sup>

In the FY1999 defense authorization bills passed by the House (H.R. 3616; H.Rept. 105-532) and the Senate (S. 2057/S. 2060; S.RPT. 105-189), the DOE national security programs would be authorized at amounts close to those recommended by the appropriations committees. The Senate bill authorized \$3.07 billion for DOE defense program R&D while the House bill authorized \$3.03 billion. Concern was also expressed about the Stockpile Stewardship program in both bills as described below. The House and Senate bills would also require DOE to fund a significant portion of its Stockpile Stewardship program with prior year unspent funds. The House version directs DOE to use about \$160 million of carryover balances while the Senate bill directs about \$68 million to be used.

---

<sup>7</sup> The assignments to the various programs given here assume that the carryover balances provided for each account in the House and Senate bills are distributed proportionately to the R&D programs within those accounts.

## R&D Programs — Descriptions and Budgets

### Energy Resources R&D

Energy Resources R&D includes the Conservation, Fossil Energy, Clean Coal Technology, Nuclear Energy, Solar and Renewable Energy, and Fusion Energy Sciences programs. The budget information of these five programs is given in Table 2. These programs are the principal DOE R&D efforts devoted to the development of new energy supply and demand technologies.

**Table 2. Energy Resources R&D**  
(millions of dollars)

Program	FY1998 (App.)	FY1999 (Request)	FY1999 Senate	FY1999 House
Conservation	456.7	617.4	513.4	505.1
Fossil Energy	362.4	383.4	376.4	320.6
Clean Coal Technology <sup>a</sup>	(101.0)	(40.0)	(40.0)	(40.0)
Nuclear Energy	211.9	259.1	256.5	236.7 <sup>b</sup>
Renewable Energy	302.0 <sup>c</sup>	389.3 <sup>c</sup>	367.4 <sup>c</sup>	303.5 <sup>c</sup>
Fusion Energy Science	232.0	228.2	— <sup>d</sup>	232.0
Total	1,565.0	1,877.4	1,513.7 <sup>e</sup>	1,597.9 <sup>f</sup>

<sup>a</sup> Rescission from prior year appropriations; not counted in total.

<sup>b</sup> Included is \$31.2 million for hot standby maintenance of the Fast Flux Test Reactor, which the House put in the Non-defense Environmental Management account.

<sup>c</sup> In addition to these funds, \$44.3 million was appropriated in the Basic Energy Sciences program for basic research related to solar and renewable energy resources. For FY1999, DOE requested \$47.9 million for these activities, which was approved by both the Senate and House. Those funds are included in the Basic Energy Sciences program amounts in Table 3 below. Counting those amounts, \$346.3 million was appropriated for all solar and renewable energy research for FY1998. For FY1999, \$437.2 million was requested for that same research while \$415.3 million was provided by the Senate and \$351.4 by the House. Because the BES portion — \$47.9 million — also appears in the BES line under the Science account, the bills subtract that portion in coming up with the Energy Supply total.

<sup>d</sup> The Senate moved funds for Fusion Energy Sciences to the Science programs account.

<sup>e</sup> The Senate directed that about \$109.7 million of these funds should come from prior year carryover balances.

<sup>f</sup> The House directed that about \$49.2 million of these funds should come from prior year carryover balances.

**Energy Conservation.** The Energy Conservation (EC) R&D program is divided into three sectors — buildings, industry and transportation.<sup>8</sup> The principal

<sup>8</sup>U. S. Library of Congress, Congressional Research Service, *Energy Efficiency: A New National Outlook?*, by Fred Sissine, CRS Issue Brief IB95085, (Washington: continually (continued...))

focus of energy conservation research is to develop technologies that reduce the energy requirements of equipment and facilities within those sectors while maintaining or improving services, and enhancing environmental quality. The buildings sector focuses on the building as an integrated system, exploring ways to make the building envelope, equipment, and appliances more efficient. The transportation sector directs its R&D at improving efficiency of the current generation of engines, developing new engine technology, and alternative transportation fuels. This sector also takes the lead in the Partnership for a New Generation of Vehicles (PNGV) initiative.<sup>9</sup> This initiative is a joint effort between the federal government and the nation's three largest automakers to develop an automobile for the next century that will be substantially more efficient without sacrificing features or invoking a price penalty. The industry sector funds R&D on improvements in basic manufacturing processes whose goal is increased productivity and energy efficiency. It also focuses on technology to reduce or re-cycle process waste streams, and on advanced, on-site energy generating technology. Finally, this program has responsibility for application of energy efficiency and renewable energy technologies to public sector facilities.

For FY1999, DOE has asked for a 35.2% increase for this program, the largest for any program within the agency. Each of the three sectors would receive sizable increases: industry, 22.3%, transportation, 27.3%, and buildings, 55.2%. For FY1999, the Conservation program forms a major component of the Climate Change Technology Initiative (CCTI). An important focus of the R&D is to be carbon emission reduction through development of technologies that would operate at higher energy efficiencies and/or use alternative fuels. Areas that would receive significant increases for FY1999 include advanced combustion turbines for industry, commercial and residential building systems, equipment, and materials, automobile and heavy vehicle engine technology (PNGV project), and manufacturing processes in selected industries. The program has set out quantitative goals for efficiency improvements, energy cost savings, and emissions reductions for the year 2010.

The House Appropriations Committee recommended \$505.1 million for conservation R&D for FY1999. Of that amount, \$43 million would result from transfer of advanced turbine R&D from the Fossil Energy program. Adjusting for that transfer, the FY1999 recommendation is 25.2% below the request but 1.2% above the FY1998 level. Under the Committee's recommendations, the building technology subprogram would receive the largest reduction from its request, 36%, followed by transportation, 25%, and industry, 16% (adjusting for the turbine R&D transfer). The Committee directed DOE not to solicit any new starts in the Industries of the future activity resulting in a recommended reduction of \$19 million from the request. Other large reductions included \$17 million in the Advanced heavy vehicle technologies activity and \$15.5 million in the Building equipment and materials activity. The Committee provided DOE with a list of directives including

---

<sup>8</sup>(...continued)  
updated).

<sup>9</sup>U.S. Library of Congress, Congressional Research Service, *The Partnership for a New Generation of Vehicles*, by Fred Sissine, CRS Report 96-191 SPR, (Washington: February 28, 1996).

requirements to “streamline and consolidate” its buildings research program by FY2000, spend no funds to implement Kyoto accords, improve research coordination with States and industry, and improve management of uncosted balances.

The Senate Appropriations Committee has recommended \$513.4 million for conservation R&D for FY1999. This amount is 16.8% below the request but 12.4% above the FY1998 level. The recommendation would reduced the building technology subprogram 22.4%, the industry subprogram by 14.1%, and the transportation subprogram 12.8% below the request. Large reductions from the request recommended by the Committee included \$23.1 million in the Advanced automotive technologies activity, \$20.5 million in the Industries of the future activity, and \$9.4 million in the Buildings systems designs activity. The Committee expressed its continued disappointment in the DOE justification for the conservation budget request. It stated that the justification did not provide a clear explanation for budget increases and decreases from the previous year. The Committee acknowledged DOE’s actions to stop taxing programs for crosscutting projects and noted that it provided sufficient funds in the Policy and Management subprogram for these activities. It also directed DOE to adhere to normal reprogramming guidelines.

**Fossil Energy R&D and Clean Coal Technology.** Fossil Energy R&D is divided into three subprograms: coal, gas, and petroleum. Coal research focuses on advanced power generation technologies, advanced emission clean-up technologies, and economic, alternative transportation fuels. Natural gas R&D focuses on development of currently uneconomic conventional and unconventional gas resources, and advanced power generation technologies. Petroleum R&D focuses on enhanced oil production and reservoir life extension. In addition, the program carries out R&D on environmental problems associated with all phases of oil and natural gas production. Coal R&D also includes the Clean Coal Technology (CCT) program, a separate series of demonstration projects in pursuit of cleaner and more efficient use of coal, which receive at least 50% of their support from the private sector. All federal funds for CCT were appropriated in previous years.

For FY1999, Fossil Energy has requested an increase of 5.8% above the FY1998 appropriation. The largest increase would occur for coal R&D, about 21%. Petroleum R&D would grow by 3% while natural gas R&D would decline by 1%. For coal R&D, the increases would be concentrated in advanced power generation development, including support for demonstration projects being carried out by the CCT program. Advanced coal research would also receive a substantial increase for a variety of work on fuel conversion and emissions control. Part of the increase would fund research initiatives aimed at the Vision 21 concept. That concept, which emerged from the PCAST study, envisions energy complexes based on coal that would produce electricity, clean transportation fuels, steam, and chemicals with virtually no pollutant emissions and possibly no net carbon emissions. To that end, the coal R&D effort will include research on carbon sequestration processes. Components of the natural gas and petroleum R&D effort would be funded at close to FY1998 levels. The CCT program requested that \$40 million of previously appropriated funds be deferred until FY2000 or beyond. Completion of several projects is expected by the end of FY1999 with no new project starts scheduled.

The House Appropriations Committee recommended \$320.6 million for fossil energy R&D for FY1999. Included is a recommendation to transfer advanced turbine R&D funding to the Conservation program, although the Fossil Energy program would retain management of the R&D. Adjusting for that transfer, the Committee's recommendation is 5.2% below the FY1999 request but 0.3% above the FY1998 level. Most of the reduction below the request is in the carbon sequestration research and Vision 21 concept activities, two elements of the CCTI. The Committee also directed DOE to enhance research coordination with the States and industry, and prohibited any funds from being used to implement Kyoto accords.

The Senate Appropriations Committee has recommended \$376.4 million for fossil energy R&D, 1.8% below the request but 3.9% above the FY1998 level. The major portion of the reduction from the request is in the Advanced clean/efficient power systems activity, which would receive \$11.3 million less than requested. Most of that is a result of the Committee's recommendation to reduce the carbon dioxide sequestration technologies request by \$8 million. The Committee also stated that any strategy to reduce greenhouse gas emissions should emphasize technology rather than regulation. The Committee recommended an increase of \$2.6 million above the request for the Natural gas subprogram concentrated in gas utilization. The Committee added \$3 million to the Energy Technology Center program direction request urging DOE to make more use of the expertise residing in the centers.

Both the House and Senate Appropriations Committees recommended approval of the request to defer for future years \$40 million of previously appropriated funds.

**Nuclear Energy R&D.** This program supports a diverse array of projects in nuclear energy. Included are R&D on advanced radioisotope power production, electrometallurgical treatment of spent fuel (formerly in the National Security category as Nuclear Technology R&D), and university reactor fuel assistance. In addition, the program carries out R&D on and technical support for radioisotope production for a variety of commercial and medical uses. The program also supports a number of DOE reactor facilities. In addition, the program manages the DOE uranium programs, although that activity is not R&D and is not included in table 2.<sup>10</sup>

For FY1999, DOE has requested a 22.3% increase for nuclear energy R&D, as defined by CRS, over the FY1998 appropriation. The increase is concentrated in three areas: the assumption of the nuclear technology program, maintaining the Fast Flux Test Reactor (FFTF) in hot-standby mode, and a nuclear energy research initiative. The FFTF work is part of the DOE effort to develop a source of tritium for the nation's nuclear weapons stockpile.<sup>11</sup> The initiative is designed to start a research

---

<sup>10</sup>DOE does not include several activities in its definition of nuclear energy R&D that are included in the CRS definition. Those activities are facilities management, isotope support, nuclear energy plant optimization, and program direction. All of these activities, however, lend direct or indirect support to nuclear energy or other R&D activities within DOE, and therefore are included in the CRS-calculated total nuclear energy R&D amount.

<sup>11</sup>U.S. Library of Congress, Congressional Research Service, *The Department of Energy's Tritium Production Program*, by Richard E. Rowberg and Clifford Lau, CRS Issue (continued...)

program to address a broad array of issues critical to the future of nuclear power. DOE proposes to establish an advisory committee to guide the implementation of that research program. A similar activity, called the Nuclear Energy Security initiative, was introduced last year but did not receive funding because of concerns that it appeared to assume private sector responsibilities. DOE believes that it has addressed those concerns with this year's version.

The Senate approved \$256.5 million for nuclear energy R&D, 1.0% below the request but 21.1% over the FY1998 amount. The bill emerging from the Appropriations Committee had assigned funding to maintain the FFTF in a hot-standby mode until a long-term source for tritium production can be developed to the Non-defense Environmental Management account. A floor amendment, however, shifted the funds back to the Nuclear Energy R&D program. Because of budget authority caps on the Energy Supply account, nearly all of the funds for the FFTF now must come from prior year carryover balances. The Senate expressed strong support of the nuclear technology R&D activities and the nuclear energy research initiatives, for which it recommended funding the full request. The Senate stated that nuclear energy is the best available base-load energy supply option for reducing greenhouse gas concentrations to justify that support.

The House approved \$205.5 million for nuclear energy R&D, 20.7% below the request and 3.0% below FY1998. Those funds include \$31.2 million to maintain the FFTF in a hot-standby mode. The House, however, put the budget authority for these funds in the Non-defense Environmental Management account. While expressing its support for the nuclear energy research initiative, the House approved \$5 million for the first year of the program, a reduction of \$19 million from the request. In addition, the House did not provide funds for the nuclear energy plant optimization initiative. It also included \$20 million for nuclear energy R&D — basically electrometallurgical technology — under termination costs.

**Solar and Renewable Energy R&D.** The Solar and Renewable Energy R&D program focuses on a wide range of energy supply technologies.<sup>12</sup> Major efforts are directed toward photovoltaic (PV) technology, solar thermal central power plants, and fuel production from biomass. The PV activity is aimed at reducing production costs and improving conversion efficiency. The program also is funding R&D on solar heating and cooling for buildings, improving the cost performance of wind machines, exploitation of geothermal resources, and the development of hydrogen as an energy carrier. The program includes research on potential electric energy storage technologies and application of high temperature superconductivity. R&D on technologies for integrating renewable energy systems into the electric utility grid is also a key responsibility of this program. An important function of this program is to help the private sector develop promising new renewable energy technologies for the commercial market.

---

<sup>11</sup>(...continued)  
Brief IB97002, (Washington: continually updated).

<sup>12</sup>U.S. Library of Congress, Congressional Research Service, *Renewable Energy: A New National Outlook?* by Fred Sissine., CRS Issue Brief IB93063, (Washington: continually updated).

In addition to R&D funded directly by this program, DOE's Basic Energy Sciences program also funds renewable energy research. This is basic research focused on photovoltaic energy, biomass energy, and hydrogen. The budget request for these areas was included with the Basic Energy Sciences program request.

For FY1999, DOE has asked for a 28.9% increase over the FY1998 appropriation for the Solar and Renewable Energy program. Subprograms that would receive the largest increases are photovoltaic energy, biomass/biofuels, wind energy systems, and hydrogen. For biomass, most of the increase would go toward biofuels energy systems development and ethanol production. For PV energy, the increases would go toward PV energy systems development and collector research. For wind energy, the bulk of the increase would go toward turbine research, pilot and demonstration plants, and field tests. In most cases, the increases are aimed at expanding efforts to push technologies toward commercial readiness.

Within the Basic Energy Sciences (BES) program, DOE has requested \$47.9 million for basic research primarily related to solar and renewable energy technologies. These funds support research in the BES materials and chemical sciences subprograms, and in the energy biosciences subprograms.

For FY1999, the Senate appropriated \$367.4 million for the elements of the program within the Energy Supply portion of the DOE budget request (Energy Resource R&D in Table 2), and \$47.9 million for those elements funded by the Basic Energy Sciences program. The former is 5.6% below the request but 21.7% above the FY1998 appropriation, while the latter meets the request and is 8.1% above the FY1998 amount. The Senate Appropriations Committee had recommended \$297.6 million for the Energy Supply portion of the program, but an amendment adopted by the full Senate added \$69.8 million. The addition was offset in part by a 1.587% reduction in several other DOE programs including all of the Science programs, in part by about \$10.8 million from prior year carryover balances. Subprograms that received significant increases from the amendment over the Committee mark include photovoltaic energy systems, biomass/biofuels energy systems, and wind energy systems, although all remained below the request.

The Senate expressed concern about DOE's choice of projects from this program to be included in the CCTI. It argued that DOE should emphasize basic research that had the promise of providing substantial reductions in greenhouse gas concentrations in the longer term, and reduce support of research leading toward incremental improvements in commercial or near-commercial technologies. The Senate argued that with some exceptions, the latter type of research was best left to the private sector.

As a consequence of those concerns, the Senate approved funding for the full request for the renewable energy research falling within Basic Energy Science, and an additional \$5 million above the request for hydrogen research. The Senate also expressed concern about the effect of electricity deregulation on the reliability of the electric transmission system, and provided \$5 million for a national laboratory-utility industry partnership for relevant research.

The House appropriated \$303.5 million for solar and renewable energy R&D included in the Energy Supply portion of the DOE budget request (Energy Resources in Table 2), and \$47.9 million for such research funded by the Basic Energy Sciences program. The former is 22.0% below the request but 0.5% above FY1998, while the latter meets the request and is 8.1% above the FY1998 level. As a general comment, the committee repeated its concern that DOE was putting too much of its effort into trying to commercialize solar and renewable technology that is not yet ready, and not enough into more basic or long-term research that could result in significant technological advances. It also questioned the premise that more funding was needed for the CCTI and noted that the choice of projects included in that initiative seemed somewhat arbitrary.

For specific subprograms, the House provided essentially level funding for photovoltaic energy systems and wind energy systems, and a substantial increase — \$13.85 million — for biomass/biofuels energy systems compared to the FY1998 levels. In addition, the House recommended a slight decrease from FY1998 for hydrogen research. The House also urged DOE to coordinate research on electric transmission system reliability related to electric utility deregulation.

**Fusion Energy Science.** The Fusion Energy Science (FES) program concentrates on basic research in plasma and fusion science and technology to expand the knowledge base needed to develop fusion-based power reactors and to enhance the application of plasma science in industry.<sup>13</sup> The program supports research on two major tokamak facilities and a number of alternative concepts. The FES program also participates in the International Thermonuclear Experimental Reactor (ITER) project, the major international effort to control the fusion reaction for electric power production. For the past 6 years, the project has concentrated on developing an engineering design for ITER. This design activity ends in 1998. It was originally hoped that a decision to proceed with construction would be made at that point. Now, however, that decision has been put off for at least 3 years.

For FY1999, DOE's request for Fusion Energy Sciences is about 1.6% below the FY1998 appropriation. Within that request, however, are some significant changes. With the end of the ITER design activity, DOE has asked that most of the funds that had been going to the ITER project — for FY1998 about \$52.5 million — be shifted to domestic research needs. A total of \$39 million would be shifted. DOE is still requesting \$12 million for the ITER project, which would be in a transition phase awaiting a new construction decision point. Another major change in the FES budget would be an increase of about \$7 million for operation of the National Spherical Tokamak Experiment, which is expected to begin operations in FY1999. This experiment is part of the FES alternative concept effort. Funding for the two major tokamak facilities would increase slightly from FY1998. Funds for these two tokamaks would make up about 37% of the entire FES budget request.

---

<sup>13</sup>U.S. Library of Congress, Congressional Research Service, *Magnetic Fusion Energy: The DOE Fusion Energy Sciences Program*, by Richard Rowberg, CRS Issue Brief IB91039, (Washington: continually updated).

The Senate appropriated \$232 million for the program for FY1999, an increase of 1.7% over the request and equal to the FY1998 amount. The Senate noted the efforts underway by the U.S. fusion community to determine how the program should proceed in light of the end of the ITER project as it now stands. While agreeing that such steps are necessary, the committee urged DOE to undertake an extensive review of all of the fusion options it currently funds — laser fusion, heavy-ion fusion, pulsed-power fusion, and magnetic fusion — before it makes any commitment to a future large magnetic fusion project. Noting the difficulty of such a review, the Senate nevertheless argued that it was necessary before any decisions about the next steps in fusion energy development are made. The Senate asked DOE to consider specifically, non-magnetic options. At a minimum, the Senate stated, roadmaps that justify the continued development of the different options should be created.

The Senate also placed the Fusion Energy Science program account under the DOE science programs. For the FY1998 appropriations, the Congress had placed the program in Energy Supply R&D (Energy Resources in table 2) as part of an effort to consolidate the DOE science account. Many in the fusion research community, however, felt that the program was still primarily basic research and should be placed with the other basic research activities funded by DOE. The Senate has apparently agreed with this argument.

The House approved \$232 million for FY1999, an increase of 1.7% over the request and equal to the FY1998 amount. It expressed its support of DOE's efforts to emphasize alternative concepts and increase university research. It also directed DOE to carry out a comprehensive review of all fusion concepts funded by the Department and develop a program plan that includes all such work including inertial confinement fusion research supported by DOE defense programs. The House also reminded DOE that Congress clearly stated that the United States has no obligation for participation in the ITER project beyond 1998. The House further expressed concern about the possibility that DOE would enter into an agreement to proceed with a lower cost version of ITER, and objected to the proposed extension of the ITER engineering design activity. Accordingly, the House did not provide any new additional funds for ITER or any ITER-related activity, and told DOE to use prior year funds for any closeout costs. In addition, a letter from the Chairman of the House Energy and Water Development Appropriations Subcommittee to the Secretary of DOE urged the agency not to enter into any extension of the ITER agreement before the Congress had the chance to look at DOE's review of options.

## Science

The DOE science programs are a broad array of basic research activities whose stated mission is the development of the scientific basis for advanced energy technologies and the understanding of environmental effects of energy production. Table 3 (next page) shows funding information for these programs. In fact, these programs serve a much broader mission. Some support the most fundamental science funded by the federal government with applications, at best, decades away. Others perform research on scientific areas with potential applications well beyond energy. In addition, these programs are the principal source of support for the non-defense R&D carried out at DOE's nine multi-purpose national labs. Administratively, these programs fall within the Office of Energy Research.

**Table 3. Science**  
(millions of dollars)

Program	FY1998 (App.)	FY1999 (Request)	FY1999 (Senate)	FY1999 (House)
High Energy Physics	680.0	691.0	691.0	696.5
Nuclear Physics	320.9	332.6	332.6	335.1
Basic Energy Science	668.2	836.1	836.1	779.1
Computational and Technology	150.9	160.6	150.0	138.6
Biological and Environmental	406.7	392.6	407.6	405.9
Fusion Energy Sciences	—	—	232.0	—
Other	60.4	77.2	59.9	65.4
<b>Total</b>	<b>2,287.1</b>	<b>2,490.0</b>	<b>2,673.2<sup>a</sup></b>	<b>2,420.6<sup>b</sup></b>

<sup>a</sup> The total for Science was reduced by \$43 million to help pay for increases in the Solar and Renewable Energy Account adopted by amendment, and was increased by \$7 million in another amendment. The Senate also directed that \$39.6 million of this amount should come from various prior year carryover balances.

<sup>b</sup> The House directed that \$7.6 million of this amount should come from various prior year carryover balances and \$13.5 million from general reductions in the CCTI request to be shared by BES and BER..

**High Energy Physics.** The High Energy Physics (HEP) program supports experimental and theoretical studies of the fundamental structure of matter and energy. It operates several large accelerators, including the tevatron at Fermilab and the linear accelerator at the Stanford Linear Accelerator Center (SLAC). It also supports theoretical and experimental research at a number of universities in the nation. A major initiative of the HEP program is participation in the Large Hadron Collider (LHC) project at the Center for European Nuclear Research (CERN) in Europe. The LHC is an expansion of the particle accelerator at CERN, which would provide a substantial increase in its capability, making it the largest high-energy accelerator in the world. An agreement between DOE and CERN was reached last year on U.S. participation in the project.

For FY1999, DOE has requested a 1.6% increase for the HEP program over FY1998. Increases were sought for operation of the Fermilab facility and contribution to the LHC project. It is expected that the main injector project at Fermilab will be complete by FY1999 as will the B-factory at SLAC. Much of the increase for Fermilab would go to the neutrinos at the mains injector project now under construction, which is expected to be completed in FY2002. The increase requested for the LHC was \$30 million over FY1998 to a total of \$65 million for FY1999. DOE has also requested \$329 million in advanced appropriation to provide the funds needed to complete DOE contribution to the project.

The Senate appropriated full funding of the DOE High Energy Physics program request for FY1999. The Senate did not approve any advance appropriation for the LHC, which had been requested by DOE.

The House approved \$696.5 million for FY1999, 0.8% above the request and 2.4% above the FY1998 level. The increase over the request is for facility operations and the R&D program. The House stated its strong support of the fundamental research carried out by the High Energy Physics program. The House also expressed its strong support of the U.S. participation in the Large Hadron Collider project and provided the full request for FY1999, although it did not provide any of the advance appropriation requested by DOE. In granting the request, the House stated that U.S. scientists should have the opportunity to participate in the world's largest accelerator and that it would make sure that U.S. investment in the project was protected. It also hoped that the LHC would serve as a model or future international science projects.

**Nuclear Physics.** The Nuclear Physics program (NP) supports research into the structure of the nucleus of the atom and the forces holding the nucleus together. It supports theoretical and experimental research at universities and the national laboratories. Large research facilities within this program include the Thomas Jefferson National Accelerator Laboratory in Newport News, VA, now in operation, and the relativistic heavy ion collider (RHIC) at Brookhaven National Lab, currently under construction.

For FY1999, DOE has requested a 3.6% increase for the NP program over FY1998. An increase of about \$47 million was requested for the startup of operations at the RHIC, which will be completed in FY1999. Part of that increase would be offset by a decrease in RHIC construction costs. Funding close to the FY1998 level was requested for other activities in the program.

The Senate appropriated full funding of the DOE High Energy Physics program request for FY1999.

The House approved \$335.1 million for FY1999, a 0.7% increase over the request and a 4.7% increase over FY1998. The House also noted its strong support of the fundamental research carried out by the Nuclear Physics program.

**Basic Energy Sciences.** The Basic Energy Sciences (BES) program is the most diverse research program within DOE. Its stated goals are to carry out scientific research related to energy technology development, and to maintain and develop major research facilities for national use. The research in BES consists of a wide range of basic research activities in materials, chemistry, engineering, earth sciences, and energy biosciences. In addition to energy technologies, BES research has potential applications in a wide variety of industrial areas. The major user facilities — synchrotron radiation and neutron sources — operated by BES at the DOE labs are used extensively by industry, universities, and government on a cost shared basis. Support of these user facilities constitutes nearly half of the DOE BES budget.

For FY1999, DOE has requested a 25.1% increase for the BES program over FY1998. Most of that increase was for the spallation neutron source (SNS), for which DOE has requested \$157 million for FY1999 compared to \$27 million

appropriated for FY1998. The SNS is to be a major user facility producing neutrons to probe all types of molecular structures such as DNA and advanced materials. It is to be built at Oak Ridge National Laboratory at a cost of \$1.3 billion. Completion is expected in FY2005. Increases were also requested to continue the DOE program to upgrade all its major user facilities. Including the SNS, about \$445.5 million of the BES budget request was for those facilities. Within the BES budget request is \$47.9 million for basic research related to the solar and renewable energy program as mentioned above. Finally, \$6 million of the request was directed at research in materials, chemistry, and carbon sequestration fundamentals as part of the CCTI.

The Senate appropriated the full DOE Basic Energy Sciences program request for FY1999 including the full amount for the SNS. The Senate noted the unique nature of the DOE user facilities among all federal R&D agencies and expressed its wish for DOE's continued success in that area. The Senate also pledged to do all that it could to see that "optimal" funding was provided so the SNS could be completed on schedule.

The House approved \$779.1 million for FY1999, 6.8% below the request and 16.6% above the FY1998 level. The House expressed its continuing support of the research support in the BES program including the "world-class" research user facilities. It also noted the need for the SNS, but, due to severe budget constraints, was only able to provide \$100 million for the facility for FY1999, 36.1% below the request. All of the shortfall between the request and appropriation for BES is in the SNS project.

**Computational and Technology Research.** The Computational and Technology Research (CTR) program supports basic research in mathematics and computer science, and advanced energy projects. The program funds research on advanced computer applications and provides access to high performance computers for researchers in the DOE laboratories. This program also is responsible for the DOE portion of the Next Generation Internet (NGI) initiative.<sup>14</sup> Finally, DOE civilian technology transfer activities are contained in this program.

For FY1999, DOE has requested a 6.4% increase for the CTR program over FY1998. The increase was for the NGI request, which amounts to \$22 million for FY1999. Congress did not fund the FY1998 request for NGI from DOE. The CTR program would also emphasize the development of computer networks among the DOE laboratories in order to facilitate collaborative research.

The Senate appropriated \$150 million for the CTR program for FY1999, 6.6% below the request and 0.6% below FY1998. It noted that budget pressures precluded it from approving the entire request.

The House appropriated \$138.6 million for FY1999, 13.7% below the request and 8.2% below FY1998. The House did not provide any funds for the Next

---

<sup>14</sup>U.S. Library of Congress, Congressional Research Service, *Next Generation Internet*, by Glenn McLoughlin, CRS Report 97-521 SPR, (Washington: updated September 5, 1997).

Generation Internet initiative. It argued that DOE's justification for starting a new program in this area was inadequate given the large investment made by the private sector in the Internet and related technologies. The House noted that DOE's wish to upgrade laboratory and university Internet-related hardware was already being supported by the CTR program and a new effort was unnecessary.

**Biological and Environmental Research.** The Biological and Environmental Research (BER) program is focused on basic research in the biomedical and environmental sciences for the purposes of understanding potential long-term health and environmental effects of energy production and use. Included within BER are research on global climate change, radionuclide medicine and DOE's portion of the human genome project. This program also helps operate the Environmental Molecular Sciences Laboratory (EMSL) for bioremediation research.

For FY1999, DOE has requested a 3.5% decrease in the BER budget compared to FY1998. A decrease was made possible by the absence of any request for FY1999 funds for two congressionally mandated projects funded at \$31 million in FY1998. Increased funding of \$11 million was requested for work coming under the CCTI. That work would focus on fundamentals of carbon dioxide production, and biological processes for enhancing carbon dioxide sequestration and production of clean fuels such as hydrogen. Other areas would be funded at close to FY1998 levels.

The Senate appropriated \$407.6 million for FY1999, 3.8% above the request and 0.2% over the FY1998. The Senate directed DOE to start a program in low dose effects, and provided \$20 million for it. The Senate instructed DOE to prepare a plan and 5-year budget for this effort, and submit them to the House and Senate Appropriations Committee 120 days after the FY1999 appropriations are enacted.

The House appropriated \$405.9 million for FY1998, 3.4% above the request and nearly the same as FY1998. The House included funds to increase biomedical research related to pharmaceutical development. The House also funded the full request for the National Institute for Global Environmental Change program.

The House took another action that affects both this program and the Basic Energy Sciences program. The House stated its belief that the DOE CCTI program was not solely based on sound scientific judgement, but was rather driven too much by policy. It cited several studies used by DOE that the committee said were inadequate and appeared to be designed to support policy decisions already made. As a consequence, the House reduced the \$27 million request for CCTI funds within BES and BER by 50% to \$13.5 million. The \$13.5 million reduction would come out of the two programs.

**Other.** Other activities are comprised of support and auxiliary programs including laboratory facility and equipment support, program direction, energy research analysis, and university and science education. The program direction budget contains funds for all of the programs within the science category.

For FY1999, DOE has requested a 26.2% increase for the other activities over FY1998. The source of the increase was the re-introduction of a separate budget line for university and science education (USE). This effort, which supports university

and secondary school faculty and student research at the DOE national labs, had been funded directly from the program budgets, at the direction of Congress, for the past two years. Prior to that it was a separate account. In addition to research fellowship funds, DOE requested, within the USE activity, funds for educational technology to enhance Internet-based education and to assist predominately minority educational institutions increase production of scientists and engineers.

The Senate did not provide any funds for the USE initiative. While recognizing the important contribution that DOE can make to the nation's science and engineering education, it stated that budget constraints did not permit funding this request. The Senate, however, urged DOE to continue supporting education activities out of its program funds. Finally, the Senate recommended funding for Science program direction at last years level, \$2 million below the FY1999 request.

The House did not provide any funds for the USE initiative. It noted that a significant fraction of the program research funds approved by the Congress in FY1998 are being spent at the nation's universities, which is in keeping with the committee's desire that DOE strongly support higher education. The House urged DOE to continue such funding with emphasis on university programs supporting graduate and post-graduate studies. The House also added \$3.24 million to the Science program direction request for FY1999 to support various specified fellowship and education programs that were initiated by the Secretary of Energy in the past. The House wished to give these programs identified funding and directed DOE to refrain from funding other such initiatives without congressional approval.

The Senate amendment that provided additional funds for Solar and Renewable Energy R&D reduced funds in the Science programs by 1.587% to help offset the increase. In addition, an amendment was adopted by the full Senate to increase funds for all Science programs by \$7 million. The net effect is an across-the-board reduction of about \$36 million for Science programs in the Senate bill. Also, the Senate directed that \$39.6 million of the final appropriation for all Science programs be obtained from uncOSTed prior year balances. The House directed that \$7.6 million be supplied from uncOSTed prior year funds for the terminated SSC project.

## **National Security and Environmental Management**

Although separate sectors within the DOE budget, these two activities are closely related since the prime focus of environmental management is cleanup of the DOE weapons facilities.<sup>15</sup> The major activity is weapons R&D, which supports the nation's efforts to manage the nuclear weapons stockpile in the absence of testing. Other research is funded to support nuclear weapon nonproliferation, to improve naval ship propulsion reactors, to develop new science and technology for environmental restoration, and to support DOE's environmental, health and safety activities. Table 4 (next page) shows R&D budget data for these programs.

---

<sup>15</sup>U.S. Library of Congress, Congressional Research Service, *Nuclear Weapons Production Complex: Environmental Compliance and Waste Management*, by Mark Holt, CRS Issue Brief IB90074, (Washington: archived).

**Table 4. National Security and Environmental Management**  
(Millions of dollars)

Program	FY1998 (App.)	FY1999 (Request)	FY1999 (Senate)	FY1999 (House)
Stockpile Stewardship	1,867.2	2,188.4	2,163.4	2,123.1
Nonproliferation	210.0	210.0	210.0	210.0
Naval Reactors	670.5	665.5	665.0	681.5
Environmental Quality	341.0	295.5	278.5	336.0
Total	3,088.7	3,359.4	3,316.9 <sup>a</sup>	3,350.6 <sup>b</sup>

<sup>a</sup> The Senate directed that about \$34 million of this amount should come from prior year carryover balances.

<sup>b</sup> The House directed that about \$151 million (\$145 million from Stockpile Stewardship) of this amount should come from prior year carryover balances.

**Stockpile Stewardship.** The goal of the Stockpile Stewardship program is to provide the scientific understanding, experimental facilities, and computational capability to maintain the safety, reliability and performance of the existing nuclear weapons stockpile in the absence of nuclear testing.<sup>16</sup> As the stockpile ages, it will undergo changes that may require component replacement. To assure that those changes do not compromise the deterrent capability of the stockpile, DOE is developing a massive computer capability to simulate the explosion of those weapons. The scientific facilities are designed to provide the understanding of weapon physics to develop and validate the simulation models. In addition, an important responsibility of the program is to ensure that the nation has the scientific and technical personnel necessary to maintain the stockpile.

A major item within the stockpile stewardship program is the National Ignition Facility (NIF), which is now under construction.<sup>17</sup> The NIF is to be a large, laser fusion facility that is expected to simulate portions of the ignition process of thermonuclear weapons on a very small scale. Other major activities in the program are construction of the dual axis radiographic hydrodynamic test facility to test for the safety of nuclear weapons, and the accelerated strategic computing initiative (ASCI) to develop the supercomputer technology needed for weapon simulations. The Defense Program's technology transfer activities are also in this program.

For FY1999, DOE has requested a 17.8% increase for the program compared to FY1998. The biggest contributor was an additional \$106.5 million for the ASCI project. For FY1999, that project intends to enhance efforts to develop three-

<sup>16</sup>U.S. Library of Congress, Congressional Research Service, *Nuclear Weapons Stockpile Stewardship: Alternatives for Congress*, by Jonathan Medalia, CRS Report 96-11 F, (Washington: December 14, 1996).

<sup>17</sup>U.S. Library of Congress, Congressional Research Service, *The National Ignition Facility and Stockpile Stewardship: Highlights and Issues*, by Richard Rowberg, CRS Report 97-464 SPR, (Washington: updated February 10, 1998).

dimensional simulation codes and increase computational capability to three trillion operations per second (3 Tf). (Effective simulation is expected to require 100 Tf.) An increase of \$86.4 million was requested for the NIF bringing the FY1999 total to \$284.2 million for the project. FY1999 is expected to be the peak year for NIF construction costs. The transfer of waste management activities to the Stockpile Stewardship program from the DOE Office of Environmental Management is projected to require an additional \$61.9 million for the program.

The FY1999 defense authorization bill passed by the Senate provides an authorization of \$2,123.4 million for Stockpile Stewardship for FY1999. This amount is \$65 million below the request. The Senate directed DOE to take the reduction from the ASCI program. The Senate argues that DOE is moving too rapidly on this program and cites the large percentage of underutilized supercomputer capacity within the DOE defense programs. Further, the Senate noted that much of the experimental data for the simulation codes to be run on ASCI computers has not been collected yet because most of the experimental devices are still under construction. The Senate also approved continuation of the prohibition of DOE performing cooperative stockpile stewardship R&D with foreign countries, and directed DOE to continue R&D in robotics and intelligent machines. An amendment approved by the Senate would establish an outside commission to assess the reliability, safety, and security of the weapons stockpile and report to Congress, annually, on the results of that assessment.

The House-passed version of the FY1999 defense authorization bill, provides an authorization of \$2,138.4 billion for Stockpile Stewardship for FY1999, a reduction of \$50 million from the request. Like the Senate bill, the reduction would all be in the ASCI program. The House expressed concern about the high risk nature of the ASCI effort, and notes contractor delays in meeting the next program target. The House also noted that the necessary software for the computer is developing at a slower rate. Perhaps more importantly for the Stockpile Stewardship program, the House directed that DOE reduce its carryover balance — the funds left unspent at the end of the fiscal year — to 12%. This action would require DOE to provide about \$162 million of the authorization for Stockpile Stewardship from carryover funds. The House-passed bill also requires DOE to submit a report providing the technical performance criteria that are necessary to assure a high confidence level in the safety and reliability of the stockpile for the Stockpile Stewardship Program facilities now under development. It feels that DOE has not sufficiently defined such criteria.

The Senate appropriated \$2.163 billion for the Stockpile Stewardship program for FY1999, 1.1% below the request but 15.9% above the FY1998 amount. The Senate expressed “serious” concern about the sufficiency of budget projections for the program to “sustain” the stockpile stewardship initiatives and provide adequate confidence in stockpile’s safety and reliability. The Senate also noted situations of management laxity that had resulted in excessive cost growth of some projects within the program. The Senate directed DOE to ensure proper management attention to the program particularly in view of severe budget restrictions. As for the core stockpile stewardship program, the Senate also expressed its concern about the sufficiency of the FY1999 and future budget projections. It also stated its skepticism about the adequacy of current engineering and surveillance approaches to maintain the stockpile in the absence of testing.

The appropriation for FY1999 is \$25 million below the request. The Senate directed that this reduction be taken in the ASCI program. It expressed concern that the ASCI effort is growing faster than justified and continued growth at that rate might adversely affect other parts of the Stockpile Stewardship program in view of the constrained budget environment.

The House appropriated \$2.123 billion for FY1999, 3.0% below the request but 13.7% above the FY1998 level. In providing those funds, the House expressed concern about management inefficiencies in the Stockpile Stewardship program. It cited examples of activities that were funded that it considered somewhat outside the mission of the program. It also noted examples of cost and schedule creep that resulted in significant expansion of program costs. The House argued that DOE should undertake a thorough assessment of the activities included within the program to determine which are essential and should institute procedures to ensure greater cost control. Without such actions, the House noted that future funding increases for the program might be hard to come by.

The appropriation assigned \$30 million of the reduction from the request to general cost efficiencies the House considered achievable. Another \$25.3 million were to come from the deferral of the start of construction projects. The House directed DOE to determine causes for past project management failures before embarking on a set of new projects. The House expressed support of the ASCI program and funded the full request. It added \$10 million to the inertial confinement fusion program for additional research on high average power lasers.

In its appropriation for the Stockpile Stewardship program, the Senate directed DOE to use about \$24 million of uncosted carry over balances. The House directed DOE to use about \$145 million in that way. This action follows direction of the FY1999 defense authorization bill passed by the House.

**Nonproliferation and Verification R&D.** Nonproliferation and verification R&D focuses on methods for detection of the production and testing of nuclear weapons, and for dismantlement of nuclear warheads. Remote sensing and regional monitoring are the principal areas of investigation. This research supports arms control treaty monitoring, provides technology for collection of intelligence of potential proliferation, and develops technologies for detecting diversion of weapons of mass destruction.

For FY1999, DOE has requested the same funding level for this program as the FY1998 appropriation. The program proposed to expand its emphasis on chemical and biological weapons in FY1999 and asked for an additional \$3.95 million for that purpose. Most of the other activities would remain at FY1998 levels.

In the FY1999 defense authorization bill, the Senate approved an authorization of \$210 million, the amount requested, and the reaffirmed its endorsement of DOE's efforts in forensic analysis. The Senate also expressed its support of DOE's activities in detection of and response to biological and chemical warfare and terrorism. The House-passed bill also recommends an authorization of \$210 million for FY1999.

The Senate appropriated funding for the full FY1999 request. The Senate noted that this funding will provide DOE with a substantial increase in funds for efforts directed at weapons of mass destruction including biological and chemical weapons.

The House appropriated funding for the full request for FY1999. The House expressed concern, however, about the apparent unfocused nature of the program. It noted that there was not overall program plan or “technology roadmap” that provided guidance about how the individual projects fit within an overall mission. The House suggested an external peer review of the program could give it more credibility and focus.

**Naval Reactor R&D.** Naval reactor R&D is directed at the development and test of advanced reactor systems and components for submarines, and support of the ship reactors currently in service. The program examines ways to bring new technology into existing reactor systems, tests components and materials in existing systems, and develops new reactors that are less costly and more reliable. The program has responsibility for all 115 operating reactors in the fleet.

For FY1999, DOE has requested a slight decrease of about 0.8% for this program compared to FY1998. The program will focus on maintaining reactor service life, and on reactor safety and reliability. It will also continue the inactivation process for six test reactors, and development and testing of the New Attack Submarine plant.

The Senate approved a \$16 million increase in the authorization for this program for FY1999 to a total spending level of \$681.5 million in the FY1999 defense authorization bill. The increase is for efforts to decommission and decontaminate prototype reactor facilities that are no longer needed. The bill passed by the House also authorizes an increase of \$16 million for FY1999. The increase is to go expedite shutdown and remediation of prototype reactors in New York and Idaho.

The Senate appropriated full funding for FY1999 request. The Senate noted its support of DOE’s efforts to optimize activities to shutdown prototype reactors although it is not able to provide additional funds. The Senate however, urged DOE to examine its need for more resources in this area and make such requests as appropriate in the future.

The House appropriated \$681.5 million for FY1999, 2.4% above the request and 1.6% above FY1998. The additional \$16 million is to continue inactivation of test reactors and make sure that environmental cleanup efforts are not delayed.

**Environmental Quality R&D.** Environmental quality R&D consists of technology development and environmental science within Environmental Management (both defense and non-defense waste), and environment, safety, and health (ESH) for civilian energy R&D activities. The first activity is charged with expanding the scientific understanding of the character and risks associated with the defense and non-defense wastes created at weapons manufacturing sites, and developing new technologies for carrying out restoration and management in a safer, less costly manner. The second program, ESH, supports health studies, technical

assistance, compliance with the National Environmental Policy Act, and administrative support to the several DOE civilian R&D programs.

For FY1999, DOE consolidated its science and technology activities under Environmental Management into two Science and Technology programs; one for defense wastes and one for non-defense wastes. For the former, DOE has requested \$193 million and for the latter it requested \$26.5 million. The total, \$219.5 million, is about 20.2% below the FY1998 appropriation. The reduction was in response to congressional direction to DOE to shift emphasis to transfer of new technologies into the waste management program away from developing new technologies. The Congress argued that DOE was putting too much effort into the latter and not enough in getting the new technologies into the field. R&D would continue in all of the subprogram areas, but at reduced levels. The goal of the non-defense science and technology program is to make sure that the entire DOE complex has access to new technologies and science about environmental restoration.

For the ESH program, DOE has requested a 15.2% increase over FY1998. The reason for the increase was a shift of personnel from defense environmental health activities to the EHS program. When adjusting for that shift, the budget request for FY1999 is down about 5.6% from the comparable FY1998 appropriation.

Senate action on the FY1999 defense authorization bill would provide an authorization of \$250 million for technology development within the defense environmental management program, an increase of \$57 million. The Senate agreed with DOE about the need to accelerate the introduction of new technology in the cleanup process if it was to meet the new goals for that activity. The Senate did not specify where the added funds should go, but asked DOE to report back to the committee on their allocation. The House-passed bill authorizes an additional \$77.8 million to \$270.8 million. Those additional funds are to help develop new technologies for waste cleanup. The House expressed its belief that such technologies are necessary to expedite cleanup and reduce costs.

The Senate appropriated the full request of \$76 million for the ESH program. It directed that \$20 million of the total, however, be obtained from DOE defense program funds. The Senate recommended \$225 million for environmental restoration science and technology, both civilian and defense. It directed that the funds requested under the civilian cleanup efforts be included in the defense cleanup funding. The appropriation is 2.5% above the request for the combined civilian and defense science and technology program. The Senate urged DOE to develop ways to reduce disincentives for new technologies that have high potential for reducing clean-up costs but that have a high risk.

The House appropriated \$46 million for civilian ESH activities for FY1999. It split the program direction portion of that program, however, and placed \$20 million under DOE other defense programs. Therefore, the total appropriation for ESH, as defined by the request, is \$66 million for FY1999, 13.2% below the request and the same as the FY1998 level. The net reduction from the request made by the House of \$10 million is directed at funding for contract support. The House repeated its concern that DOE relies too much on outside contract support for these activities that should be performed by regular DOE employees.

For environmental restoration science and technology, the House appropriated \$270 million for FY1999. The appropriation includes funding for both the civilian and defense requests. Therefore, it is 23% above the combined request and 1.8% below the FY1998 level. Of the \$51 million increase above the request, the House directed that \$30 million should be used to accelerate the new technologies for cleanup missions, and \$10 million should be used to start a new round of research grants for the science portion of the program. The House noted the good reviews that program had received. The remaining portion of the increase is directed to be used for a variety of activities including an additional \$3 million for risk policy work.

## Budget Issues

Several issues are emerging from the FY1999 budget request and congressional action. This section presents a discussion of five issues that appear to be receiving significant attention during the consideration of the DOE budget.

**Climate Change Technology Initiative.** Studies sponsored by DOE over the past year along with the PCAST study argued that new energy supply and demand technology in selected areas could lead to significant reductions in carbon emissions at little or no net cost. With the agreement reached by the Administration at Kyoto to reduce carbon emissions in the 2008-2012 period to 1990 levels, chose, in part, to implement these findings by asking for significant increases in certain energy R&D programs, primarily Energy Conservation and Solar and Renewable Energy R&D.

For the two programs combined, DOE asked for a 32.7% increase over the FY1998 appropriation. This increase is comparable to the percentage increases requested by DOE for each of the past three fiscal years. For those years, Congress approved an increase over the year before but considerably below that requested by DOE. The nature of the requested increase for FY1999 was similar to those in the past three years. Activities designed to accelerate the readiness of technologies for commercial acceptance — demonstration and pilot projects, and systems development — were to receive the largest increases.

These activities, however, have usually been those least favored by Congress. It has argued that support of projects like those is the responsibility of the private sector and not the federal government. Accordingly, for DOE to provide funding in those cases is placing the government in the position of picking winners and losers without the discipline of the market. DOE counters that the private sector has not been funding this so-called pre-competitive research, and without DOE help, few if any of these technologies would receive the boost they need to become competitive.

Action by the Senate and House suggests that the Congress is concerned that the requested increases represent an implicit commitment to the Kyoto accords before the Senate has formally considered the treaty. Concern has been expressed that the justification for increases is not based on sound analysis but is more policy driven. At a minimum, attempts to justify the large increases by the CCTI do not seem to have changed the views of many that DOE should reduce its efforts to assist commercial development of new technologies. Renewable energy R&D, however, is still supported by many Members as evidenced by the successful Senate

amendment to increase funding. In addition, there may be action on both the House and Senate floor during consideration of the Interior and Related Agency bills to add funding for Energy Conservation R&D.

The Fossil Energy R&D program also contributes to the CCTI. DOE asserts that coal R&D is an important component of its efforts to combat the buildup of greenhouse gases. Coal is the largest single source of such gases and emits more carbon dioxide per unit of energy than either oil or natural gas. Because of the abundant coal resources possessed by the United States, DOE believes it very important to carry out R&D on ways to minimize the emission of carbon dioxide, and other air pollutants, from coal combustion. Part of this research is directed at ways to sequester carbon dioxide. While an interesting goal, effective sequestration is likely to prove very difficult to achieve because of the large quantities of carbon dioxide that are emitted from coal combustion.

The Congress does not appear to share DOE's enthusiasm about the potential payoff from research to reduce carbon emissions from coal combustion. Both the House and Senate Appropriations Committees recommended substantial reductions in the requests for those activities. They seem to be willing to provide some support, but there is concern that DOE is attempting to use such activities to implement the Kyoto agreement. The House Appropriations Committee specifically directed DOE to refrain from such actions.

**Nuclear Energy.** DOE once again requested funds to launch a research initiative to help maintain the nuclear power option in the United States. For FY1998, DOE requested about \$39 million to carry out research in a variety of areas about the operation of the nation's existing nuclear power plants. That request, called the nuclear energy security initiative, also contained proposals to fund research on various spent fuel issues. For FY1999, DOE requested \$24 million to begin a research program, called the nuclear energy research initiative (NERI), designed to help maintain the nuclear power option for the United States, by focusing on the long-term enhancement of nuclear energy technology. The source of this initiative, according to DOE, was a recommendation from the PCAST report that urged DOE to establish a new effort in nuclear energy research and recognition of the role nuclear energy could play in mitigating greenhouse gas buildup. In presenting the initiative, DOE laid out a selection of possible research areas, including proliferation-resistant reactor and fuel technologies, nuclear safety and risk analysis, and advanced, lower-power reactor design and applications. Joint research activities among universities, industry and the government would be encouraged. An important goal of the initiative is to enhance university capabilities in nuclear engineering research.

In addition to the NERI, DOE requested \$10 million for a program called the nuclear energy plant optimization initiative to help enhance the life, efficiency, and capacity of existing nuclear power plants, and aid license renewal. This proposal also was based on the PCAST study and forms part of the CCTI.

There has been substantial criticism of these initiatives by members of the renewable energy community. They argue that the programs are just a recycling of last year's proposals, which were rejected. The critics state that the industry does not need DOE's assistance and the proposals represent "corporate welfare at its most

egregious.”<sup>18</sup> They point out that DOE funding for nuclear energy over the last 20 years has been substantially greater than for renewable energy and conservation, and that the latter would be much more effective at reducing greenhouse gas emissions than nuclear.<sup>19</sup> Finally, the critics claim that nuclear energy is no longer economically competitive, cannot be revived, and the resources should go elsewhere.

Others, however, believe nuclear energy needs a fresh look. They argue that we will need all of the non-fossil energy options to halt the buildup of greenhouse gases. Indeed, that is the argument presented by PCAST in making its recommendation for more nuclear energy research. Appropriations actions suggest the Congress is in support of this idea as well. The rejection of the initiatives last year was based more upon concerns that the proposal would be of little value in dealing with the problems facing the nuclear power industry. Success this year appears to be the result of DOE making a better case that the initiative is more designed to shore up the long-term health of the nuclear energy option than to aid the current nuclear power industry, on the level of congressional confidence in the industry’s long-term future, and on the belief by Congress that such a research program is important to address the global climate change uncertainties.

**Fusion Energy Science and the International Thermonuclear Experimental Reactor (ITER).** The ITER project engineering design activity will soon be complete. (It is scheduled to end on July 21, 1998). Originally, a decision on whether to construct the machine was to be made at that time. The partners have agreed to postpone that decision, however, and have proposed a three-year transition period where they will review options and other considerations before making a decision. This action is a result of the high cost of the ITER project as it currently stands, which is more than the partners are willing to pay at this time. DOE wishes to remain in the ITER project during the transition phase, but at a substantially reduced level — \$12 million compared to \$52 million in FY1998 — and to redirect the remaining funds to domestic needs.

The DOE budget action reflects the advice of the Fusion Energy Science Advisory Committee and most of the fusion research community. It would allow DOE to retain a place at the table where the fate of ITER will be decided, but with a much lower commitment of funds. At the same time, funds that had been used for ITER up to now would be available for much-needed development of technology for domestic applications such as improvements of large power tubes used for electromagnetic heating of plasmas. Finally, DOE argues that much of that technology research will have potential applications for ITER if and when it is built.

---

<sup>18</sup>Safe Energy Communication Council, *New Energy Budget Resuscitates Previously Rejected Nuclear Power Funding*, Press Release, February 3, 1998, Washington, DC.

<sup>19</sup>In the calculation used to make this claim, the Safe Energy Communication Council included civilian funds for nuclear energy R&D, civilian nuclear waste R&D, magnetic fusion energy R&D, uranium supply enrichment activities, and the nuclear waste disposal fund. If only nuclear energy R&D is included, total funding for solar and renewable energy and conservation R&D exceeded that for nuclear energy R&D for 1978-1998.

With the demise of ITER, the next phase of U.S. fusion research is now being determined. One possibility is a smaller version of ITER built by the current ITER partners. Another is a multiple machine approach where each would explore a different fusion problem. The Congress, however, has expressed serious concern about the DOE continuing in the program under current condition. The Senate and House both want DOE to examine its entire slate of fusion options — both magnetic and inertial — before proceeding with that “next-step”. The House did not provide any funds for the DOE to continue in the ITER project for FY1999. Letters by the Chairmen of the House Science Committee and the House Energy and Water Development Appropriations Subcommittee have strongly urged DOE not to proceed with the ITER project extension before Congress can give serious consideration to the consequences of such an action including a full review of alternative steps. As a result, DOE has chosen not to sign the extension agreement. Without U.S. participation, it is quite possible that the project may end altogether.

**Basic Energy Sciences and the Spallation Neutron Source.** The spallation neutron source (SNS) would be the most costly project undertaken in DOE civilian R&D since the demise of the superconducting supercollider. When completed, the SNS would be one of the most important neutron sources in the world. There is substantial support for the project because of the importance of neutron sources to research in areas ranging from microbiology to advanced materials. The neutrons serve as probes to explore the basic structure of molecules in those areas. Products already developed on the basis of research using neutron sources include new pharmaceuticals, fibers, and automotive parts. The three neutron sources currently operated by DOE are currently in much demand by researchers from industry, universities, and federal labs.

Perhaps the largest concern about the SNS is its cost, estimated at \$1.3 billion. DOE’s record with large projects over the past several years has not been good as far as meeting budget and completion targets. Even without an overrun, it is still an expensive project and there might be congressional concern expressed about the total cost. The SNS is the lower-cost option for new neutron source planned by DOE since 1984. Indeed, DOE originally proposed a steady-state neutron source called the advanced neutron source (ANS). Congressional concern about its proposed \$2.7 billion cost, however, caused DOE to cancel the project and move the SNS forward. Appropriations action by the Congress suggests strong support for the project and its research value, and satisfaction, at least for now, with DOE cost and schedule estimates. While the Senate provided the full request for FY1999, however, the House did not do so citing budget constraints.

**Stockpile Stewardship.** The goal of the Stockpile Stewardship program, to replace underground nuclear testing with computer simulation and laboratory experiments, is unprecedented in its scale and complexity. As discussed above, with the signing of the comprehensive test ban treaty (CTBT)<sup>20</sup>, the Administration has committed to a complete cessation of nuclear tests for the indefinite future.

---

<sup>20</sup>U.S. Library of Congress, Congressional Research Service, *Nuclear Weapons: Comprehensive Test Ban Treaty*, by Jonathan Medalia, CRS Issue Brief IB92099, (Washington: continually updated).

Achieving the level of simulation that DOE is seeking will require substantial advances in computer power and understanding of weapons physics. According to DOE, that is the only way the nation can retain confidence in the reliability and performance of its nuclear stockpile in the decades to come.

DOE argued that it needs the large increase it requested for this program, along with the companion stockpile management program, to achieve the desired level of confidence in the program's efficacy in a timely manner. In particular, the funding increase is needed to make rapid progress toward the goal of 100 trillion operations per second for the ASCI project and for maintaining the construction schedule of the National Ignition Facility (NIF). According to DOE the first goal is critical for achieving full three-dimensional simulation of the nuclear explosion. The second goal is important for timely understanding of the critical weapon physics needed to develop and validate those simulation codes.

The Stockpile Stewardship program has evoked considerable controversy. There are those who believe it is more complex and costly than it needs to be to maintain safety, reliability, and performance of the stockpile.<sup>21</sup> These critics believe that the stockpile can be maintained by remanufacturing components as they age to original specifications, and by experimental tests of non-nuclear portions to maintain safety. Others believe that the program as DOE outlined will not be sufficient, particularly as the stockpile reaches ages well past historical highs in the next few decades.<sup>22</sup> Some of those critics argue that we should not rely just on the DOE program but should resume testing while others in that group are willing to give the test ban a try, but believe, at a minimum, that the DOE effort needs to expand. The requested budget increase for FY1999 was, to a degree, a response to those critics who argue that DOE had underestimated the resources it needs for the program.

Debate over the program during appropriation and authorization actions was somewhat greater than in previous years, but it is clear that Congress still strongly supports the program, and that there is not much support for any of the other options, ranging from remanufacturing to a resumption of testing. Appropriations and authorization actions, however, suggest that Congress considers the large increase requested for FY1999 greater than justified. At the same time, the Senate has expressed concern that DOE is underestimating the long-term resources it will need to meet the goals of the program. The House expressed concern that the program contains inefficiencies and management problems that are adding significantly to its costs. Authorization action in both the House and Senate and Senate appropriations action reduced funding from the request for the ASCI subprogram, for which a large increase was requested for FY1999.

Another funding issue that has appeared concerns the use of prior year uncosted balances. Appropriations and authorization actions in the House thus far are directing DOE to provide about 7% of the FY1999 funds for the Stockpile

---

<sup>21</sup>Ray E. Kidder, "Problems with Stockpile Stewardship," *Nature* 386 (April 17, 1997): 645-647.

<sup>22</sup>James Kitfield, "At Ground Zero," *National Journal*, no. 8 (February 21, 1998): 388-392.

Stewardship program from these past year funds. DOE argues, however, that those funds are needed for current year obligations and will not be available. If so, the House actions would mean a substantial reduction from the request for this program, bringing FY1999 funding down to FY1998 levels. While the Senate has also directed DOE to use uncosted carryover funds, the amount is much less, on the order of 1%.

## **Concluding Comments**

While a significant increase in R&D funding over FY1998 seems likely, the total appropriations for R&D will fall short of the request. Congressional support for basic research appears to be strong, however, and this support has been translated into appropriations for funding of DOE Science programs that, for the most part, meet the requested levels. Support for DOE defense program R&D also appears to remain strong, although questions are mounting about the pace and likely effectiveness of the Stockpile Stewardship program. The energy supply programs, however, have not enjoyed similar support. To some extent the large funding gaps between the requests and the requirements for certain water projects that had to be dealt with by the House and Senate appropriators, appear to have contributed to the absence of any substantial increases for the renewable energy program. Also, the funding increases approved by Congress are mitigated to some extent by the assignment of uncosted carryover balances to supply some of the appropriations.

Finally, Congressional action suggests a wariness about DOE's funding of R&D to reduce greenhouse gas emissions. Concern that such funding may be a backdoor way to implement the Kyoto accords or to support other policy measures in that direction is evident throughout the appropriations actions. While there is support to continue R&D on many of the relevant technologies, the Congress has taken clear actions to prevent DOE from going beyond the support of R&D in this connection.