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# Department of Energy Research and Development Budget for FY2001: Description and Analysis

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## Summary

For FY2001, DOE requested $8.00 billion for all R&D activities, an increase of 6.7% above the final FY2000 level. For civilian R&D activities, the request was $4.71 billion, 13.2% above FY2000, while for defense activities, the request was $3.29 billion, 1.4% below FY2000. The final appropriation for FY2001 provides $8.33 billion for all DOE R&D, 4.2% above the request and 11.2% above the FY2000 level. For civilian R&D activities, the FY2001 appropriation is $4.76 billion, 1.1% above the request and 13.2% above the FY2000 level, while for defense R&D activities the FY2001 appropriation is $3.56 billion, 8.2% above the request and 6.9% above the FY2000 level.

For the Energy Resources sector, DOE's FY2001 request was 10.0% above FY2000, driven by a large increase in the request for the Renewable Energy and Conservation R&D programs, 17.6% above FY2000. For Energy Resource R&D, the final appropriation is 0.3% below the request but 9.7% above the FY2000 level. For Renewable Energy and Conservation R&D, the final appropriation is 5.6% below the request but 10.9% above FY2000. This is one of the largest year-to-year increases in the last several years. Congress also restored funds for the Partnership for a New Generation of Vehicles program that would have been eliminated as the result of an amendment to the House version of the appropriations bill.

For the DOE science programs, the FY2001 request was 12.1% above FY2000 including a $162 million increase in construction funding for the Spallation Neutron Source (SNS) project. The final appropriation for the Office of Science is 1.8% above the request and 16.9% above the FY2000 level. The entire request for the SNS was funded. Each program within the Office of Science, except Advance Scientific Computing Research received more funding equal to or greater than its request.

For FY2001, DOE asked for a 1.0% decrease for national security and environmental management (EM) R&D programs. The decrease was due primarily to a reduction in funding requirements for the National Ignition Facility (NIF) under its original baseline. The revised baseline, announced in September, resulted in a significant increase in the FY2001 NIF funding requirements. Congress approved a budget authorization for nearly all of the revised NIF request along with a significant increase for the remainder of the weapons R&D program. The final appropriation for nuclear weapons R&D is 8.6% above the request and 7.4% above the FY2000 level. For NIF, Congress provided $134.1 million in new appropriations and approved the transfer of $65 million from other weapons R&D accounts.

Congress restored the Laboratory Directed Research and Development allowance to 6% for FY2001. Concern about NIF cost overruns and technical problems caused the 106th Congress to set several conditions for NIF to meet in order to receive the entire FY2001 appropriation. Attention to NIF along with several other issues considered during the FY2001 appropriations process is likely to continue in the 107th Congress.

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## 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 ERDA, 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 four federal power marketing administrations, an energy information function, civilian nuclear waste responsibilities, and the strategic and naval petroleum reserves. Over the last several years, 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 management R&D. Those categories, which approximate the way DOE has divided up its programs, are set up to keep similar research activities together.[1] This arrangement is somewhat different from the way the R&D budget is approached by the congressional appropriations committees.

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[1] DOE separates the Conservation, Fossil Energy, and Clean Coal Technology programs from the Renewable and Solar Energy and Nuclear Energy programs, whereas all of those programs are combined under Energy Resources in this report. DOE makes that distinction because the first three programs fall within the jurisdiction of the Interior and Related Agencies Subcommittee of the Appropriations Committees, while all other programs fall within the jurisdiction of the Energy and Water Development Subcommittee.

This report gives a description of the programs within each category including their research objectives and the activities where significant budget changes were requested for FY2001. It then describes the request and congressional actions on the request. There follows a discussion of issues about the FY2001 request that emerged during congressional consideration of the budget.

## DOE Request

Table 1 shows the FY2000 appropriations, the FY2001 budget request, and FY2001 appropriations. All amounts in this and subsequent tables are for budget authority and are in current dollars. For FY2001, DOE requested $8.00 billion for all R&D activities, an increase of 6.7% above the FY2000 level. The House appropriated $7.40 billion for these R&D programs for FY2001 (see below for details) while the Senate appropriated $7.88 billion (see below). In the enacted appropriations (P.L. 106-377 and P.L. 106-291), Congress appropriated $8.33 billion, 4.2% above the request and 11.2% above the FY2000 level. For civilian R&D activities, the request was $4.71 billion, 13.2% above FY2000, while for defense activities, the request was $3.29 billion, 1.4% below FY2000. Congress appropriated $4.76 billion for civilian R&D programs, 1.1% above the request, and $3.56 billion for defense R&D programs, 8.2% above the request. DOE as a whole requested $18.94 billion compared to an appropriation of $17.36 billion in FY2000, a 9.1% increase. For FY2001, Congress appropriated $19.80 billion for all of DOE, 4.5% above the request and 14.1% above FY2000. Funding for R&D will make up about 42.1% of the total FY2001 DOE budget compared to 43.1% in FY2000.

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

| Activity | FY2000 (Appro.) | FY2001 (Request) | FY2001 (House) | FY2001 (Senate) | FY2001 (Conf) |
|---|---|---|---|---|---|
| Energy Resources R&D | $1,372.5 | $1,509.9 | $1,222.5 | $1,479.4 | $1,505.0 |
| Science | 2,788.1 | 3,200.5 | 2,839.6 | 2,920.8 | 3,258.6 |
| National Security R&D | 3,100.8 | 3,088.9 | 3,093.8 | 3,235.1 | 3,307.9 |
| Environment Qual R&D | 229.4 | 196.5 | 242.4 | 252.9 | 256.9 |
| Total | $7,490.8 | $7,995.8 | $7,398.3 | $7,888.2 | $8,328.4 |

As justification for its FY2001 request, DOE emphasized its scientific and technological capabilities. It has called itself a "science agency" and pointed out its large investment in many areas of basic research. It stated that the FY2001 request "builds on previous investments to: promote scientific progress; advance peace; [and] ensure the availability of secure, clean, and efficient energy resources ... ."[2] For national security, DOE requested increased funding for R&D programs underlying its efforts to maintain the reliability, safety, and performance of the nation's nuclear weapon stockpile. The weapons program R&D budget request along with that of

[2] U.S. Department of Energy, Office of the Chief Financial Officer, *FY2001 Budget Request to Congress: Budget Highlights*, DOE/CR-0068-8, February 2000, 1.

other defense R&D activities were prepared for FY2001 within the newly created National Nuclear Security Administration (NNSA). In the science area, DOE requested increased funding for construction of a major scientific research facility, the Spallation Neutron Source, to expand scientific computing, and to increase nanoscience (manipulation of matter at the molecular level) research. And in the energy resource area, DOE requested increased funding for conservation, renewable energy, and nuclear energy research as part of the DOE Climate Change Technology Initiative and to support a new international clean energy initiative.

## Congressional Action for FY2001

On June 16, 2001, the House approved the Interior and Related Agencies Appropriations Bill, 2001 (H.R. 4578, H.Rept. 106-646), appropriating $775.5 million for the DOE R&D programs under that bill's jurisdiction (conservation and fossil energy R&D), 20.9% below the request and 18.3% below FY2000. On June 28, 2000, the House approved the Energy and Water Development Appropriations Bill, 2001 (H.R. 4733, H.Rept. 106-693). It appropriated $6.62 billion for R&D programs within the jurisdiction of the Energy and Water Development Subcommittee. This amount is 5.6% below the request but 1.2% above FY2000.

In the report accompanying the energy and water development appropriations, the House stated that severe funding constraints resulted in its recommendations for many of the DOE programs being well below the request. In addition, it noted its strong support of the establishment of an Office of Engineering and Construction Management to improve project management and avoid large cost overruns that have plagued many DOE projects. The House also approved of DOE's proposal to include a project engineering and design (PED) line in the budget request to fund up to 30% to 35% of a new construction project's design before it is submitted to Congress for authorization. In another matter, the House directed that DOE retain its laboratory research and development (LDRD) rate at 4% for FY2001. It noted that DOE has requested returning the rate to 6%. The House also directed DOE to submit a separate line for LDRD funding in future budget requests rather than enacting a straight tax on all operating dollars. In this manner, the House hopes to improve accountability of LDRD funding and to put it on the same budget footing as other DOE programs.

On July 17, 2000, the Senate approved the Interior and Related Agencies Appropriations Bill, 2001, (H.R. 4578, S.Rept. 106-312) providing an appropriation of $957.7 million for the DOE R&D programs within the jurisdiction of that bill. This amount is 2.3% below the request but 0.9% above the FY2000 level.

In the accompanying report, the Senate expressed its dismay at DOE for its slow pace in responding to specific funding directions from Congress as provided in the appropriations reports over the past few years. In particular, the Senate argued strongly that DOE did not have prerogative to chose whether to fund the projects directed by Congress in the report language. It went on to state that if DOE did not expeditiously fulfill such specific Congressional funding mandates in the future, it would put them in the bill giving them the force of law.

On September 7, 2000, the Senate approved its version of the Energy and Water Development Appropriations Bill, 2001 (H.R. 4733, S.Rept. 106-395) providing $6.93 billion for DOE R&D programs within its jurisdiction, 1.2% below the request but 6.0% above the FY2000 appropriation.

In the accompanying report, the Senate approved an increase of contractor travel for FY2001 to $200 million compared to $150 million approved for FY2000. The Senate noted that the FY2000 total had the desired effect of ensuring that management of contractor travel was more efficient, but it also reduced scientific and programmatic travel below optimal levels. The Senate also approved an amendment that would increase the allowable rate for Laboratory Directed Research and Development (LDRD) to 8% of the funds provided to the Laboratories by the appropriation bill. The amendment also stated that funds for the Environmental Management programs were to be made available for LDRD. The Senate Appropriations Committee had recommended a restoration of the Laboratory Directed Research and Development (LDRD) funding to 6% of its operating budgets from the 4% level imposed in FY2000. In doing so, the Committee had stated its view that the LDRD program is essential and necessary if the DOE Laboratories are to maintain "preeminence" in science and technology. The Committee had also strongly endorsed the use of these funds for the environmental management program and recommended the establishment of a similar program in the nuclear weapons production plants.

On September 28 and October 2, 2000, the House and Senate respectively passed the conference report (H.Rept 106-907) for the Energy and Water Development Appropriations bill for FY2001 and the bill was signed into law (P.L. 106-377) on October 27, 2000. The Act provides $7.32 billion for R&D programs within the bill's jurisdiction, 4.4% above the request and 11.9% above the FY2000 level. The Congress expressed its approval of the project design and engineering (PED) process being developed by DOE to correct management problems that have appeared in many of its large projects. Congress also capped contractor travel funds for DOE at $185 million compared to the $200 million requested by the agency. It directed DOE to apply the reductions to those organizations having the "most questionable travel practices." Congress approved a 6% level for LDRD funds, midway between the levels approved separately by the Senate and House. In addition, Congress directed DOE to prepare a financial accounting report for LDRD expenditures and deliver it to Congress on December 31 of each year. Congress also approved an accounting change for safeguards and security expenditures that had been requested by DOE. These costs are now centered in specific accounts rather than within the overhead accounts of each program. Funding adjustments were made to the final DOE appropriation to reflect these changes. At the same time, Congress directed DOE to keep the responsibility for safeguards and security with the various line units and not to consolidate them under the Office of Security and Emergency operations.

On October 11, 2000, the President signed into law the Interior and Related Agencies Appropriations Act, FY2001 (P.L. 106-291, H.Rept. 106-914), which provides DOE with $1,007.4 million for the two DOE R&D programs within the bill's jurisdiction. This amount is 2.7% above the request and 6.1% above the FY2000 level. Congress encouraged DOE to work closely with State and Federal

environmental and energy organizations to ensure effective coordination of policy and to reduce pollution, and improve energy efficiency, energy supply reliability.

# R&D Programs — Descriptions and Budgets

## Energy Resources R&D

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

For FY2001, DOE proposed one new initiative and the continuation of several others within Energy Resources R&D. The new program is the international clean energy initiative, which is designed to help develop international energy markets for clean energy technologies coming out of the Conservation, Renewable Energy, Nuclear Energy, and Fossil Energy R&D programs. DOE requested $46 million for this effort in FY2001. The agency also requested increased funding — an additional $23.0 million — for the energy grid reliability initiative, which is designed to develop policies and technologies to enhance the reliability of the nation's natural gas and electric power distribution systems in light of forecast growth and deregulation. The Renewable Energy and Fossil Energy R&D programs will be the principal loci of this work. For the climate change technology initiative (CCTI), which encompasses all of the Conservation and Renewable Energy R&D programs as well as a portion of the Nuclear Energy R&D program, DOE requested an additional $189.5 million for FY2001. Its focus is the development of energy supply and demand technologies that DOE hopes will be able to reduce the consumption of fossil fuels because of their emission of greenhouse gases.

In the report accompanying the interior and related agencies appropriations (H.Rept. 106-646), the House combined the fossil energy R&D and energy conservation programs into one account. It argued that such a combination was appropriate because all of these programs focused on the "efficient use of traditional fuel sources" unlike the DOE programs funded under the energy and water development appropriation account. The Senate retained the current structure in its version of the bill.

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

| Program | FY2000 (Appro.) | FY2001 (Request) | FY2001 (House) | FY2001 (Senate) | FY2001 (Conf) |
|---|---|---|---|---|---|
| Conservation | $545.4[a] | $596.0 | $410.1 | 556.3 | 573.8 |
| Fossil Energy | 403.9[a] | 384.6 | 365.4 | 401.4 | 433.6 |
| Clean Coal Technology | (146.0)[b] | (155.0)[b] | (89.0)[b] | (67.0)[b] | (67.0)[b] |
| Nuclear Energy | 116.1 | 119.8 | 103.6 | 124.7 | 122.7 |
| Renewable Energy | 310.1[c] | 409.5[c] | 343.4[c] | 397.0[c] | 374.9[c] |
| Total | $1,372.5 | $1,509.9 | $1,222.5 | $1,479.4 | 1,505.0[d] |

[a] Includes $25 million, in each program, from the Biomass Energy Development funds.
[b] Deferral of prior year appropriations.
[c] In addition to these funds, $47.9 million was appropriated in FY1999 and $47.1 million for FY2000 in the Basic Energy Sciences (BES) program for basic research related to solar and renewable energy resources. For FY2001, the request is $47.1 million, the amount approved by the House and Senate and the full Congress. Because the BES portions also appear in the Science account, the appropriations bills subtract that portion in arriving at the Energy Supply total, and those amounts are not included in this table.
[d] Congress approved a reduction of $16.58 million for safeguards and security for the Energy Supply account in the Energy and Water Development Appropriations bill. Because the reduction has not yet been allocated to the specific programs, some of which are not R&D, it is not now included here.

**Energy Conservation.** The Conservation R&D program is divided into three sectors — buildings, industry and transportation.[3] The principal 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. 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, in cost-shared partnerships with industrial concerns, funds R&D on improvements in basic manufacturing processes to increase productivity and energy efficiency. The sector's strategy is built around "industries of the future," which are the nations' most energy intensive industries. It supports research on technologies specific to the individual industries and those that cut across all of the industries. It also focuses on technology to reduce or recycle 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.

[3] U.S. Library of Congress, Congressional Research Service, *Energy Efficiency: Budget, Climate Change, and Electricity Restructuring Issues*, by Fred Sissine, CRS Issue Brief IB10020 (Washington: continually updated).

For FY2001, DOE requested $596.0 million for Conservation R&D, 9.3% above FY2000. Included in the request are $114.8 million for buildings research and standards, 29.5% above FY2000, $184.0 million for the industry sector, 5.0% above FY2000, and $250.9 million for the transportation sector, 7.8% above FY2000. The largest increase requested was in the equipment, materials, and tools activity to increase appliance standards research in order to facilitate international trade and to accelerate research on natural gas fired heat pumps among other activities. In the Industry sector, requests for funding increases were concentrated in the program's specific industries of the future activity, primarily in research supporting the forest and paper products industry and in agriculture. Funding for crosscutting technologies in the industries of the future activity is projected to decline, primarily due to a decrease in the request for distributed generation R&D. In the Transportation sector, the requested increases were concentrated in the vehicle technologies R&D activity. Significant increases are being requested for hybrid systems, fuel cell, and advanced combustion engine R&D. This activity is the center of the PNGV research program. In all three sectors, no funds were requested for cooperative programs with states and the energy efficiency science initiative, programs added by Congress for FY2000.

The House approved $410.1 million for conservation R&D for FY2001, 31.2% below the request and 24.8% below the FY2000 level. In the bill that emerged from the House Appropriations Committee, the amount recommended for conservation R&D was $515.1 million. On the House floor, amendments were adopted that reduced the amount by $126.5 million and increased the amount by $21.5 million The latter funds were allocated as follows: $9.5 million for the buildings sector, $7 million for the transportation sector, and $5 million for the industry sector.

The bill that came out of the Committee funded the R&D programs in the three sectors at or close to their FY2000 levels. The Committee recommended an increase of $13.5 million from FY2000 for industrial gasification resulting primarily from the transfer of the black liquor gasification efforts from Fossil Energy R&D. At the same time, the Committee recommended a reduction from FY2000 of $12 million for distributed generation. The Committee also directed that no funds be used for the million solar roof initiative or for the international initiative. When the bill reached the House floor, an amendment was offered and adopted to eliminate all funds for the PNGV program. This had the effect of reducing the total conservation R&D program appropriation by $126.5 million primarily in the transportation sector. The amendments sponsors argued that the PNGV program represented "corporate welfare" in that it was providing payments to the major automakers for work that was their responsibility. Other supporters argued that the program was funding research on technologies that were environmentally unsound, namely diesel technology.

Including the two amendments, the industry sector would increase by $12.5 million over FY2000, but would be $15.7 million below the request. The transportation sector was reduced by $131.6 million from FY2000 and $155.6 million from the request. The buildings sector was increased $9million from FY2000 but reduced $15.7 million from the request.

The Senate approved $556.3 million for Conservation R&D, 6.7% below the request but 2% above the FY2000 level. Included in the reduction from the request are $14.7 million in buildings research and standards programs within the Building

Technology Sector and $18.8 million in the industries of the future programs within the Industry sector. In the Transportation Sector, the Senate recommended a reduction of $4.3 million from the request for vehicle technology R&D and a $4 million increase for materials technology. All other programs were funded close to the requested level.

The enacted appropriations provides $573.8 million for Conservation R&D, 3.7% below the request but 5.2% above the FY2000 level. The final bill provides $13.45 million below the amount requested for buildings research and standards sector programs, $9.38 million below the amount requested for industry sector programs, and $5.09 million above the amount requested for transportation sector programs. Congress approved restoration of the $126 million for the PNGV program that was removed during action by the House. In addition, $7.8 million was approved for the energy efficiency science initiative and $4 million for cooperative programs with the states. Both activities were initiated by Congress in the FY2000 appropriations cycle.

**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. In particular, the subprogram is supporting development of a concept called the "Vision 21 Powerplex" that attempts to integrate several advanced technologies, including carbon sequestration, designed to burn coal efficiently and cleanly. 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. The Fossil Energy R&D program emphasizes technology transfer to the private sector. DOE also maintains 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 FY2001, DOE requested $384.6 million for the Fossil Energy R&D program, 4.8% below the FY2000 level. Included in the request were $193.8 million for the coal and power systems subprogram, $38.8 million for natural gas technologies, and $52.6 million for oil technology. For FY2001, increases were requested for carbon sequestration R&D (+$10.2 million), advanced coal research (+$3.8 million), and natural gas infrastructure R&D (+$12.2 million – as part of the energy grid initiative), while funding cuts were sought for advanced turbine systems and coal-derived fuel research. The Fossil Energy program also proposed a $10 million initiative to develop very low sulfur petroleum fuels. The decrease in advanced turbine systems ($25.5 million) is a result of the winding down of the research program on utility-scale turbines.

The House approved $365.4 million for Fossil Energy R&D for FY2001, 5.0% below the request and 9.5% below the FY2000 level. The bill that emerged from the House Appropriations Committee had recommended $410.4 million. An amendment offered and adopted on the House floor reduced this amount by $45 million. The

funds were transferred to the DOE conservation programs, $23.5 million to the weatherization program and $21.5 million to conservation R&D as described above.

The House Appropriations Committee recommended that the program be renamed, Power Generation and Large-Scale Technologies. This recommendation was adopted by the full House. In addition, the Committee recommended increases above the request for both the coal and power systems and the petroleum – oil technology programs. In particular, increases above the request were provided for the integrated gasification combined cycle, indirect fired cycle , and steelmaking feedstock activities in the coal program, and for exploration production – supporting research in the petroleum program. The gas program was funded by the Committee at very close to the requested level. No details were provided on how the $45 million reduction from the recommendation adopted as an amendment by the full House should be allocated to the various programs. Supporters of the amendment argued that much of the fossil energy R&D funding represents "corporate welfare" and that it funds the development of technologies that have only a slight chance of commercial success. Opponents argued that the reduction will hurt prospects for expanding the use of the nation's most abundant fossil energy resource, coal, and for enhancing production of domestic petroleum resources.

The Senate approved $401.3 million for Fossil Energy R&D, 4.4% above the request but 0.5% below the FY2000 level. The increase includes $6.2 million for advanced systems and $4.5 million for distributed systems - fuel cells both within the Coal and Power Systems program. In addition, the Petroleum - Oil Technology program would receive an additional $11.8 billion above the request. That increase, however, would be offset by a $12 million reduction from the request resulting from a transfer of $12 million of unobligated Strategic Petroleum Reserve funds, a action not requested by DOE. In the report, the Senate noted that it had directed DOE to deliver a report by March 1, 2000, on establishing a Federal arctic technology center to carry out research on ways to enhance the development of Alaskan energy reserves. The failure to meet that deadline and the absence of any discussion in the budget request about arctic energy issues caused the Senate concern and it repeated its desire for the report and discussions with DOE on that issue.

The Senate approved a deferral of $67 million for the Clean Coal Technology program, compared to a requested deferral and rescission of $155 million. The Senate also directed DOE to prepare a report on a possible new round of demonstration projects making use of the technologies have emerged from Fossil Energy R&D since the first round of CCT projects was selected in 1992. The Senate noted that significant advances have been made since that time in new coal burning power technology and the fact that coal will continue to be a major energy source for the U.S. for several decades to come.

In the final bill, Congress approved $433.6 million for fossil energy R&D, 12.7% above the request and 7.3% above the FY2000 level. Congress increased funding for coal and power systems programs by $28.9 million above the request and transferred an additional $95 million from previously appropriated funds from the clean coal technology program. The latter is to fund a power plant improvement initiative designed to "demonstrate advanced coal-based technologies applicable to existing and new power plants." The objective of Congress with this action is to enhance the

potential of coal to provide needed electric power plant capacity over the next several years. The initiative as described in the conference report appears similar to ongoing programs within the CCT program. Congress also added $6.4 million to the request for gas R&D programs and $14.5 million to the request for petroleum-oil technology programs. The latter included a transfer of $12 million from the Strategic Petroleum Reserve petroleum account. Finally, Congress restored $45 million in general reductions to the fossil energy R&D program approved by the House. For the CCT program itself, Congress approved a deferral of $67 million.

**Nuclear Energy (R&D).** Among other activities, the DOE nuclear energy program supports a diverse array of R&D projects in nuclear energy. Its principal objective is to help maintain nuclear power as a safe, reliable, and environmentally acceptable long-term energy option for the United States. The R&D portion of the program supports the nuclear energy research initiative (NERI), which is focused on advanced nuclear technologies, and the nuclear energy plant optimization (NEPO) activity, which addresses issues concerning long-term operation of nuclear power plants. Also included are R&D on advanced radioisotope power production, and university reactor fuel assistance. In addition, the program carries out activities not considered R&D including technical support for radioisotope production for a variety of commercial and medical uses, support of a number of DOE reactor facilities, and management of the DOE uranium program.

For FY2001, DOE requested $119.8 million for nuclear energy R&D activities, 3.2% above FY2000. An increase of $12.6 million was requested for NERI, part of which would be used for the nuclear energy R&D contributions to the international clean energy initiative. DOE also proposed to end the program's research efforts in accelerator transmutation of waste resulting in a requested reduction of $9 million from the FY2000 level. A reduction of $2.9 million in the advanced radioisotope power systems production activity was also being sought.

The House appropriated $103.6 million for nuclear energy R&D for FY2001, 13.5% below the request and 10.8% below the FY2000 level. Nearly all of the reduction is from the nuclear energy research initiative which the House funded at the FY2000 level, $22.5 million, compared to the request of $35 million. The House stated that it was strongly in favor of the NERI, as well as the NEPO, but cited severe funding constraints in being unable to increase NERI funding above the current level. The House also recommended a reduction of $2 million from the request for the advanced radioisotope power systems stating that it did not fund the new initiative for special purpose fission power technology.

The Senate appropriated $124.7 million for nuclear energy R&D for FY2001, 4.1% above the request and 7.4% above the FY2000 level. The Senate recommended an addition of $5 million for advanced radioisotope power systems for support of future national security and NASA missions, and $6.5 million for the NERI program to accelerate DOE efforts to develop a new generation of nuclear power plant technology. In making the latter recommendation, the Senate noted the potential environmental, safety, and cost benefits from new nuclear technologies. It directed DOE to develop a roadmap to commercial deployment of the next generation nuclear technology ("generation IV") and provided a list of characteristics that such

technology should strive for. The Senate also asked that DOE evaluate public/private partnerships in developing the most promising candidates.

The final bill provides $122.7 million for nuclear energy R&D, 2.4% above the request and 5.7% above the FY2000 level. Congress fully funded the NEPO and NERI activities and added $7.5 million for nuclear energy technologies. The latter funds, which were not requested, are to be used to examine a variety of new and advanced reactor concepts. Congress also added $1.3 million to the advanced radioisotope power systems program for national security and NASA activities.

**Solar and Renewable Energy R&D.** The Solar and Renewable Energy R&D program focuses on a wide range of energy supply technologies.[4] 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 applied research and development on: concentrating solar power systems for electric power production; biomass and biofuels technology for fueling power systems and transportation; 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 electric energy delivery systems, electric energy storage technologies, and on the 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 activity. An important function of the Solar and Renewable Energy R&D program is to help the private sector develop promising new renewable energy technologies for the commercial market.

In addition to the applied research just described, DOE also funds basic research in renewable energy focusing on photovoltaic, biofuels and hydrogen energy. This research, called renewable energy research, is funded by the Basic Energy Sciences program, within the Office of Science, but is part of the overall DOE solar and renewable energy R&D effort.

For FY2001, DOE requested $409.5 million for Solar and Renewable Energy R&D within Energy Resources, 32.0% above the FY2000 level. It also requested $47.1 million for renewable energy basic research, the same as FY2000. Within the program, $82 million was requested for photovoltaic (PV) energy systems, $15 million for concentrating solar power, $102.4 million for biomass/biofuels energy systems, $50.5 million for wind energy systems, $27 million for geothermal, $23 million for hydrogen research, and $48 million for electric energy systems and storage. DOE requested an increase of $16.1 million for PV research focused primarily on basic research; an increase of $31.7 million for biomass/biofuels, emphasizing power, fuel, and product production from diverse bioenergy feedstocks; and an increase of $18 million for wind, primarily for field verification projects. In addition, the program requested an increase of $7.7 million for international solar energy efforts as part of the international clean energy initiative and $10.2 million for electric power transmission reliability research.

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[4] U.S. Library of Congress, Congressional Research Service, *Renewable Energy: Tax Credit, Budget, and Electricity Restructuring Issues*, by Fred Sissine, CRS Issue Brief IB97031.

The House appropriated $343.4 million for renewable energy R&D within the Office of Energy Efficiency and Renewable Energy (EERE) and $47.1 million renewable energy research within the Office of Science for a total of $350.5 million. The former is 16.1% below the request and 10.7% above theFY2000 level, while the latter is equal to the request and the FY2000 level. The Appropriations Committee has recommended an appropriation of $303.4 million but an amendment adopted by the full House added $40 million. The House noted the results of a study by the National Academy of Public Administration that sharply criticized the EERE management and organization. In particular the House pointed out that the study characterized the program management as fragmented with little coordination between the different components. The House stated that the FY2001 budget request reflected this fragmentation and showed little coordination and prioritization among the various programs. As a result, the House stated that it could not justify the large increases being requested for FY2001.

The House also criticized DOE for the lack of coordination between the renewable energy research activities within EERE and the Office of Science. In recent years, the House has been combining the funding these activities but it stated that it has seen little evidence that the two groups are cooperating with each other. It directed DOE to identify ways to improve coordination and report back to the House Appropriations Committee.

In specific budget action, the House Appropriations Committee had recommended funding most of the renewable energy programs near the FY2000 levels. The additional $40 million approved by the House has not yet been allocated to the specific programs. In some cases, notably hydrogen and photovoltaic energy systems, the Committee cited funding constraints as a partial reason for being unable to provide more funds. For concentrating solar thermal, the Committee recommended funding a substantial reduction — $9 million — from the request and the FY2000 level. The Committee cited a National Research Council report that was skeptical of commercial prospects for these technologies, in particular power-tower and power-trough technologies. As a result, the Committee did not fund either of these two activities. Finally, the Committee recommended funding the full request — $3 million — for distributed power generation, and indicated its support for such technologies in helping to meet electricity demand. The Committee directed DOE to recommend ways for the federal government to facilitate more private funding for distributed energy resource development.

The Senate appropriated $397.0 million for renewable energy R&D programs within the Office of Energy Efficiency and Renewable Energy (EERE) and $47.1 million renewable energy research within the Office of Science for a total of $444.1 million. The EERE amount is 3.0% below the request but 28% above the FY2000 level. The level approved for the Office of Science is at the request and the FY2000 level. The amount appropriated by the Senate would reduce funding from the request by $10.4 million for biomass transportation, by $4.9 million for photovoltaic energy systems, and by $6.5 million for wind energy systems. It would increase funding from the request by $8.0 million for hydrogen energy systems and $9.1 million for high-temperature superconducting R&D.

The Senate stated that uncertainty about the future effects of global climate change makes it prudent to support R&D on a range of energy production technologies that reduce the accumulation of atmospheric pollutants. It repeated its argument, however, that the Administration should not focus on reducing annual emissions production but rather on the reduction of total concentration of such pollutants. In that connection, the Senate argues that existing energy production technology will not provide the means to reduce such concentrations. As for the renewable energy R&D budget, the Senate's appropriation attempts to emphasize the development of low-emission energy production technologies post 2010. The approved levels for the most part, therefore, support basic research over that aimed at improving existing technologies. While providing some support for technology demonstration, the Senate expressed its expectations that product development should be handled by the private sector.

The Senate expressed its support of efforts to expand international markets for renewable energy technologies but did not recommend any funds for the international clean energy initiative. Rather, it stated that the Administration should establish a task force with other agencies involved in international trade and with the advice of the private sector to develop a plan for expanding these international markets. The Senate also expressed its strong support for continued funding of hydrogen energy systems and high-temperature superconductivity.

The final bill provides $374.9 million for renewable energy R&D, 8.4% below the request but 20.9% above the FY2000 level. Funding for the hydrogen, geothermal technology development, and electric energy systems and storage programs, Congress appropriated an increase from the request. For the other programs — solar energy, wind energy systems, biomass/biofuels energy research, and renewable support and implementation — it approved funding levels below the request. Congress also approved $5 million for the international renewable energy program and $3 million for the million solar roofs initiative. Finally, Congress approved the full $47.1 million requested for the renewable energy research program, which is housed in the Office of Science's Basic Energy Science program. For the most part, final Congressional action mirrored that of the separate House and Senate actions that emphasized long-term renewable energy research relative to nearer-term technology development.

## 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 in 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.

For FY2001, DOE announced some initiatives for the Science programs. DOE is participating in the national nanotechnology and nanoscience initiative, which will

support research on the characterization and manipulation of matter at the atomic level, and requested an increase of $45.9 million for these activities. DOE plans to focus on nanoscale synthesis research related to solar energy conversion, advanced transportation materials, and manufacturing sensors among other potential applications. The agency also plans to participate in the Administration's information technology (IT) initiative. For FY2001, DOE requested an increase of $150 million in both the Office of Science and Office of Defense Programs for IT activities. In the Office of Science, DOE plans to focus on computer modeling and simulation applied to complex problems in physical and biological science.

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

| Program | FY2000 (Appro.) | FY2001 (Req.) | FY2001 (House) | FY2001 (Senate) | FY2001 (Conf) |
|---|---|---|---|---|---|
| High Energy Physics | $697.8 | $714.7 | $714.7 | $677.0 | 726.1 |
| Nuclear Physics | 347.7 | 369.9 | 369.9 | 350.3 | 369.9 |
| Basic Energy Science | 771.6 | 1,015.8 | 791.0 | 914.6 | 1,013.4 |
| Adv Scientific Computing | 127.9 | 182.0 | 137.0 | 140.0 | 170.0 |
| Biological and | 432.9 | 445.3 | 404.0 | 444.0 | 500.3 |
| Fusion Energy Sciences | 244.7 | 247.3 | 255.0 | 227.3 | 255.0 |
| Other | 165.7 | 175.8 | 173.0 | 167.6 | 174.1 |
| Total | $2,788.1 | $3,200.5 | $2,839.6[a] | $2,920.8[a] | 3,258.6[a] |

[a]The House and Senate approved general reductions of $13.5 million and $50.7 million respectively. Congress approved a general reduction of $34.0 million and a reduction for safeguards and security of $38.4 million. No attempt has been made at this time to allocate those reductions to the individual programs, and they are not now included in the totals.

Prior to the convening of the Energy and Water Development Appropriations conference, Congress decided to increase the 302b allotments to several of the appropriations subcommittees. For the Energy and Water Development bill, this increase is reflected most noticeably in the final appropriations for programs within the Office of Science. In each case the final funding level exceeds the levels approved separately by the House and Senate.

**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 effort of the HEP program is participation in the Large Hadron Collider (LHC) project at the Center for European Nuclear Research (CERN) in Geneva. The LHC is an expansion of the particle accelerator at CERN, and would provide a substantial increase in its capability, making it the largest high-energy accelerator in the world.

For FY2001, DOE requested $714.7 million for the HEP program, 2.4% above FY2000. A majority of the request – $402.1 million – is to be for the three major facilities in the program, Fermilab, SLAC, and HEP-related experiments on the Alternating Gradient Synchrotron (AGS) at Brookhaven National Lab (BNL). Small increases are being requested for research on the next linear collider and for operation of the B-factory at SLAC. DOE requested $70 million for the LHC project to be split among accelerator systems, procurement, and detectors.

For FY2001, the House appropriated the full request for the HEP program, an increase of 1.6% above FY2000. The House reduced the research and technology portion of the request by $12.9 million. Specifically, it limited expenditures on R&D for the Next Linear Collider and the Muon-Muon Collider to $15 million citing funding constraints as the reason for not wanting to fund planning of new, large accelerators at this time. At the same time, the House added $23.9 million to the request for facility operations at Fermilab arguing that the requested level would be detrimental to operations at that facility. Finally, the House reduced the request for the LHC by $11 million citing delays in the project at CERN making these funds available.

The Senate approve an appropriation level 5.3% below the request and 4.4% below FY2000. The Senate did not provide any funds for the Next Linear Collider. Rather it directed DOE to put off any work on that project until the high energy physics community has reached agreement on a long-term future strategy. The amount approved by the Senate would also reduce funding for the Muon-Muon Collider by $8.7 million below the request and remove $16 million from that request for High Energy Physics facility operations. The Senate expressed strong support for the HEP program goals and noted that the funding request could not be met because of the "severe budget constraints" under which the Senate was operating. It also directed DOE to allocate the cuts only after consultation with the research community.

In the final bill, Congress appropriated $726.1 million for the HEP program, 1.6% above the original request[5] and 4.1% above the FY2000 level. An amount of $230.9 million was approved for Fermilab operations.

**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 Facility (TJNAF) in Newport News, VA, the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Lab, the Bates Accelerator at MIT, the AGS, and the Radioactive Ion Beam at Oak Ridge.

For FY2001, DOE requested $369.9 million for the NP program, 6.4% above FY2000. Operation of TJNAF and RHIC would consume more than half of the

[5] A budget amendment was submitted by DOE that increased the HEP request to the amount approved in the final bill.

budget, $194.2 million. Small increases were sought for those two facilities as will as Bates and the Radioactive Ion Beam.

The House appropriated the full request for the NP program, 4.0% above the FY2000 level.

The Senate approved a level 5.3% below the request and 0.5% below the FY2000 level. The appropriation would reduce funding from the request by $5.7 million for new research initiatives and by $8 million for facility operations. The Senate noted "severe budget constraints" as the major reason for the reduction from the request.

The final bill provides $369.9 million for the NP program, equal to the original request and 6.4% above the FY2000 level.

**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. Most of DOE's nanoscience research is carried out in this program. 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. DOE is currently constructing a new user facility, the Spallation Neutron Source (SNS).[6] This facility is designed to produce large fluxes of neutrons for use as a tool to study, among other areas, genetic structure, chemical reactions, and structure of materials.

For FY2001, DOE requested $1.015 billion for the BES program, 31.6% above FY2000. About two-thirds of that increase is planned for construction of the SNS, whose construction budget would grow by $161.9 million. An increase of $36.1 million was sought for the BES portion of DOE's nanoscience research. An increase of $8 million was requested for upgrade of the SPEAR 3 facility at Stanford, a project being carried out jointly with the National Institutes of Health. The BES program also requested $17.5 million for continuation of shutdown and surveillance of the high-flux beam reactor at BNL.

The House approved an appropriation of $791.0 million for BES, 22.1% below the request, but 1.5% above the FY2000 level. The House cited "severe funding constraints" for being unable to provide the requested funds. As a result, several of the new initiatives, for which the House expressed strong support, would have to be deferred. Within the appropriation, the House provided $100 million for SNS construction, the same as FY2000. It noted the improvements DOE has made in SNS

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[6] Congressional Research Service, *The Department of Energy's Spallation Neutron Source Project: Description and Issues*, by Kai-Henrik Barth, CRS Report RL30385, December 10, 1999.

project management and stated that its inability to provide the request was not a reflection of any concern about the project but was due to funding limitations.

The Senate approved $914.6 million for BES, 10% below the request but 17.4% above the FY2000 level. The appropriation for materials science would be $47.7 million below the request. It also does not provide $8 million requested for the SPEAR 3 upgrade at Stanford. Of the $261.9 million sought by DOE for the SNS, the Senate provides $241.0 million including $221.9 million for construction. In making the appropriation, the Senate noted the importance of the project for advancing science and technology and its potential contribution to scientific and industrial research. While noting that budget constraints prevented the Senate from providing the full request for the SNS, it gave its endorsement of the project as it begins construction and expressed hope that more funds can be found. As for the nanotechnology initiative, the Senate expressed strong support but was able to provide only about 56% of the funding increase requested within BES for this initiative for FY2001.

The final bill provides $1,013.4 million for the BES program, 0.2% below the original request but 31.3% above the FY2000 level. Congress provided $278.6 million for the SNS including $259.5 million for construction. While this level is below the original SNS request of $281.0 for FY2001 (including $261.9 million for construction), it is equal to the amended request submitted by DOE. The funding increase requested for the nanoscale science initiative was also approved.

**Advanced Scientific Computing Research.** The Advanced Scientific Computing Research (ASCR) program (formerly called the Computational and Technology Research program) supports basic research in mathematics and computer science. The program funds research on advanced computer applications and provides access to high performance computers for researchers in the DOE laboratories through the National Energy Research Scientific Computing Center (NERSC). Included in the ASCR program is the Laboratory Technology Research subprogram, which supports technology transfer partnerships focusing on advanced energy technologies.

For FY2001, DOE requested $182.0 million for the ASCR program, 42.3% above FY2000. Nearly all of the increase – $49.4 million – would be spread among many activities directed at enhancing DOE's high-performance computational capability and its application to complex scientific problem solving. Included are efforts to enhance the NERSC facility to 5 teraflops (trillions of floating point operations per second) and the energy sciences network (ESnet) for terascale applications, and to expand centers to develop technologies for terascale computing.

The House approved an appropriation of $137 million for this program, 24.7% below the request but 7.1% above the FY2000 level. Again, the House cited "severe funding constraints" as the reason for being unable to fund the request. It did note, however, that DOE has put in a great deal of effort in developing an advanced computing program that would serve DOE's scientific needs. Of the increase requested by DOE, the House provided $5 million for computer upgrades at NERSC.

The Senate approved $140.0 million for this program for FY2001, 23.1% below the request but 9.5% above the FY2000 level. The Senate noted the increase requested by DOE for high-performance computing and recognized the need for such capabilities to support DOE's scientific research. It stated, however, that "current budget constraints" prevented the Senate from providing the requested amount. The Senate directed that the entire $140 million be used for mathematical, information, and computing sciences, which eliminated funding for the laboratory technology research program. The net result would be an increase of $20.9 million for the math and computing programs, and the Senate directed DOE to begin the most important parts of its high-performance computing initiative.

The final bill provides $170 million for the ASCR program, 6.6% below the request but 32.9% above the FY2000 level. While not specifically mentioned in the conference report, the final appropriation presumably would fund most of the increase requested to enhance DOE's scientific supercomputer capabilities.

**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, including basic research on potential carbon management and sequestration processes, 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 FY2001, DOE requested $445.3 million for the BER program, 2.9% above FY2000. Included in the request is a reduction of $30.4 million for projects directed by Congress in the FY2000 appropriation, which DOE wants to discontinue in FY2001. As a result, the other BER activities would see a $42.8 million increase over FY2000. Of that amount, an increase of $18.2 million was sought for the Life Sciences subprogram, including new structural biology research facilities, and enhanced microbial genomics research, and a boost of $9.7 million to begin the microbial cell project. An increase of $6.1 million was requested for climate change research. The DOE portion of the human genome project requested $88.9 million for FY2001, $1.4 million above FY2000.

The House approved an appropriation of $404.0 million for the BER program, 9.3% below the request and 6.9% below FY2000. Again, severe funding limitations were cited as the reason why the House could not fund the full request. It did note, however, that the appropriation would be consistent with the current level of effort in BER when adjusted for the programs added by Congress to the FY2000 appropriations.

The Senate approved $444.0 million for this program, 0.3% below the initial request but 2.6% above the FY2000 level. The appropriation contains $2.5 million for construction of the Comparative and Functional Genomics Laboratory at Oak Ridge National Laboratory. The Senate did not provide funding for a new initiative to image the expression of genes in cells and stated that it did not support development of any facilities for this initiative. The Senate provided $4.7 million for

the microbial cell project citing budget constraints as the reason for not meeting the requested increase.

The final bill provides $500.3 million for the BER program, 12.3% above the request and 15.6% above the FY2000 level. Included is $20.1 million for the low-dose effects program, $8.4 million above the request, $9 million for molecular medicine. In addition, the appropriation includes $43.9 million for projects specifically identified by Congress in the conference report.[7]

**Fusion Energy Sciences.** The Fusion Energy Sciences (FES) program concentrates on basic research in plasma and fusion science and technology to expand the knowledge base needed to develop a fusion-based energy source and to enhance the application of plasma science in industry.[8] The program supports research on two major tokamak facilities — the DIII-D at General Atomics in San Diego and Alcator Mod-C at MIT — and a number of alternative concepts. Included in the latter is the National Spherical Torus Experiment (NSTX) at Princeton and research on heavy ion accelerators for application to inertial fusion energy.

For FY2001, DOE requested $247.3 million for the FES program, 1.1% above FY2000. Of this amount, $95.2 million would be dedicated to operation of the DIII-D, Alcator Mod-C, and NSTX. This level is slightly below the FY2000 amount. An increase of $6.2 million was sought for decontamination and decommissioning of the Tokamak Fusion Test Reactor (TFTR) at Princeton. The remaining activities would be funded near their FY2000 levels.

The House approved an appropriation of $255 million for FES, 3.1% above the request and 4.2% above the FY2000 level. The House also noted that it added $25 million to the inertial confinement fusion program within DOE's nuclear weapons activities directed at high-average power laser development. In making the appropriation, the House directed that the funds for FES be allocated in accordance with the recommendations of the Fusion Energy Sciences Advisory Council (FESAC) in its report on Balance and Priorities. The House expressed its pleasure with the actions of the FESAC review in helping FES take advantage of the international fusion effort and "to accelerate the development of fusion energy."

The Senate approved $227.3 million for FES, 8.1% below the request and 7.1% below the FY2000 level. The Senate cited "severe budget constraints" and "shortfalls" in other DOE programs as the reason for the reduction. The level approved by the Senate would keep funding for TFTR decontamination flat.

The final bill provides $255 million for the FES program, 3.1% above the request and 4.2% above the FY2000 level.

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[7] Conference Committee, *Making Appropriations for Energy and Water Development for the Fiscal Year ending September 30, 2001, and for Other Purposes,* 106th Congress, 2nd Session, H.Rept. 106-907, 106-107.

[8] 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).

**Other.** Other activities within the Science programs related to R&D comprise support and auxiliary efforts, including laboratory facility and equipment support, program direction, science education, and energy research analysis. The program direction budget contains funds for all of the programs within Science, both in the field offices and at DOE Headquarters. In addition, the Science account provides funding for infrastructure and operations support of the Oak Ridge Operations Office and for program-specific support from the DOE field office. These last two items include support of DOE R&D activities, but they also support non-R&D activities. No attempt is made in this report to allocate the funds of these items, and they are not included in the R&D totals.

For FY2001, DOE requested $175.8 million for these other activities, 6.1% above FY2000. An increase of $9.5 million was sought for program direction including $2.0 million for various education activities.

The House approved an appropriation of $173.0 million for these other activities, 1.6% below the request but 4.4% above the FY2000 level. The House did not provide the $2 million increase sought by DOE for education activities.

The Senate approved $167.6 million for these activities, 4.7% below the request but 1.1% above the FY2000 level. The appropriation would keep headquarters program direction at the FY2000 level, and would reduced funding for science education by $3.5 million from the requested amount of $6 million.

The final bill provides $174.1 million for these other activities, 1.0% below the request, but 5.1% above the FY2000 level. Congress reduced funding for science education by $2 million from the request.

## National Security and Environmental Management

Although separate sectors within the DOE budget, these two activities are closely related because the prime focus of environmental management is cleanup of the DOE weapons facilities.[9] The major activity is stockpile stewardship 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, and to develop new science and technology for environmental restoration. Table 4 shows R&D budget data for these programs.

For FY2001, the DOE national security programs will be in the National Nuclear Security Administration (NNSA), which begins operation on March 1, 2000. DOE is also proposing a reorganization of the budget structure of the nuclear weapons activities based on recommendations that a closer integration of research, development, and production is desirable. As a result, the core stockpile stewardship and maintenance programs of the past several years have been replaced by Stewardship Operations and Maintenance (O&M), and Construction activities. The

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[9] Some of the environmental R&D funding supports cleanup of DOE's civilian activities. DOE has combined all of the environmental R&D in one program, however, and those totals are given here.

Stewardship O&M activity, in turn, consists of three subcomponents: Directed Stockpile Work, Campaigns, and Readiness in Technical Base and Facilities (RTBF). Stockpile stewardship R&D activities — formerly the core stockpile stewardship program — fall mainly in Campaigns, and RTBF. The Construction activity contains all of the facilities that are being constructed that would have supported both the old core stockpile stewardship and maintenance programs.

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

| Program | FY2000 (Appro.) | FY2001 (Request) | FY2001 (House) | FY2001 (Senate) | FY2001 (Conf) |
|---|---|---|---|---|---|
| Nuclear Weapons R&D | $2,200.6 | $2,178.3 | $2,194.2[a] | $2,277.5 | $2,364.7[a] |
| Nonproliferation | 225.0 | 233.0 | 222.0 | 263.0 | 253.0 |
| Naval Reactors | 675.1 | 677.6 | 677.6 | 694.6 | 690.2 |
| Environmental Quality | 229.4 | 196.6 | 242.6 | 252.9 | 256.9 |
| Total | $3,330.2 | $3,285.5 | $3,336.4 | $3,488.0 | $3,564.8 |

[a] The House approved a general reduction of $26.1 million and a contractor travel reduction of $46.0 million for all weapons programs. Congress approved a general reduction of $35.7 million and a reduction for safeguards and security of $310.8 million for all weapons programs. No attempt has been made at this time to allocate those reductions to the weapons R&D program totals given here.

**Nuclear Weapons R&D.** The goal of the R&D in the DOE nuclear weapons 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.[10] 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 nuclear weapons R&D is the National Ignition Facility (NIF) now under construction.[11] 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 (DAHRT) to test for the safety of nuclear weapons, and the Accelerated Strategic Computing Initiative (ASCI) to develop the

[10] 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).

[11] Congressional Research Service, *The National Ignition Facility: Management, Technical, and Other Issues*, by Richard Rowberg, CRS Report RL30540, updated October 6, 2000.

supercomputer technology needed for weapon simulations. Technology transfer activities are also in Stewardship O&M.

For FY2001, DOE requested $2.178 billion for nuclear weapons R&D, 1.0% below FY2000. An increase of $7.2 million was requested for stockpile directed R&D, $21.1 million for inertial confinement fusion, and $80.0 million for ASCI. A reduction of $173.1 million was sought for construction funding of NIF based on its baseline funding schedule in place at the time of the budget request.[12] DOE also requested a reduction of $25.6 million for construction funding for the DARHT facility, based on its current baseline. In order to improve estimates of such baselines for future construction projects, DOE requested $14.5 million to begin a pilot program for preliminary project design and engineering.

The House approved an appropriation of $2.194 billion for nuclear weapons R&D, 0.7% above the request but 0.3% below FY2000. The House added $25 million to the inertial confinement fusion (ICF) program to perform research on high average power lasers. It also reduced funding for the ASCI program by $20 million. All other programs were funded at their requested levels. An amendment adopted by the full House reduces funding for contractor travel from the House Appropriations Committee recommendation for the entire Stockpile Stewardship program by $46 million. How that will effect weapons R&D is to be determined.

In making its appropriation, the House directed DOE to combine funding for all of the ICF work within the Campaigns programs. This involves moving $144.7 million for ICF activities from the Readiness in Technical Base and Facilities (RTBF) programs and the $74.7 million requested for construction of the National Ignition Facility (NIF) from the Construction programs. In addition, the House directed DOE to consolidate its stockpile computing activities in the Campaigns programs by moving $477.1 million for ASCI from RTBF and $70 million from the Construction programs for various ASCI-related construction activities. It is the House's view that these moves more accurately reflect the cost of the ICF and the defense computing and modeling campaigns.

The House Committee also noted that Congress had directed DOE to submit a revised baseline estimate for NIF by June 1, 2000, or if unable to do so, an estimate of termination costs. The House further noted that DOE did not meet that deadline although it did submit and estimated total project cost of $3.26 billion, which it has not yet been able to certify. As a result, the House stated that it was not able to determine additional appropriations for FY2001, but stated that it will wait until the final certification is delivered in September before deciding what action to take. While recognizing the importance of a timely completion of NIF, the House directed DOE to make sure support for other aspects of the inertial fusion effort did not suffer because of the need for additional resources for NIF.

The Senate approved $2.278 billion for nuclear weapons R&D, an increase of 4.6% above the request and 3.5% above the FY2000 level. Included in the

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[12] That baseline is currently being adjusted to account for major cost overruns identified last year. See CRS Report RL30540, *The National Ignition Facility.*

appropriation is an increase above the request of $25 million for stockpile research and development, $15 million for advanced radiography, and $10 million for primary certification. The Senate also recommended substantial increases from the request (about $65 million) for operations of facilities related to R&D.

The Senate expressed serious concern that the stockpile stewardship program is "not on schedule" and stated that it requires more funds. This sentiment is the basis for the substantial increases provided by the Senate for FY2001. It was particularly concerned about the continued loss of trained and experienced personnel and the growing difficulties in replacing those individuals. The Senate also expressed concern about the difficulty DOE appears to be having in constructing its experimental and computing facilities within budget and on schedule. It hoped that the new NNSA would be able to deal with these problems. Finally, the Senate expressed its approval of the new format in which DOE presented its budget and directed the Department to clearly identify the funding required for each program element under each of the three budget categories in future budget requests. The Senate did state, however, that the campaigns category should not let long- range research suffer at the expense of short-term goals.

In an amendment adopted by the full Senate, funding for the National Ignition Facility was capped at $74.1 million for FY2001 — the formally requested amount. The amendment would not permit additional funds for the project until a study by the National Academy of Sciences (NAS) is conducted on whether "NIF is required in order to maintain the safety and reliability of the current nuclear weapons stockpile." In addition, the NAS study is to look at, among other things, current technical problems with NIF, likely construction cost, and the "advisability" of a smaller version of the facility. If this amendment is enacted into law, the study would be due on September 1, 2001.

The Senate Appropriations Committee had recommended that the full request of $74.1 million for NIF construction be provided. It did, however, express serious concern about the project. The Committee noted the large cost overrun that DOE has reported and interim report giving a new baseline for the project. It also noted that DOE has reaffirmed its belief of the importance of NIF to the stockpile stewardship program. The Committee, however, questioned whether NIF was still so "essential" given the new cost estimate. In noted that DOE has submitted a budget request amendment for FY2001 to accommodate the additional funds needed for NIF. At the same time, the Committee argued that DOE had not balanced the long-term needs of the SSP with the requirements to complete NIF. In particular, it stated that DOE should consider options for completing NIF at less than full design capacity and determine how those options would affect the overall SSP. The Committee directed DOE to analyze these issues and stated that it would not provide additional funding for the project until they were satisfactorily resolved. The Committee also stated that it was very important for DOE to continue to support work on the other large facilities and elements within the Inertial Confinement Fusion program.

The final bill provides $2.365 billion for weapons R&D, 8.6% above the request and 7.5% above the FY2000 level. Congress increased funding for stockpile research and development by $19 million above the request, primarily for life extension development activities and additional sub-critical experiments. It also added $15

million to the advanced hydrodynamic test facility program. In the inertial fusion program, Congress added $25 million for high average power laser development. It also reduced funding for defense computing and modeling by $10 million from the request. While making some modifications, Congress approved the new budget format for the nuclear weapons programs proposed by DOE in its FY2001 budget request. Congress directed DOE to combine within the campaigns account: all ICF activities together, including NIF construction; all defense modeling and computing activities together, including ASCI and construction; and all advanced radiography activities together, including DAHRT construction.

For NIF Congress approved a budget authority of $199.1 million. DOE had requested $209.1 million in its revised baseline delivered on September 15, 2000 compared to its original request of $74.1 million. Of the amount approved by Congress, $25 million is to come from other weapons activities being performed at Lawrence Livermore National Lab, the site of NIF, $40 million is to be transferred from NIF operations to construction, and $134.1 million is from new appropriations. Because of concerns about the project as a result of its large cost overrun, Congress approved statutory language that limits the amount DOE can use for NIF to $130 million until certification by DOE, after March 31, 2001, that several requirements have been met. Only then, can the remaining $69.1 million be used. The requirements, among others, include certification that project technical and budget milestones set forth in the revised baseline are being met, a recommendation about how to proceed with the project after reviewing alternative construction options, and completion of a study about whether a full-scale NIF is needed to support the goals of the stockpile stewardship program.

**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.[13] The program provides the science and technology for arms control, nonproliferation, nuclear safeguards, energy security, and emergency management. Current R&D activities include design, development, and production of sensor systems for early detection of production of weapons of mass destruction, treaty monitoring, detection of proliferation of chemical and biological weapons, and dismantlement of nuclear warheads.

For FY2001, DOE requested $233.0 million for Nonproliferation and Verification R&D, 3.6% above FY2000. Of the request, $42 million would be to develop and demonstrate technologies aimed at reducing the threat of potential chemical or biological terrorism. Within the requested $8 million increase, DOE asked for $2.1 million for chemical and biological nonproliferation and $3.3 million to restore efforts in deterring proliferation and nuclear explosion monitoring.

The House approved an appropriation of $222.0 million for this program, 4.7% below the request and 1.3% below the FY2000 level. The House stated that this recommendation would fund the chemical and biological nonproliferation request.

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[13] Congressional Research Service, *Nuclear Nonproliferation Policy*, by Carl Behrens, CRS Issue Brief IB98039.

The House pointed out that it had directed DOE to carry out an external review of the Nonproliferation and Verification R&D program and to prepare a report identifying the value of each of the projects supported by the program. It was concerned that the program was funding a large number of projects that seemed to be unconnected and that the program lacked focus. The House noted that those steps had not been taken. It further noted that while DOE has carried out a review on the quality of the research funded by this program, that review, while helpful, did not meet the objectives of the House's request of DOE.

The Senate approved $263.0 million for this program, 12.9% above the request and 16.9% above the FY2000 level. Included in the appropriation is $17 million for construction of the Nonproliferation and International Security Center and Los Alamos.

The Senate approved the large increase to permit NNSA to enhance ground and space-based monitoring, to deploy new detection technologies, and to help meet chemical and bioterrorism threats. The Senate stated that the R&D program is essential for development of new technologies to meet growing security and arms control demands. The Senate also expressed its pleasure at the results of a review of the program ordered in the FY2000 Conference Report. It noted that with 20% of the program's funds going to universities, the program had established an "excellent" means for ensuring close coupling between nonproliferation R&D being carried on in universities, the labs, and industry.

In the final bill, Congress approved $253.0 million for the Nonproliferation and Verification R&D program, 8.6% above the request and 12.4% above the FY2000 level. Included in the appropriation is $17 million for construction of the Nonproliferation and International Security Center and Los Alamos. Congress also noted the concerns about the availability of the program's research funds to open competition. It cited a DOE study that, among other things, recommended greater opportunity for the U.S. scientific and technical community. In the conference report, DOE is directed to make 25% of its R&D funding for ground-based systems treaty monitoring available for open competition, and report to the Appropriations Committees its progress in implementing the study's recommendations.

**Naval Reactor R&D.** Naval reactor R&D is directed at the development and testing 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 and test 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. In addition, the program is developing the reactor for the new CVNX aircraft carrier, and the next generation reactor systems for the new VIRGINIA-class submarines. The latter includes development of a life-of-the ship reactor core: 50 years for aircraft carriers and 40 years for strategic submarines. The program has also been carrying out inactivation of several prototype reactors no longer needed.

For FY2001, DOE requested $677.6 million for Naval Reactor R&D, 0.4% above FY2000. The agency asked for an additional $21 million to accelerate

development of core and control drive mechanisms for the new aircraft carrier reactor, and a reduction of $15 million for prototype reactor inactivation.

The House appropriated the full request for Naval Reactor R&D. It expressed concern that DOE was not adequately funding the environmental cleanup program being performed by the Naval Reactors program and that additional funds could be used by the reactor deactivation efforts. The House stated that funding constraints precluded adding any funds for these activities.

The Senate approved $694.6 million for this program, 2.5% above the request and 2.9% above the FY2000 level. The additional $17 million is to "optimize" the program for shutting down prototype reactors and completing inactivation work by FY2002. The Senate directed DOE to request additional funds in future years if needed to complete these programs.

In the final bill, Congress approved $690.2 million for Naval Reactors, 1.9% above the request and 2.2% above the FY2000 level. Included the additional $17 million approved by the Senate for prototype reactor shutdown.

**Environmental Management R&D.** Environmental management R&D is carried out by the Office of Science and Technology within the Environmental Management (EM) (both defense and non-defense waste) program. The Science and Technology activity includes: technology development and deployment, technology acceptance and support, science, and risk policy. It is charged with expanding the scientific understanding of the character and risks of defense and non-defense wastes created at weapons manufacturing sites, developing new technologies for carrying out restoration and management in a safer, less costly manner, and ensuring that technologies developed by the program are used at DOE sites.

For FY2001, DOE requested $196.5 million for Environmental Management Science and Technology, 14.3% below FY2000. The decrease is due largely to completion of work related to reactive barrier technology development, and to fuel pools and associated structures.

The House approved an appropriation of $242.6 million for environmental management R&D (Science and Technology), 23.4% above the request and 5.8% above the FY2000 level. The House added $10 million for technology deployment activities, which it stated were not being adequately pursued by DOE. The House also added $10 million research grants for FY2001. It noted that this activity, which is a collaborative effort between the Offices of Environmental Management and Energy Research, had received a good review from the National Research Council and should be continued. The House transferred $20 million from other EM accounts to S&T. Those funds are used for programs that had originally been funded from the S&T account. Finally, the House added $5 million to support the long-term stewardship program. The goal of this program is to address cleanup problems from the enduring stockpile stewardship program once the current cleanup is complete.

The House also directed that 4% of the EM funds could continue to be used for the laboratory directed research and development (LDRD) program. In order to ensure accountability and proper use of the funds, however, the House directed that

these LDRD funds only be used for projects relating to environmental research, and the awards be made only after review by the EM Office of Science and Technology.

The Senate approved $252.9 million for this program, 28.6% above the request and 10.2% above the FY2000 level. Included in the increase are $10 million for management science, and $8 million for accelerated site technology deployment. In addition, the Senate also approved a transfer of $22.5 million from the "Site/project completion" sub-account. It noted that the Deactivation and Decommissioning focus area has been successful in deploying new technologies that have reduced the cost of deactivation and decommissioning at the various DOE weapons sites.

In the final bill, Congress approved $256.9 million for Science and Technology Development, 30.7% above the request and 12.0% above the FY2000 level. It also approved transfer of $21 million from the Idaho validation and verification program. In the conference report, Congress directed DOE to provide $10 million in FY2001 for innovative research grants in the environmental management science program, and $10 million for technology deployment.

# Budget Issues

Several issues emerged from an analysis of the FY2001 budget request. In this section, these issues along with others that appeared during congressional consideration of the DOE budget are presented for each of the three program areas. Significant issues included the appropriateness of R&D in the Conservation and Renewable Energy R&D programs, the use of laboratory research and development funds, DOE's approach to cost overruns on the National Ignition Facility, and implementation of legislation establishing the National Nuclear Security Administration. While these issues were addressed during the 106th Congress, most are likely to reemerge in the 107th Congress.

## Energy Resources

**Conservation and Renewable Energy R&D Issues.** DOE once again requested a substantial increase for these two programs, 17.5% above the FY2000 appropriation. Requested increases of that magnitude for the Renewable Energy and Conservation R&D programs have been the norm for DOE in its last six budget requests to Congress. In each case, Congress granted an increase for the two programs over the year before, but well below the request. That changed somewhat for FY2001 when the availability of additional funds at the end of the appropriations process led Congress to approve funding for these two programs that is just 5.6% below the request and 10.9% above the FY2000 level.

While supportive of energy efficiency and renewable energy (EERE) R&D, many in Congress have argued that the DOE programs support a great deal of research that is best left to the private sector. Both programs contain a sizable component directed at premarket development of technologies. This focus was noted last year during House and Senate actions on the FY2000 DOE budget requests. The House in particular argued that a sizable portion of the DOE renewable energy R&D budget

was devoted to help commercialize products that were not yet ready for the market, and that DOE should shift its priorities to more basic research. The action by the House to remove funding for the Partnership for a New Generation of Vehicles (PNGV) suggested that sentiment in Congress remains that DOE is funding programs best left to the private sector.

Both programs also form the major portion of DOE's contribution to the climate change technology initiative (CCTI). That activity has been criticized as constituting a U.S. commitment to the Kyoto Accord for greenhouse gas reduction before the Senate has considered the treaty, and that it is not a well thought out plan to address possible global warming. The Senate, during consideration of the FY2000 budget request, argued that the focus of the Kyoto Accords — reduction in annual emissions — did not appear to be very effective because the real goal was reduction in absolute concentrations of greenhouse gases. The House also stated in 1999 that DOE had not made it clear why some programs were part of the CCTI and others, that appeared equally appropriate, were not. It was not apparent that DOE addressed this criticism with its FY2001 budget request.

Nevertheless, there are many supporters of an expanded EERE R&D program. They argue that the private sector is unlikely to undertake much of this research, particularly in periods of relatively low competing energy prices. Without some kind of economic incentives, these proponents state, the investments in developing technologies needed to reduce greenhouse gases, should that prove to be necessary, will not be made in time to stem the severity of climate change. Further, they have argued that when energy supplies get tight, it will lead to higher prices unless greater efficiency is achieved and more abundant alternate supplies are available. Indeed, this argument was used to justify the transfer of $45 million from the DOE Fossil Energy R&D program to its conservation program that was approved by the full House. While that action was overturned by the conferees, nevertheless Congress provided considerably more funding for conservation R&D than the final House mark. Supporters of the EERE R&D programs also argue that global climate change is real and that the most economic way to deal with the problem is with new technology that increases energy efficiency or makes use of energy sources that do not emit greenhouse gases.[14]

The final numbers for these two programs suggest two things. First, support for renewable energy and conservation R&D remains strong in Congress. The recent oil and natural gas price increases and the possibility of shortages in electric generation capacity have raised the specter of another energy "crisis'. As a result, there is renewed attention to the role of renewable energy and conservation in the nation's energy future. Second, there remains a difference of opinion between Congress and the Administration about the emphasis of federally-funded conservation and renewable energy R&D. Funding was increased from FY2000 more for those programs that focus on long-term research than for those that focus on technology

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[14] See, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, *Scenarios of U.S. Carbon Reductions: Potential Impacts of Energy Technologies by 2010 and Beyond,* 1998.

and precommercial product development. It should be noted, however, that the differences are not as great as in past years.

**Nuclear Energy R&D Issues.** In the FY2000 budget request, DOE attempted to revitalize nuclear power R&D with the Nuclear Energy Research Initiative and the Nuclear Energy Plant Optimization program. Both were relatively small activities that focused on the current and future status of nuclear power in the United States. Congress funded both programs. For FY2001, DOE asked for an increase for the NERI.

There is renewed interest in nuclear power because of possible climate change resulting from combustion of fossil fuels and concerns about possible shortfalls in generation capacity in the next few decades. Indeed, the NEPO program is part of DOE's CCTI program. During its consideration of the FY2000 request, the Senate affirmed this perspective by pointing out that nuclear energy was the only currently available technology that could bring about any significant reduction in greenhouse gas concentrations, and argued that nuclear power should be accorded a higher role in dealing with climate change. It further directed DOE to develop plans for a new generation of nuclear power plants. The House, also while considering the FY2000 request, noted the importance of nuclear power to the nation's electric energy supply and that it should remain an important part of the nation's energy mix. For FY2001, the House reiterated its support of these programs in helping to revitalize nuclear energy, but was unable to provide the increase requested because of constrained budget resources. The Senate, for FY2001, also noted the importance of nuclear power to the nation's energy future, but argued that that promise could only be fulfilled with a new generation of nuclear power technology. The Senate provided more funds than requested for the NEPO and NERI efforts.

Nevertheless, nuclear power has many critics, and there are significant concerns that must be addressed if it is to become a growing contributor to the nation's energy supply. One of the most contentious concerns is disposal of nuclear waste from reactor operations, now being stored at the reactor sites. This concern was noted by the Senate in its FY2001 DOE appropriations report. While DOE supports the use of a planned geologic repository in Nevada to bury that waste, there remains much opposition to that plan.[15] An alternative that has been raised by some, including DOE itself, is accelerator transmutation of waste (ATW), a process that converts the long-lived waste components to shorter-lived waste that might make geologic storage more acceptable.[16] ATW, however, is far from developed and much R&D is needed before any decision to proceed can be made. DOE has eliminated any funding of ATW R&D in its nuclear energy R&D program for FY2001, and the funds were not restored during action by the House or the Senate. The conference agreement, however, provided $34 million for advanced accelerator applications including ATW. In

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[15] Congressional Research Service, *Civilian Nuclear Waste Disposal,* by Mark Holt, CRS Issue Brief IB92059.

[16] Congressional Research Service, *Tritium Production for the U.S. Nuclear Weapons Program: An Analysis of Key Issues*, by Richard Rowberg, Mark Holt, Carl Behrens, and Stephen Redhead, CRS Report RL30129, April 17, 1999, 25.

particular, it directed DOE to prepare a program plan for this research involving, among others, DOE's ATW expertise.

Whether a resurgence in nuclear power is possible or even desirable remains unclear. Nevertheless, funding for nuclear energy R&D for FY2001 suggests a growing interest in Congress in the option. If such a resurgence is called for, however, it is not clear how much current DOE efforts can contribute. A larger, more concerted R&D effort may be necessary.

## Science

Programs within the Office of Science support DOE's basic research efforts. As noted above, DOE is emphasizing basic research by asserting that it is a "science" agency. While the issues associated with these programs are generally less controversial than others associated with DOE, there were, nevertheless, some that appeared before Congress as it considered the DOE request for FY2001.

**Basic Energy Sciences Issues.** A cardinal feature of the BES program is the heavy investment in major scientific user facilities located at the various national laboratories. DOE as a whole is requesting $1.2 billion in FY2001 for user facilities under its Scientific User Facilities activity. While not all of these facilities are in the BES program — large components are in the HEP and Nuclear Physics programs — most are. Furthermore, the largest civilian construction project DOE currently has underway, the Spallation Neutron Source (SNS), is in the BES program. As noted above, the increase requested for SNS construction constituted about two-thirds of the increase requested for the BES program for FY2000.

Concern about the SNS project emerge in 1999.[17] Some Members criticized DOE's management of the project, stating that it should not proceed until substantial improvements are made. They were concerned that if the project continued as was structured at the time, substantial cost and schedule overruns would have occurred. The project, to be built at Oak Ridge National Laboratory, involves major contributions from six DOE labs, and critics believed that arrangement to be too unwieldy for effective management. In appropriations action last year, the House directed DOE to provide Congress with evidence, as defined by the House Science Committee, that it had taken the necessary management reform steps to ensure successful completion of the project. DOE made changes in the project's management structure, including appointing a new project director. While retaining the multi-lab structure, DOE argued that the new management structure and personnel will get the project completed in an acceptable manner. Because of the management restructuring that took place, DOE increased the total project cost by $80 million to $1.44 billion and extended the construction schedule by six months to the third quarter of FY2006.

The funding requested for the SNS for FY2001 would permit completion of Title II engineering design and the start of construction of several important and major

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[17] Congressional Research Service, *The DOE Spallation Neutron Source Project*. CRS Report RL30385.

components. Actions by the House and Senate suggest that concern about the management may no longer be an issue at least for the time being. There also seems to be strong support in Congress for the scientific goals of the SNS. The existence of severe budget constraints at the time, however, prevented the House from providing any increase for project construction funds over the FY2000 level. The Senate, however, expressed its belief that the project should go forth as planned even to the point of reducing funding for other Science programs to ensure that happens. Final action by Congress funded the entire request. This was made possible by the emergence of additional funds to the appropriations committees. The fact that Congress put the biggest share of those additional funds towards Science and fully funded the SNS, suggests the strong support within Congress for the SNS research goals as well as the basic research supported by the DOE Office of Science.

A longer-term question concerns the entire suite of scientific user facilities owned and managed by DOE. There is little doubt that much good science is done on these facilities, and they are an important part of all U.S. basic research, public and private. Yet they consume a large and growing portion of the budget of DOE science programs, particularly that of BES. How long this can continue is not clear. At some point, without additional sources of funding, the operation of those facilities may create serious problems for the productivity of BES research. DOE has raised the idea of user fees for those facilities but did not include a proposal to that effect with its budget request. This issue was not explicitly raised during congressional consideration of the FY2001 DOE budget request.

**Advanced Scientific Computing Research Issues.** For FY2001, DOE proposed the Scientific Simulation Initiative (SSI), requesting $70 million, $52 million of which was to be for the ASCR program's predecessor, the Computation and Technology Research program. Congress did not fund any of that request. For FY2001, DOE again proposed an effort to expand application of high-performance computers to complex scientific problems. As noted above, about $50 million of that increase would go to civilian supercomputer activities funded in the ASCR program. DOE notes that its total request for information technology (IT) research for FY2001 is $667 million, most of it in the ASCI program within DOE's defense programs.

The advent of computers capable of teraflop (trillions of operations per second) speeds and terabyte memories (called terascale computing) has opened the possibility for performing very complex computer simulations of physical events. Indeed it is just that possibility that forms the rationale for the nuclear weapons stockpile operation and maintenance program. Such simulations offer the possibility of making significant breakthroughs in many fields of science and technology by allowing the computer to simulate very complex processes and experiments that might not be capable of being analyzed short of full-scale testing or operation.

The growth of two supercomputer operations within DOE — the National Energy Research Scientific Computing Center (NERSC) and ASCI — has started to raise concerns in Congress. Currently the two operations are distinct because of the separation between defense and civilian missions of DOE. The size of the efforts and importance of potential civilian applications, however, are starting to generate questions about that separation and create pressure on DOE to bring about a greater merger of the two systems. During consideration of the FY2000 budget request, the

House did not provide funding for the SSI in large part because it was not clear about the need to support two, large supercomputer projects. It noted that DOE had stated that ASCI would have applications beyond its defense mission. The House Science Committee in its DOE R&D authorization bill (H.R. 1655) did not fund the SSI program either. In that bill, the House transferred authorization of all DOE civilian information technology activities to another bill designed to authorize government-wide civilian networking and information technology R&D funding for FY2000 through FY2004 (H.R. 2086). That bill, as passed by the full House, also did not authorize any of the funds requested by DOE in FY2000 for the SSI, and reduced authorization for DOE civilian information technology research to one-half the level approved in FY2000.

In part, the initiative described in the FY2001 request could be an attempt to integrate the supercomputing activities within DOE to address complex scientific problems, although there is no explicit statement in the budget justification how this might be done. The document only notes that certain advances in computational techniques would be useful to both the NERSC and ASCI efforts, and that DOE's efforts to enhance scientific computing and networking will build upon the advances made in the ASCI program. An added complication for closer integration may be the existence of the National Nuclear Security Administration, which will now have administrative control over ASCI. This issue is discussed further below.

There appears to be substantial promise in the application of high-performance computing and networking to scientific research. Already, significant advances have been made in molecular biology, astrophysics, and materials science, among other areas, by the NERSC facilities.[18] Nevertheless, greater integration of DOE civilian and defense supercomputing facilities appears important and could possibly go a long way in ensuring success of this potentially critical endeavor.

Appropriations action by the House for FY2001 suggests that some of the concerns about the DOE high performance computer programs have been allayed. The House noted that DOE had worked very hard to develop an program that addressed the varied computational needs of the scientific community. Again, the lack of funds appeared to be the main reason why the requested increase was not funded. The Senate was even more positive about the high-performance computer initiative but was also unable to provide full funding because of budget constraints. It did, however, direct a shift in funding from other programs to fund part of the requested increase for FY2001. The infusion of funds to the appropriations process allowed the Congress to provide nearly all that DOE had requested for this initiative.

**Fusion Energy Science Program Issues.** The Fusion Energy Sciences (FES) program has entered a post-ITER (International Thermonuclear Experimental Reactor) phase. While the ITER project still has life among the other partners, it is clear that U.S. participation is over, at least for the near future. The program, which is also completing a transition to science research from one being primarily directed at energy resource development, is now also embarking on a congressionally directed

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[18] U.S. Department of Energy, Lawrence Berkeley National Laboratory, *1998 Annual Report: National Energy Research Scientific Computing Center,* LBNL-42920, March 1999.

effort to examine all fusion options, inertial and magnetic, funded by DOE, in order to integrate those efforts in the quest to achieve successful fusion power.

Despite the success of its transition to date, the future of the FES program remains uncertain. An increase of $25 million above the request for the FY2000 appropriation suggests solid congressional support for the program as it is currently configured, but how well that support will carry in the years ahead remains unclear.[19] In particular, greater integration of the inertial and magnetic fusion energy research paths may be difficult to obtain. There may be potentially important research areas, such as heavy ion ICF drivers, that bridge the two principal fusion directions that may not now be adequately supported by either the FES or ICF programs. The creation of the NNSA to operate DOE's weapons activities and, as a consequence, the DOE ICF program might make such integration still more difficult.

In the longer term, the program will likely be faced with decisions about how to proceed from the scientific base it is now enhancing with the research it is funding on other alternative concepts as well as the main-line tokamaks. Those decisions, however, appear to be a few years off and did not appear to affect this year's congressional review of the program's FY2001 budget request. Indeed action by the House in providing a small increase for the program above the request suggests those issues are not now of concern. The Senate did not express any concerns about the program, but again noted that budget constraints would limit available resources. Again, the infusion of funds just prior to the conference resulted in Congress providing the amount approved by the House, although no comment was made in the conference report about the program.

## National Security and Environmental Management R&D

The reorganization of the weapons R&D programs, the cost overruns reported for the National Ignition Facility (NIF), and implementation of the NNSA were the principal foci of congressional review during consideration of the FY2001 budget request for DOE's national security programs.

**Nuclear Weapons R&D Issues.** As part of its implementation of the NNSA, DOE reorganized the budget structure of the its nuclear weapons stockpile stewardship and maintenance program. As noted above, the components of the separate, core stockpile stewardship and maintenance programs from the FY2000 budget were divided into **directed stockpile work**, which focuses on direct support of specific weapons; **campaigns**, which supports work on the broad-based science and technology needed to maintain the stockpile; and **readiness in technical base and facilities**, which supports the physical infrastructure and operations needed for directed stockpile work and campaigns at the national labs. While the rationale for this restructuring is to present an integrated stockpile stewardship program combining R&D with operations, the new structure makes it difficult to determine just what portion of the budget request constitutes R&D and what constitutes maintenance activities. According to the crosswalk provided by DOE in its budget justification

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[19] Congressional Research Service, *Congress and the Fusion Energy Sciences Program: A Historical Analysis*, by Richard Rowberg, CRS Report RL30417, January 31, 2000.

document, about one-half of the old core stockpile stewardship budget is in readiness activity, one-third in campaigns and the remainder in directed stockpile work. What is more, some key programs, in particular ASCI and inertial confinement fusion (ICF), are split between two of these activities, making it difficult to determine total funding for each program.

The new structure, however, does appear to give a more systematic view of the different stages of the total stockpile stewardship program. As a result, it is possible that a clearer picture will emerge of how the science and technology base is integrated in the stockpile maintenance effort and how to judge its success. Whether this will be of sufficient value to offset the loss of other information about the stockpile stewardship R&D budget request remains to be seen.

In general, Congress has agreed to the new arrangement but not without reservation and has made changes in the structure. In particular, the House directed DOE to consolidate funding for the ICF program and for the defense modeling and computing/ASCI program within the campaigns account. The House in its version of the FY2001 defense authorization act (H.R.4205, H.Rept. 106-616) also directed DOE to make the same steps. The Senate version of that bill (S.2549, S.Rept. 106-292) directs consolidation of the defense modeling and computing/ASCI programs but not for ICF. In addition, the House in H.Rept, 106-616 expressed its view that the new structure does not comply with the requirements of the law establishing the NNSA that directed the agency's budget be prepared in individual, dedicated program elements. The Senate was even more favorable about the new format and did not make any significant changes in the budget structure other than consolidating some construction projects with their respective program elements. The final appropriations bill agreed with the House action directing consolidation of ICF, and the defense modeling and computing activities. It also directed consolidation of the radiography activities within the campaigns account. In addition, it directed DOE to place all remaining construction projects within the readiness in technical base account. The conferees for the defense authorization bill (H.Rept. 106-945) agreed with much the same format except they retained remaining construction projects in a separate account.

As for the budget request itself, DOE asked for a slight decrease in nuclear weapons R&D for FY2001 compared to the FY2000 appropriation. Because of the large decrease requested for NIF construction, based on the NIF baseline in operation at the time, the request was a net significant increase for the remaining nuclear weapons R&D activities. Action by Congress, however, suggested that it did not believe DOE has asked for enough. Of particular concern was the additional funds needed for NIF (see below).

Most of the increase contained within the FY2001 nuclear weapons R&D budget request would be for the ASCI program and related computer activities. The requested increase for ASCI, however, is smaller than that requested for FY2000. The size of the latter elicited some concern from Congress last year about the rate of growth of the ASCI. The increase finally approved by Congress was below that request, but it is larger than the increase requested in the FY2001 budget.

The House version of the appropriations bill and the Senate version of the defense authorization bills did not provide any significant additional funding for nuclear weapons R&D. The House version of the defense authorization bill authorized an additional $95 million for NIF but no significant increases for the rest of the weapons R&D program. The Senate , however, apparently believed that the program needed substantial additional funding to keep on schedule. It expressed substantial concern that DOE has let the program slip and, when combined with cost overruns, believed that substantial budget adjustments may be needed in future years. The final appropriations bill provided almost $200 million more than the request. About one-third of the increase went for NIF (see below) with the rest to the other parts of the program. In the defense authorization bill conference report, the conferees authorized an increase of about $130 million above the request, about one-half of which went to NIF. As for ASCI, both the final appropriations and authorization bills provide that program with less than requested — $10 million and $20 million respectively — but still well above the FY2000 level. The infusion of funds into the appropriation process at the time the energy and water development conference met appears to have permitted Congress to fund the weapons R&D program at level commensurate with its concerns about the program's level of support.

The premise of the stockpile stewardship program, however, is still unproven. That is, can DOE assemble a suite of experimental and computational tools that will enable it to substitute simulation for nuclear testing in maintaining the reliability, safety, and performance level of the nation's nuclear stockpile? The ASCI project is the heart of this effort and is a substantial challenge. DOE appears to be making good progress in meeting its computer goals, but demonstration that simulation can adequately model nuclear weapon behavior is years off.

In the meantime, the other principal component of the Stockpile Stewardship program, the National Ignition Facility (NIF), has run into significant cost and technical problems.[20] The revised, certified baseline for the project reports a new estimate of $3.35 billion compared to the original estimate of $2.03 billion. GAO reports that the total cost estimate is now $4.1 billion. DOE amended its FY2001 request to add an $135 million to the NIF budget, but it did not ask for any additional appropriations. Both House and Senate action on the appropriations bills occurred prior to release of the final revised baseline. The House expressed concern about the project but did not take any action other than approving the initial request — based on the original baseline — pending receipt of the revised baseline. The Senate Appropriations Committee expressed concern about the implications of the transfer of funds from other parts of the weapons program to NIF to meet this addition. As described above, the full Senate adopted an amendment capping project funding and requiring outside review of the potential contribution of the project.

The final appropriations bill provided nearly all of the funds asked for by DOE but not without some significant reservations about the project's future. It is clear that there remains considerable uncertainty about whether a full-sized NIF is needed

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[20] For an extended discussion of the NIF problems, see Congressional Research Service, *The National Ignition Facility*.

to meet the needs of the SSP, particularly given the large increase in cost of the project. Nevertheless, it appears that Congress is willing to give DOE the benefit of the doubt at this time. If the project shows that it cannot meet the new cost and schedule milestones and/or the remaining technical problems appear more significant that DOE now believes, however, it is likely that action to reduce the ultimate size of NIF or, possible terminate the project, will be taken by Congress.

**National Nuclear Security Administration Issues.** Based on several disturbing reports about serious security lapses at DOE and subsequent concerns about severe management problems at the Department, Congress established the National Nuclear Security Administration (NNSA) within DOE to address those problems.[21] The new agency was formed as a result of an amendment in conference to the FY2000 defense authorization bill (P.L. 106-65). Early action by DOE to implement the agency, however, suggested that it was taking steps to reduce the intended independence of the new organization. A director from outside DOE has been selected, but it appears to be assigning some of the positions in the NNSA to DOE officials holding comparable positions in DOE. The Department claims that it would create unnecessary duplication and administrative difficulties to have two individuals doing essentially the same function within DOE. Many in Congress, however, do not agree with what DOE is doing and insist that the agencies be separate except for a common overall head, the Secretary of Energy. They state that the intent of the legislation was that the NNSA should not be subject to management problems within DOE, and that having key personnel serve dual roles in both DOE and the NNSA would perpetuate the very problem the legislation was intended to solve. It is clear that Congress is watching closely how DOE implements the NNSA legislation.

The House expressed concern during its appropriations action that the new agency did not yet appear to be addressing the management problems the Committee believes have seriously plagued DOE throughout the years. It stated that such action was one of the things Congress intended when it established the NNSA and that the new director should take the opportunity to make "bold and strategic improvements." As noted above, the House Armed Services Committee had strong concerns about how the NNSA prepared its first budget. That Committee stated that it will have to establish the program elements required by law because of the lack of cooperation from DOE in formulating a proper budget request. In addition to making the changes described above, the Committee provided DOE with criteria for submitting future budgets. The Senate expressed hope that NNSA would be able to deal with serious problems the Senate sees in the current nuclear weapons program. In the final appropriations bill, Congress restricted the authority of the Secretary of Energy to modify the NNSA organization and prohibited anyone working at NNSA from being paid if that person also held a position outside NNSA. Similar provisions were included in the final FY2001 defense authorization bill.

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[21] Congressional Research Service, *Technology Transfer to China: An Overview of the Cox Committee Investigation Regarding Satellites, Computers, and DOE Laboratory Management*, by Marcia Smith, Glenn McLoughlin, and William Boesman, CRS Report RL30231, 11 June 1999, 12-17; President's Foreign Intelligence Advisory Board, *Science at its Best, Security at its Worst.* [http://www.whitehouse.gov/WH/EOP/pfiab/index.html]

In addition to these concerns, there are others that may show up after the agency has had some time to operate[22] For DOE's R&D programs the principal concern appears to be whether an independent agency would isolate the weapons labs and scientific research undertaken in the weapons programs from the rest of DOE. Of particular concern are the ASCI and inertial confinement fusion (ICF) programs within DOE's national security activities, which have a number of civilian applications. Indeed, DOE has noted that both ASCI and NERSC — DOE's civilian supercomputer program — are part of the Department's information technology initiative. Even if care is taken to continue interaction between the civilian and defense research programs, the fact that there will be different management structures for each could create difficulties whenever decisions have to be made about allocation of resources and use of DOE facilities. It may be, however, that the benefits of a new organizational structure for the nuclear weapons program would be sufficient to outweigh these potential problems, and the latter can be dealt with. Currently some DOE facilities are used by other federal agencies, and cooperative research agreements exist that involve several of the DOE labs and outside organizations. Nevertheless, the possibility of barriers that might hinder the effective flow of scientific knowledge throughout all of DOE bears watching.

**Environmental Management Science and Technology Issues.** Congress considers the Environmental Management Science and Technology (S&T) program an important part of DOE's effort to clean up the wastes generated by years of its defense and civilian nuclear activities. In the past, however, it has expressed concern about the rate at which new technologies developed in the program are transferred to the actual cleanup activities. In the FY2001 request, DOE is asking for reduced funding for deployment activities and congressional questions about how fast and effectively new technologies are being put to use for cleanup are being raised. Indeed, the House approved an increase of $10 million for technology deployment while the Senate approved a substantial increase for the entire program. The final bill also approved a substantial funding increase well above the request and the deployment funds.

**Laboratory Directed Research and Development Program Issues.** The Laboratory Directed Research and Development (LDRD) program allows DOE laboratory managers to allocate a percentage of its operation and maintenance funds for discretionary research in support of the laboratories' missions. Until last year, Congress has permitted 6% of the O&M funds to be used in this manner. For FY2000, however, Congress, in the DOE appropriation bill, reduced that to 4% and eliminated the funds for environmental management from the funding base. For FY2001, DOE is requesting that the allocation be returned to 6%.

For FY1998, DOE spent about $250 million on LDRD activities. About 82% of those funds went for research in support of the national security or environmental management programs. The three DOE defense labs allocated the full 6% of their operating budgets while the six Office of Science labs allocated on average 3%.

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[22] Congressional Research Service, *Department of Energy: Programs and Reorganization Proposals*, coordinated by Carl Behrens and Richard Rowberg, CRS Report RL30307, October 28, 1999.

A report by a working group of the Laboratory Operations Board (LOB), itself a subcommittee of the Secretary of Energy Advisory Board, argues that the cut will have a serious consequences for DOE's national security and environmental management efforts.[23] The report claims that LDRD programs have been "highly effective" and a 6% level is "marginally acceptable at best." It further makes the case that despite criticisms, cases of mismanagement are not significant. The LOB recommended that the funding fraction be restored to at least 6% and that Environmental Management programs be once again included in the base.

The Congress, in reducing the amount allowed for LDRD for FY2000 to 4%, did not provide any explicit arguments for making the change. The House, which had approved elimination of all LDRD funding for FY2000, noted that about $100 million of the funds projected for FY2000 would come from nuclear weapons activities, and it "thus" was eliminating the program. It is probable that the House felt that DOE should be using all of the funds appropriated for specified activities and not for discretionary research that had not been approved by Congress. The absence of direct oversight by Congress of the research activities supported by the LDRD funds as well as concerns about possible mismanagement also might have contributed to the reduction. That appears to be the case as the House, for the FY2001 appropriation, limited LDRD funding to 4% and directed DOE to take steps to make the funds spent under LDRD more accountable. Further, its action to limit those LDRD funds coming from the Environmental Management funds to environmental research projects suggests concerns about the focus of LDRD funds. The Senate, on the other hand, during its consideration of the FY2001 DOE request, stated that DOE needs at least the full 6% to help ensure that the Labs remain competitive in science and technology. Indeed the approval of the amendment that would raise that total to 8% and include Environmental Management program funds would seem to be an attempt to ensure that the enacted figure is 6%. Further, the Senate approved a similar program for the weapons production facilities in order to help them attract new talent. The final bill compromises on the separate House and Senate levels, restoring the allowance to 6%.

## 107th Congress - Outlook

As for the 107th Congress, it is likely that many of the above issues will be revisited. In particular, questions about the proper role of the Federal government in supporting the development of renewable energy technologies will probably come up during consideration of renewable energy budget request. Also, there may be renewed interest in the future of nuclear power and how the DOE budget request can support that renewal. In the Science area, the 107th Congress may have to deal with the growing requirements to maintain the national scientific user facilities. Also, the Office of Science may request another large budget increase (on the order of 10 to 15%) for FY2002. Such an increase would push the civilian side of DOE even further towards Science as opposed to energy and could result in a review of the true mission of the agency.

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[23] U.S. Department of Energy, Secretary of Energy Advisory Board, *Review of the Department of Energy's Laboratory Directed Research and Development Program,* January 27, 2000 [http://www.hr.doe.gov/seab/].

In the national security area, there is likely to be continued oversight of the NIF project to ensure that it is staying within the revised budget projections. There may also be a review of the entire stockpile stewardship program and whether a smaller version of NIF should be considered. The National Nuclear Security Agency will have completed its first full year of existence in 2001, and likely will be the subject of congressional scrutiny during FY2002 budget request consideration.

## Concluding Observations

While numerous issues faced the DOE budget request for FY2001 during the appropriations process, the major one until just before conference action appeared to be the availability of funds to meet its requested increases. The budget caps — even with the adjustments that took place — were quite constraining.[24] The Administration appeared to have ignored the existing caps in its FY2001 budget request. While Congress raised the caps for discretionary funds somewhat, they were still below the levels that would be required to fund the administrations request. Furthermore, non-R&D activities in DOE, primarily the Environmental Management and other national security programs, constituted a significant share of the DOE budget and have high priority missions. Indeed, many times — particularly for the DOE science programs — the House and Senate separately, during consideration of DOE FY2001 appropriations, cited severe funding constraints as the primary reason for being unable to meet the DOE request. This was not a factor, however, during conference with because of changes in the budget allocations to the committees.. While the budget caps were breeched significantly this year, however, no agreement appeared about the longer-term treatment of those caps. Therefore, it is likely that the issue of availability of funds will arise again next year, particularly if DOE requests a substantial increase for its R&D programs based on its success this year.

The DOE's R&D budget request for FY2001 itself appeared to have only a few relatively controversial issues, primarily the NIF cost overrun and implementation of the NNSA. The apparent growing support for continued federal research funding, particularly for basic research, and need for maintaining the nation's nuclear weapon stockpile are likely to remain priority concerns with Congress. DOE is critical to both of these goals with its large and diverse R&D portfolio and its responsibility for the upkeep of the nuclear weapons stockpile. These two factors played a key role in the large increases received by DOE for these areas once budget constraints were removed.

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[24] Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 2001-2010,* January 2000, 76-77.