

GAO

Report to the Chairman, Committee
on Energy and Natural Resources,
U.S. Senate

April 2002

TECHNOLOGY TRANSFER

Several Factors Have Led to a Decline in Partnerships at DOE's Laboratories



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United States General Accounting Office
Washington, DC 20548

April 19, 2002

The Honorable Jeff Bingaman
Chairman, Committee on Energy and
Natural Resources
United States Senate

Dear Mr. Chairman:

Since 1980, the Congress has enacted several laws designed to make federally funded technology available to the public by facilitating the transfer of technology from federal laboratories to U.S. businesses. In particular, the National Competitiveness Technology Transfer Act of 1989 authorized federal laboratories operated by contractors—including the Department of Energy's (DOE) national laboratories—to enter into cooperative research and development agreements (CRADAs) that are consistent with the laboratories' missions. Under a CRADA, the partner and DOE laboratory agree to jointly conduct research and typically share the research costs. By fiscal year 1992, DOE's national laboratories were among the leading federal laboratories participating in CRADAs with businesses, universities, and other partners. In addition to CRADAs, DOE's laboratories have participated in technology partnerships by providing technical assistance to small businesses. DOE's laboratories have also transferred technology to businesses and other nonfederal entities without using partnerships by (1) "work-for-others" agreements, in which laboratory scientists perform specified research and the business pays full costs; (2) licensing their technology to businesses; and (3) making specialized user facilities available.

To further encourage DOE's laboratories to enter into CRADAs and provide technical assistance, the Congress began providing funding specifically designated for technology partnerships in fiscal year 1991. However, in fiscal year 1996, the Congress began to phase out these dedicated funds, relying instead on program managers at the laboratories to use their regular research funds for CRADAs that would significantly benefit their programs. While the use of regular research funds instead of dedicated funds ensures that a CRADA project will have primary benefits to DOE's research mission, it has raised concerns that DOE's laboratories will be less likely to support CRADAs.

In July 2001, we reported a substantial drop in the number of CRADAs and technical assistance agreements that DOE's National Nuclear Security

Administration (NNSA) laboratories and production facilities have entered into in recent years.¹ Concerned that a similar decline might have occurred among all of DOE's laboratories, you requested that we expand our analysis to include the 12 DOE laboratories that have historically been most active in transferring technology to U.S. businesses. Specifically, you asked that we (1) examine these laboratories' participation in and funding for technology transfer activities with nonfederal entities during the past 10 years and (2) obtain laboratory managers' views on any barriers that may limit technology transfer activities between DOE's laboratories and potential nonfederal partners.

To address the first objective, we surveyed the following 12 laboratories, which have accounted for almost all of DOE's technology transfer activities and funding, according to DOE:

- Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and Sandia National Laboratories within NNSA;
- Ames Laboratory, Argonne National Laboratory, Brookhaven National Laboratory, Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory, and Pacific Northwest National Laboratory within DOE's Office of Science;
- National Renewable Energy Laboratory within DOE's Energy Efficiency and Renewable Energy Program;
- Idaho National Engineering and Environmental Laboratory within DOE's Environmental Management Program; and
- National Energy Technology Laboratory within DOE's Fossil Energy Program.

DOE's other laboratories have been less active in technology transfer primarily because they (1) conduct basic research in the fields of high energy and nuclear physics and nuclear fusion, which have little near-term potential for commercial applications; (2) conduct classified research with little, if any, commercial application; or (3) are small.

Results in Brief

In recent years, the 12 DOE laboratories have substantially reduced their CRADA partnerships and their technical assistance to small businesses. Instead, the laboratories have increasingly transferred technology through

¹U.S. General Accounting Office, *Technology Transfer: DOE Has Fewer Partnerships, and They Rely More on Private Funding*, GAO-01-568 (July 6, 2001).

agreements that did not involve collaborative research and were funded by a business or other nonfederal entity. Specifically, the number of active CRADAs at the 12 DOE laboratories dropped by almost 200 from fiscal year 2000 to fiscal year 2001 because the laboratories terminated 360 CRADAs and entered into only 166 new CRADAs. In particular, active CRADAs at Oak Ridge National Laboratory dropped from 256 in fiscal year 2000 to 79 in fiscal year 2001, primarily because of funding constraints. Further, by fiscal year 2001, most of the 12 DOE laboratories did not provide technical assistance for small businesses, unless a business was willing to pay for the service. In contrast, between 1992 and 2001, the laboratories experienced more than a fourfold increase in the number of work-for-others agreements and an eightfold increase in the number of technology licenses and user facility agreements. Although work-for-others agreements have grown, the research typically is less beneficial for the laboratory than CRADA research because, among other things, the laboratory's scientists do not typically have the opportunity to collaborate closely with the nonfederal entity's researchers.

Managers at DOE laboratories most frequently cited the lack of dedicated funding for technology partnerships, including funding targeted to small businesses, as the most important barrier to their technology transfer activities. Many of the managers said that the uncertainty of continued DOE funding from year to year was a problem. Further, managers at most of the laboratories stated that the lack of a high-level, effective advocate for technology transfer at DOE headquarters and DOE's lack of commitment to technology partnerships were important barriers. Some laboratory managers also told us that certain requirements, such as DOE's advance payment clause, were often financially burdensome, particularly for small businesses.

Background

DOE laboratories have primarily used the following types of agreements to transfer technology to U.S. businesses and other organizations:

- **CRADAs:** A DOE laboratory and its nonfederal partner(s) agree that their scientists will collaborate on a research project of mutual interest and consistent with the laboratory's mission. Both parties may contribute personnel, services, and property to the CRADA project, and the partner(s) can provide funding for the laboratory's research. However, the DOE laboratory cannot provide funding to the partner(s). Intellectual property rights to technology developed under the CRADA are negotiated in advance. In general, the inventing partner retains ownership rights, while the other partner receives appropriate licensing rights.

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- **Technical assistance for small businesses:** Both NNSA's and the Office of Science's laboratories used dedicated funds (provided by the Technology Partnership Program and the Laboratory Technology Research Program, respectively) to provide technical assistance to small businesses.
 - **Work-for-others agreements:** A DOE laboratory agrees to conduct a defined scope of work or list of tasks that is consistent with DOE missions and which does not place the laboratory in direct competition with the private sector. The nonfederal entity pays for the entire cost of the project. While intellectual property rights are negotiable, the nonfederal entity typically retains title rights to any inventions.
 - **Technology licensing agreements:** A DOE laboratory grants a business an exclusive or nonexclusive license to use its intellectual property in return for a licensing fee and/or royalties.
 - **User facility agreements:** A DOE laboratory permits outside organizations to use its unique research equipment and/or facilities to conduct research. For nonproprietary research, almost all of the users are supported by federal grants, typically through the National Science Foundation or DOE. For proprietary research, the private organization pays the full cost for using research equipment or facilities and retains title rights to any intellectual property.

Table 1 shows the dedicated funding that the Congress has made available for technology partnerships through the Technology Partnership Program for NNSA's laboratories and weapons production facilities and the Laboratory Technology Research Program for DOE's Office of Science laboratories.² The Technology Partnership Program, which provided funding for DOE's nuclear weapons laboratories and production facilities, peaked at \$214 million in fiscal year 1996 and was subsequently phased out by fiscal year 2001. The Laboratory Technology Research Program, which provided funding for DOE's Office of Science laboratories, also declined from a peak of \$47 million in fiscal year 1995 to \$3 million in fiscal year 2002. DOE requested \$3 million for the Laboratory Technology Research Program for fiscal year 2003 and has announced that it will terminate this program once previously approved projects have been funded.

²The Technology Partnership Program was initially called the Technology Transfer Initiative.

Table 1: DOE's Dedicated Funding for CRADAs and Other Technology Partnership Activities

Dollars in millions

Dedicated funding	Fiscal year											
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Technology Partnership Program ^a	\$19	\$49	\$141	\$206	\$214	\$100	\$59	\$56	\$43	\$15	0	0
Laboratory Technology Research Program ^b	—	10	10	38	47	14	24	15	16	9	\$10	\$3

^aDedicated funding provided by DOE's National Nuclear Security Administration and its predecessors.

^bDedicated funding provided by DOE's Office of Science.

Source: DOE.

In the early 1990s, DOE created the Office of Research and Development Management within the Office of the Under Secretary to promote and oversee technology transfer at DOE's laboratories and production facilities. In March 1996, at the direction of the Congress, DOE disestablished this office and eliminated all of its staff positions. Subsequently, in 1999, DOE established a Technology Transfer Working Group, composed of representatives from 25 DOE organizations, to oversee and coordinate technology transfer policies. The working group has no permanent staff positions.

DOE Laboratories Have Substantially Reduced Technology Transfer Activities Not Fully Funded by Nonfederal Partners

The 12 DOE laboratories surveyed have substantially reduced their participation in CRADAs and technical assistance to small businesses in recent years, primarily because DOE research program funding has not replaced dedicated funding for technology partnerships. On the other hand, the number of work-for-others agreements, technology licenses, and user facility agreements has increased during the past 10 years. (See tables 5 and 6 in app. I for data on each laboratory's technology transfer activities and nonfederal entities' financial support.) Finally, two laboratories have identified non-DOE sources to support their efforts to provide local small businesses with technology assistance.

CRADAs Increasingly Depend on Partner's Financial Support

Table 2 shows that active CRADAs at DOE laboratories—which peaked at 1,111 in fiscal year 1996—dropped by more than 40 percent to 606 in fiscal year 2001. In particular, CRADAs that continued from the prior year dropped from 861 in fiscal year 1996 to 440 in fiscal year 2001. Much of this decline occurred in fiscal year 2000, when 360 CRADA projects ended. (See table 7 in app. I for each laboratory's newly executed and continuing CRADAs.)

Table 2: CRADA Activity at DOE Laboratories, Fiscal Years 1992 through 2001

Active CRADAs	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Newly executed CRADAs	164	241	393	424	250	190	196	223	128	166
Continuing CRADAs	30	185	369	664	861	770	642	618	672	440
Total	194	426	762	1,088	1,111	960	838	841	800	606

Source: DOE laboratories.

The initial growth and subsequent decline in CRADAs over the past 10 years mirrors the change in DOE’s dedicated funding for technology partnerships through NNSA’s Technology Partnership Program and the Office of Science’s Laboratory Technology Research Program. Since peaking in fiscal year 1996, the drop in CRADAs has been greatest at the laboratories for which dedicated funding constituted a substantial share of partnership funding. For example, from 1996 through fiscal year 2001, the number of new CRADAs dropped from 12 to 7 and total active CRADAs dropped from 55 to 30 at the Office of Science’s Lawrence Berkeley National Laboratory. The Laboratory Technology Research Program was the DOE source of funding for 68 percent of these CRADAs. The termination of Technology Partnership Program funding resulted in more than a 60-percent drop in active CRADAs at NNSA laboratories.

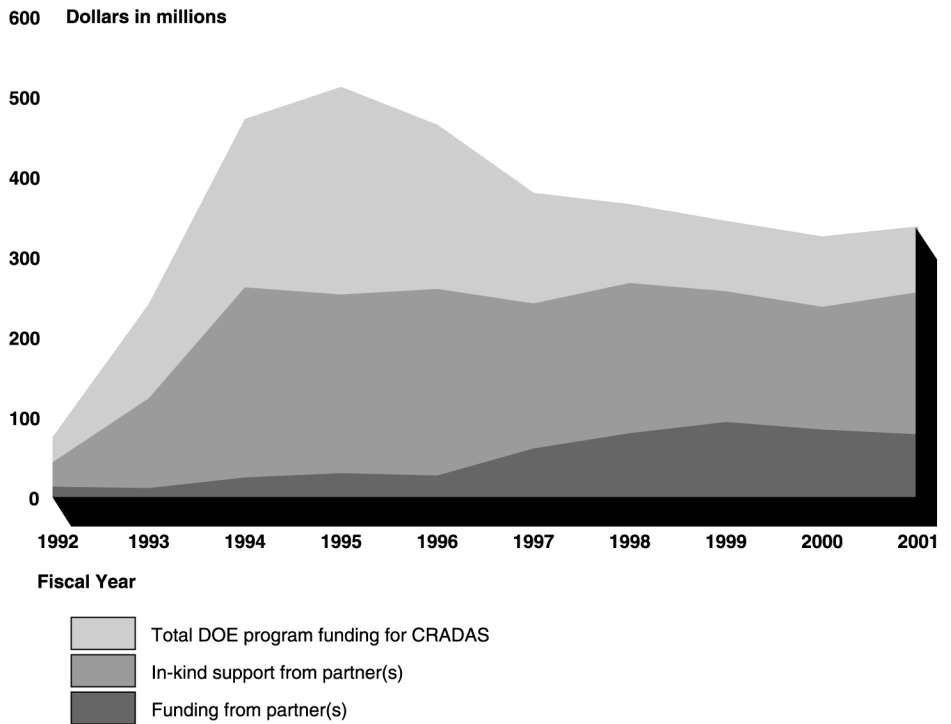
According to technology transfer managers at the DOE laboratories we visited, their laboratories are likely to have fewer CRADAs in the future because of DOE funding constraints. For example, the number of CRADAs at Oak Ridge National Laboratory dropped from 256 in fiscal year 2000 to 79 in fiscal year 2001 primarily because of funding constraints. In addition, as a result of unanticipated cuts in fiscal year 2002 funding for the Laboratory Technology Research Program—from \$10 million in fiscal year 2001 to \$3 million in fiscal year 2002—the Office of Science funded only 5 of the 12 multi-year CRADA proposals previously approved for funding by its peer review process. The partners for the other seven approved CRADAs were informed that funding for their projects would not be available in fiscal year 2002. The Office of Science has announced that these 12 CRADAs will be the last ones funded by the Laboratory Technology Research Program, which will be terminated.

The three laboratories that have historically relied on DOE program funds to support CRADAs have participated in at most 50 CRADAs per year each. For example, total CRADAs at the National Renewable Energy Laboratory have grown from 14 in fiscal year 1996 to 21 in fiscal year 2001, primarily because the Energy Efficiency and Renewable Energy Program,

whose mission includes working with industry, has provided funding support for most of these CRADAs. CRADAs at the Idaho National Engineering and Environmental Laboratory peaked at 50 in fiscal year 1996 and subsequently fell to 32 in fiscal year 2001.

Figure 1 shows that CRADA funding from all sources peaked at over \$500 million in fiscal year 1995. Since then, DOE funding has declined while partners have provided a greater proportion of CRADA support through funding and in-kind contributions. These trends reflect the decline in the total number of active CRADAs and the fact that DOE's research programs generally have not provided the funding support for CRADAs that NNSA's Technology Partnership Program and the Office of Science's Laboratory Technology Research Program had previously provided. Funding from some DOE programs has increased, however. For example, the Energy Efficiency and Renewable Energy Program, which provided \$16.6 million for CRADAs in fiscal year 1996, provided \$40.1 million of the \$81 million in total DOE funds for CRADAs in fiscal year 2001. (See tables 8 and 9 in app. I for the financial support of CRADAs by DOE research programs and partners.)

Figure 1: Sources of Funding for CRADAs at DOE Laboratories, Fiscal Years 1992 through 2001



Note: Lawrence Livermore National Laboratory could not provide data on the value of partners' in-kind support. Other DOE laboratories estimated partners' in-kind support based on their planned contributions.

Source: GAO analysis of DOE laboratories' data.

With the decline in DOE funding support for CRADAs, the bulk of support for CRADAs has come from the laboratories' partners. Before fiscal year 1997, CRADA partners primarily provided in-kind contributions that covered the costs incurred by their scientists. Since then, CRADA partners have provided more funding to cover part, or all, of the DOE laboratory's costs for CRADAs. In fiscal year 2001, CRADA partners provided 76 percent of the total financial support for CRADAs through funding and in-kind contributions—specifically, partners paid all of the costs for 23 percent of active CRADAs and jointly funded the DOE laboratory's costs for 15 percent of active CRADAs. (See table 10 in app. I for the type of financial support that partners provided.)

While these funds enabled the DOE laboratories to leverage their resources, technology transfer managers at several laboratories noted that

many ongoing CRADAs were terminated early and potentially beneficial CRADA projects were stopped during negotiations because a business learned that it would have to pay a substantial part, or all, of the laboratory's research costs in addition to its own costs. In recent years, about 33 percent of the CRADAs were with small businesses, 50 percent were with large or intermediate businesses, and 13 percent were with universities or consortia. (See table 11 in app. I.)

Nonfederal Entities Have Increasingly Used Other Technology Transfer Agreements

Table 3 shows that the DOE laboratories' other technology transfer activities funded by businesses and other nonfederal entities have grown substantially in the past 10 years—work-for-others agreements are more than four times greater and technology licenses and user facility agreements are eight times greater. Businesses and other nonfederal entities have provided more funding for work-for-others agreements than for all other types of technology transfer activities combined. Funding from nonfederal entities for work-for-others agreements increased from \$31 million in fiscal year 1992 to over \$188 million in fiscal year 1999. In fiscal year 2001, there were 1,527 work-for-others agreements funded at \$147 million.

Table 3. Active Technology Transfer Agreements at 12 DOE Laboratories, Fiscal Years 1992 through 2001

Type of agreement	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Work-for-others	350	358	367	424	604	813	917	1,126	1,355	1,527
Technology licenses	189	230	396	540	808	944	1,045	1,424	1,589	1,720
User facilities	252	421	496	672	859	1,076	1,271	1,499	1,667	2,018

Source: DOE laboratories.

Although the nonfederal entity is required to pay all of the project costs, many businesses use a work-for-others agreement, rather than a CRADA. The work-for-others program allows them to obtain title, in most cases, to any intellectual property developed under the agreement while the title and licensing rights to any intellectual property developed under a CRADA are subject to negotiations. (See table 12 in app. I for work-for-others agreements by laboratory.) In contrast, the research under a work-for-others agreement typically is less beneficial for the DOE laboratory than research under a CRADA because (1) it is not required to provide direct benefit to the program missions, although it must be consistent with them; (2) the laboratory's scientists typically do not collaborate on research with the nonfederal entity's scientists; and (3) the laboratory does not normally have rights to any resulting intellectual property.

During the past 10 years, the laboratories' technology licensing activities significantly increased, from 189 licenses with \$4.7 million in license income in fiscal year 1992 to 1,720 licenses with \$19.3 million in license income in fiscal year 2001. The growth in technology licensing can be traced to the 1984 amendments to the Patent and Trademark Amendments of 1980, commonly known as the Bayh-Dole Act, which allowed DOE's laboratories operated by universities or nonprofit organizations to retain title to inventions that their scientists made. Subsequently, the National Competitiveness Technology Transfer Act of 1989 added technology transfer as a mission of the DOE laboratories. (See table 13 in app. I for technology licenses by laboratory.)

User facility agreements, which provide access to unique DOE research equipment and facilities, increased from 252 in fiscal year 1992 to more than 2,000 in fiscal year 2001. In particular, Brookhaven National Laboratory had 741 agreements in fiscal year 2001 that provided nonfederal entities with access to its specialized facilities such as the National Synchrotron Light Source. Similarly, Oak Ridge National Laboratory had 604 agreements with nonfederal entities in fiscal year 2001.

Two DOE Laboratories Have Used Non-DOE Sources to Fund Their Technical Assistance Programs for Small Businesses

The 12 DOE laboratories have reduced their technical assistance to small businesses from a high of 746 agreements in fiscal year 1995 to 246 agreements in fiscal year 2001. This decline reflected the phasing out of dedicated funding for technology partnerships, which the NNSA and Office of Science laboratories could use to support technical assistance. More recently, two laboratories have used other, non-DOE sources of funding to provide technical assistance to local small businesses. Sandia National Laboratories have an agreement with the state of New Mexico that entitles Sandia to up to \$1.8 million per year in tax relief for assistance provided to small businesses in the state. Similarly, Pacific Northwest National Laboratory has received funding from an economic development agency in Washington to provide technical assistance. These laboratories accounted for more than two-thirds of the DOE laboratories' technical assistance agreements in fiscal year 2001.

Managers at DOE Laboratories Cited Barriers to Technology Transfer Activities

According to DOE laboratory managers, the most important barrier to effective technology transfer was the lack of dedicated DOE funding for technology partnerships, including funding targeted at small businesses.³ (See table 4.) According to laboratory managers, other important barriers are closely associated with the lack of dedicated funding for technology partnerships and raise serious concerns about the future of CRADAs at their laboratories. While the laboratory managers also identified certain administrative issues that have delayed, or even stopped, potential partnerships, several of them told us that the long delays in obtaining DOE approval of CRADAs, common in the mid-1990s, have mostly been addressed.

Table 4: DOE Laboratory Managers' Ranking of Key Barriers to Technology Transfer

Barrier	Show stopper ^a	Major barrier	Moderate barrier	Minor barrier	No barrier
Lack of dedicated DOE funding for CRADAs	3	3	2	3	1
Lack of dedicated DOE funding for technology transfer activities with small businesses	2	3	3	2	2
Uncertainty about the availability of DOE funding in subsequent fiscal years	1	4	3	2	2
Lack of a high-level, effective advocate for technology partnerships at DOE headquarters	0	7	3	0	2
Lack of DOE institutional commitment to technology partnerships as a way to accomplish agency missions	0	6	3	1	2
DOE's requirement for advance payment by the nonfederal partner	0	6	3	2	1
U.S. competitiveness requirements	0	5	2	4	1
U.S. Trade Representative review	0	2	2	5	3

^aThe laboratory would have few, if any, partnerships with affected nonfederal entities.

Source: DOE laboratories.

Lack of Dedicated DOE Funding for CRADAs

Managers at 8 of the 12 DOE laboratories we surveyed cited the lack of dedicated DOE funding for CRADAs as an important barrier that has constrained technology partnerships at their laboratories. Each of these laboratories had received dedicated funding under either the Technology Partnership Program or the Laboratory Technology Research Program. According to several laboratory and DOE officials, DOE's research managers generally have questioned whether technology partnerships would provide direct benefits to NNSA's missions of stockpile stewardship

³We considered that an issue was an important barrier to a laboratory if the managers ranked it as a "show stopper," a "major barrier," or a "moderate barrier."

and nuclear nonproliferation and the Office of Science's mission of basic science. As a result, research managers have been reluctant to substitute limited research funds for the dedicated technology transfer funding that was phased out in recent years. Because DOE funding was not available, several laboratories had to advise many of their CRADA partners that they would either have to pay the project's full costs, including those incurred by the DOE laboratory's scientists, or the laboratory would terminate the CRADA. Sandia National Laboratories managers told us that they had terminated 18 CRADAs early in fiscal year 2000 because of such funding constraints.

Three laboratories stated that the lack of dedicated DOE funding was a "show stopper" for CRADAs. For example, managers at Lawrence Berkeley National Laboratory told us that because many of the laboratory's research program budgets have been squeezed in recent years, research managers have little flexibility to support CRADAs or other types of technology partnerships. Alternatively, CRADA partners—particularly small businesses—are unwilling or unable to fund all of the research costs. The Lawrence Berkeley managers believe that dedicated funding is important for maintaining a critical mass of CRADAs—without the likelihood of funding support, scientists will not invest the effort to develop strong funding proposals for potentially useful collaborations. Moreover, according to managers at several laboratories, previous DOE funding support for CRADAs likely led to an increase in work-for-others agreements and CRADAs funded by nonfederal partners in recent years. These managers believe that dedicated funds have provided the laboratories with an opportunity to "get their foot in the door" with companies. Once the partners are familiar with the capabilities of the national laboratories, they are more likely to want to continue working with the laboratories, according to the managers.

Several managers cited the importance of dedicated funding for commercializing many of their laboratories' technological innovations because there often is a gap in the funding needed to translate the innovation into possible commercial applications, a gap that some managers referred to as the "valley of death." The Lawrence Berkeley managers told us that CRADAs have enabled technology licensees to collaborate with the laboratory's scientists to develop commercial applications. According to Lawrence Berkeley and Argonne managers, based on the number and quality of proposals that their scientists had previously submitted for Laboratory Technology Research funding, each of these laboratories could effectively use \$10 million per year in dedicated funding for CRADAs.

Managers at 4 of the 12 laboratories stated that the lack of dedicated DOE funding was not an important barrier for CRADAs. In particular, three of these four laboratories had not received dedicated funding. Furthermore, two of these three laboratories—the National Renewable Energy Laboratory and the National Energy Technology Laboratory—primarily conduct research for the Energy Efficiency and Renewable Energy Program and the Fossil Energy Program, respectively, which may have been more willing than some of the other DOE programs to use regular research funds to support CRADAs because their missions include working with industry.

Lack of Dedicated DOE Funding for Small Business Partnerships

Managers at 8 of the 12 DOE laboratories cited the lack of dedicated funding for technology partnerships as an important barrier that has constrained small business participation at their laboratories. In particular, managers at two laboratories told us that the lack of dedicated funding was a “show stopper” for small businesses because a small business generally did not have the funds available to pay all, or part, of the DOE laboratory’s costs—in addition to its own costs—for a CRADA research project. Managers at several of the laboratories also cited the importance of dedicated DOE funding as a basis for providing technical assistance to small businesses. Managers cited various examples of a laboratory scientist correcting a manufacturing problem or improving a product after spending a few days with a small business.

Uncertainty about Continued Funding

Managers at 8 of the 12 laboratories told us that uncertainty about DOE’s continued financial support for CRADAs was an important barrier. In particular, managers at several Office of Science laboratories told us that Laboratory Technology Research Program funding cutbacks in recent years had created ill will among CRADA partners whose funding support was cut and uncertainty among laboratory scientists and their partners about whether to pursue CRADA proposals for projects that were unlikely to get funded. Some scientists at laboratories we visited discussed their frustration at having funding disappear after they had nurtured working relationships with industry scientists to develop potential technology transfer projects and—much more time-consuming, in their perspective—persuading the partner’s key financial and management staff of the project’s merit. These experiences create “legends” about the difficulties of working with DOE laboratories, according to the deputy director of the Lawrence Berkeley National Laboratory.

Lack of Commitment for Technology Partnerships

Managers at 10 of the 12 DOE laboratories cited the lack of a high-level, effective advocate for technology partnerships in DOE headquarters as an important barrier that has constrained their technology transfer activities. Similarly, managers at 9 of the 12 laboratories told us that the lack of DOE institutional commitment to technology partnerships as a way to accomplish program missions was an important barrier. Managers stated that technology partnerships, which cut across DOE programs, need an advocate in DOE headquarters who is not tied to a specific research area and has sufficient visibility within DOE to effectively foster technology partnerships. More specifically, managers at several Office of Science laboratories cited the need for an advocate because they believe that funding technology partnerships is a low priority within the Office of Science. They noted that when the Congress reduced the fiscal year 2002 funding for the Office of Advanced Scientific Computing Research, funding for the Laboratory Technology Research Program was disproportionately cut—from the president’s budget request of \$6.9 million to \$3 million—compared with other research programs in this office. In March 2002, the Office of Science announced that it will terminate the Laboratory Technology Research Program once its previously approved CRADAs have been funded.

Both laboratory managers and DOE headquarters officials stated that DOE’s lack of commitment to technology partnerships is caused, in part, by the cross-cutting nature of the research carried out through CRADAs and other technology transfer activities. They noted that technology partnerships often provide important results and fulfill DOE’s broader responsibility to disseminate knowledge, but the partnerships may not always be directly tied to the specific goals of a single DOE research program. As a result, these partnerships are likely to be a lower priority for research managers responsible for meeting specific goals. Because DOE’s research budgets have declined in recent years, it is even less likely that these managers will be willing to fund research activities that, while potentially valuable, extend beyond their immediate programs, according to the laboratory managers.

Finally, DOE officials noted that DOE’s Technology Transfer Working Group is not an internal advocacy group for technology transfer, but a virtual organization with no full-time permanent staff. The working group was established after DOE eliminated its full-time technology transfer organization in 1996 at the Congress’ direction. The working group, which convenes monthly by teleconference, oversees technology transfer policy and practices, identifies issues, and coordinates the DOE headquarters response to these issues. Other than through its organizational

representatives, the working group has no direct interface with Secretarial-level officials concerning matters related to resources for technology transfer and is not in a position, by itself, to serve as an advocate among top-level DOE officials for such resources.

Requirement That Partners Pay for the Laboratory's Research Costs in Advance

Managers at 9 of the 12 laboratories told us that DOE's requirement that the partner pay in advance for research conducted at the laboratory was an important barrier to technology partnerships at their laboratory. Generally, DOE requires an advance payment for about 90 days of work, if (1) a project is expected to cost more than \$25,000 and last more than 90 days or (2) the nonfederal partner will contribute more than \$25,000 for its portion of the research that DOE laboratory scientists will conduct. (For shorter or less costly projects, the partner is required to pay its entire share in advance.) Some laboratory managers told us that the advance payment requirement has presented problems in negotiating, for example, work-for-others agreements or jointly funded CRADAs with small or large businesses or with universities. While the requirement rarely stops an agreement from being signed, it has delayed negotiations, particularly when a small business cannot readily provide an upfront payment. The advance payment requirement typically is more burdensome for small businesses than large businesses because small businesses are less likely to have the funds available to prepay work, according to laboratory managers. DOE's policy permits exceptions to this requirement; for example, the contractor operating the laboratory may negotiate with DOE a smaller advance payment for a small business that is unable to meet the standard requirement.

Some laboratory managers told us that the advance payment requirement had created serious problems for small businesses that sought the laboratory's assistance as a subcontractor for a project under either the Small Business Innovation Research (SBIR) program or the Small Business Technology Transfer (STTR) program. While DOE requires an advance payment for conducting research, the SBIR and STTR programs typically provide payments for completed work, leaving the small business with the problem of providing funding to bridge this gap. Managers at one laboratory questioned the need for the advance payment requirement for an SBIR or STTR project when the payment is coming from another federal program. In some cases, the federal agency funding the SBIR or STTR project has agreed to provide some funding upfront to help cover the DOE laboratory's work. Alternatively, managers at two of the DOE laboratories told us that they have assisted partners with a bridge loan by

using an account set aside for such purposes by the contractor that operates the laboratory for DOE.

Requirements to Protect U.S. Economic Interests

Managers at 7 of 12 DOE laboratories cited the U.S. competitiveness requirements in the DOE model CRADA as an important barrier to technology partnerships at their laboratory. DOE requires that partners either manufacture substantially in the United States or provide a plan for ensuring that the partnership will result in a net economic benefit to the U.S. economy. Specifically, DOE's model CRADA states that because a purpose of the CRADA is to provide substantial benefit to the U.S. economy, partners are required to (1) substantially manufacture in the United States any products embodying the intellectual property developed under the CRADA; (2) incorporate any processes, services, and improvements developed under the CRADA into the partner's U.S. manufacturing facilities either prior to or simultaneously with implementation outside the United States; and (3) not reduce the use of such processes, services, and improvements in the United States because of their introduction elsewhere. DOE officials noted that DOE's requirements are more stringent than those in the Federal Technology Transfer Act of 1986, which requires that laboratory directors "give preference to business units located in the United States which agree that products embodying inventions made under the cooperative research and development agreement or produced through the use of such inventions will be manufactured substantially in the United States."

Some laboratory managers said that DOE's requirements have created particular difficulties for large U.S.-based multinational companies, including IBM and Procter & Gamble, that would like to collaborate with a DOE laboratory. Managers noted that multinational companies often are unwilling to sign an agreement containing DOE's competitiveness clause because of its possible implications in subsequent years on the company's strategic manufacturing decisions. Alternatively, the managers noted that companies could submit a detailed explanation to DOE of how the CRADA research will provide "alternative benefits" to the U.S. economy. They pointed out, however, that documenting alternative benefits can be a long and cumbersome process.

In addition, managers at 4 of the 12 laboratories cited as an important barrier the long delays—up to 6 months—associated with consulting the Office of the U.S. Trade Representative for CRADAs involving a company controlled by a foreign company or government. The Federal Technology Transfer Act of 1986 and Executive Order 12591 require that laboratory

directors consider whether the foreign company's government permits comparable access to U.S. companies. The executive order also requires that laboratory directors consider whether the foreign company's government has policies to protect U.S. intellectual property. Moreover, the executive order directs laboratory directors to consult with the Office of the U.S. Trade Representative in addressing these issues.

Other Issues

Managers at some of the 12 DOE laboratories cited other barriers to technology transfer, but we did not find a general consensus that these problems needed to be addressed. For example, managers at four laboratories cited administrative burdens and time delays in negotiating and signing a technology partnership agreement.

- Managers at Los Alamos National Laboratory told us that it takes about 3 months, on average, from the time funding for a CRADA is approved until the agreement is signed.
- Managers at Oak Ridge National Laboratory cited the administrative burden associated with obtaining DOE headquarters approval for technology partnerships as small as a \$5,000 technical assistance project and suggested that DOE establish a threshold below which local approval would suffice.

Managers at several laboratories, however, told us that DOE has made major improvements in reviewing CRADAs since the mid-1990s, when we reported that, on average, it took four DOE contractor-operated laboratories about 7.5 months to implement a one-collaborator, one-laboratory CRADA.⁴

Agency Comments

We provided DOE with a draft of this report for its review and comment. We met with DOE officials, including the director of the Office of Science and Technology Policy, who said that DOE found the report to be a reasonable representation of the technology partnering activities at the 12 DOE laboratories surveyed. In commending GAO for gathering pertinent data and analyzing trends and barriers, DOE stated that the report

⁴U.S. General Accounting Office, *Technology Transfer: Improving the Use of Cooperative R&D Agreements at DOE's Contractor-Operated Laboratories*, [GAO/RCED-94-91](#) (Apr. 15, 1994).

provides a sound basis for assessing the current situation and charting future directions.

DOE stated that, for purposes of portraying a broad perspective, it was helpful to include the work-for-others program among the five types of agreements most commonly used to transfer technology to U.S. businesses and other organizations. DOE also noted that a considerable amount of technology transfer takes place in the normal course of executing technical work associated with mission-related contracts and financial assistance, and that this work was not included in the report as technology transfer. While we agree with DOE that the laboratories' technology transfer activities are not limited to the five types of agreements discussed, we note that the laboratories' role in other forms of technology transfer was outside the scope of our review. DOE officials also provided comments to improve the report's technical accuracy, which we incorporated as appropriate.

Scope and Methodology

To obtain trend data on technology development partnerships, we asked managers at each of the 12 DOE laboratories to provide participation and funding data for fiscal years 1992 through 2001. To help ensure consistency across locations, we worked with these managers to establish uniform definitions and resolve any discrepancies. In addition, we (1) interviewed officials at DOE headquarters and (2) visited Argonne National Laboratory, Lawrence Berkeley National Laboratory, and Oak Ridge National Laboratory to obtain the views of administrators and scientists about their laboratories' participation in and funding of technology partnerships.

To identify any barriers that may limit DOE laboratories' efforts to transfer technology to potential nonfederal partners, we interviewed officials at DOE headquarters and obtained the views of laboratory administrators at each of the 12 DOE laboratories. We conducted our review from October 2001 through March 2002 in accordance with generally accepted government auditing standards. We did not independently verify the data provided by DOE's laboratories.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to appropriate congressional committees, the secretary of energy, the director of the

Office of Management and Budget, and other interested parties. We will also make copies available to others on request.

If you or your staff have any questions about this report, please contact me at (202) 512-3841. Key contributors to this report were Richard Cheston, Kerry Hawranek, and Susan Swearingen.

Sincerely yours,

A handwritten signature in black ink, reading "John B. Stephenson". The signature is written in a cursive style with a long horizontal line extending to the right.

John B. Stephenson
Director, Natural Resources
and Environment

Appendix I: Technology Transfer Activities of 12 DOE Laboratories

Table 5: Active Technology Transfer Agreements with Nonfederal Entities at DOE Laboratories, Fiscal Years 1992 through 2001

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
NNSA laboratories										
Lawrence Livermore National Laboratory										
CRADAs ^a	13	50	96	147	152	109	78	68	50	48
Technical assistance for small businesses	^b	0	3	15	41	19	10	2	0	0
Work-for-others	75	55	80	104	110	192	192	276	299	266
Technology licenses	^c	^c	100	158	239	260	290	312	324	342
User facilities	0	0	0	0	0	0	1	1	0	0
Los Alamos National Laboratory										
CRADAs	37	65	124	175	165	132	134	130	116	115
Technical assistance for small businesses	^b	22	75	180	85	29	0	0	0	0
Work-for-others	20	25	21	14	39	50	61	74	81	83
Technology licenses	21	34	38	41	49	58	65	97	115	68
User facilities	17	22	45	60	47	58	54	31	43	42
Sandia National Laboratories										
CRADAs	55	123	195	254	253	193	150	154	153	140
Technical assistance for small businesses	^b	0	302	393	322	292	233	257	210	109
Work-for-others	6	9	22	42	80	126	183	263	351	400
Technology licenses	16	32	49	77	178	240	273	313	362	429
User facilities	0	0	3	24	56	66	89	45	33	22
Office of Science laboratories										
Ames Laboratory										
CRADAs	1	1	5	12	6	5	3	3	4	5
Technical assistance for small businesses	0	0	0	0	0	0	0	12	1	0
Work-for-others	0	1	5	0	5	6	9	11	6	5
Technology licenses	5	5	8	9	9	11	12	16	18	18
Argonne National Laboratory										
CRADAs	12	26	57	89	85	89	61	58	56	54
Technical assistance for small businesses ^d	5	4	20	35	16	31	37	40	26	33
Work-for-others	58	45	49	50	61	82	79	76	71	74
Technology licenses	16	17	25	33	39	51	59	78	99	128
User facilities	0	0	0	25	60	128	211	291	360	419
Brookhaven National Laboratory										
CRADAs	4	16	23	58	31	41	27	25	25	34
Technical assistance for small businesses	0	0	4	5	3	4	2	6	4	0
Work-for-others ^e	1	1	0	1	2	5	12	11	14	21
Technology licenses	32 ^e	27 ^e	43 ^e	27 ^e	33 ^e	52 ^e	35 ^e	265	335	383
User facilities	172	298	316	364	413	471	488	590	629	741

**Appendix I: Technology Transfer Activities of
12 DOE Laboratories**

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Lawrence Berkeley National Laboratory										
CRADAs	2	10	21	51	55	41	31	33	31	30
Technical assistance for small businesses	0	0	0	8	6	5	2	6	5	1
Work-for-others	82	70	79	81	138	165	199	176	251	317
Technology licenses	9	14	16	28	32	35	41	55	68	89
User facilities	21	28	23	41	42	48	53	70	66	86
Oak Ridge National Laboratory										
CRADAs	37	74	143	166	205	205	221	246	256	79
Technical assistance for small businesses										
Work-for-others	106	142	98	110	130	139	138	170	198	240
Technology licenses	64	68	76	97	122	137	148	150	119	113
User facilities	42	73	109	158	241	305	354	441	486	533
Pacific Northwest National Laboratory										
CRADAs	12	26	51	70	68	53	45	47	43	38
Technical assistance for small businesses	0	0	18	64	81	74	72	69	57	53
Work-for-others ^a	2	4	4	3	6	7	5	5	5	9
Technology licenses	24	30	29	45	52	49	59	64	71	77
User facilities	0	0	0	0	0	0	21	30	50	104
Other DOE laboratories										
Idaho National Engineering and Environmental Laboratory										
CRADAs	9	23	34	45	50	46	38	34	25	32
Technical assistance for small businesses	3	5	15	42	17	16	18	2	19	17
Work-for-others	0	6	9	11	16	22	38	26	55	82
Technology licenses	2	3	8	16	36	43	51	59	64	64
National Energy Technology Laboratory										
CRADAs	13	12	13	11	27	31	37	23	23	15
Work-for-others	0	0	0	0	0	0	3	5	3	1
Technology licenses	0	0	0	0	0	1	3	3	3	5
National Renewable Energy Laboratory										
CRADAs	c	c	c	10	14	15	17	24	22	21
Work-for-others	c	c	c	8	17	19	18	33	21	29
Technology licenses	0	0	4	9	19	7	9	12	11	4
All DOE laboratories										
CRADAs	195	426	762	1,088	1,111	960	838	841	800	606
Technical assistance for small businesses	13	35	440	746	576	490	403	428	348	246
Work-for-others	350	358	367	424	604	813	917	1,126	1,355	1,527
Technology licenses	189	230	396	540	808	944	1,045	1,424	1,589	1,720
User facilities	252	421	496	672	859	1,076	1,271	1,499	1,667	2,018

^aIncludes four cost-shared procurement agreements under the Federal Acquisition Regulation that were used to expedite research and development contracts at Lawrence Livermore. This table does not include data on cost shared procurement agreements at any other laboratory.

^bFunding was made available beginning in fiscal year 1994 through DOE's Defense Programs' Small Business Initiative.

**Appendix I: Technology Transfer Activities of
12 DOE Laboratories**

^eData were not readily available.

^fIncludes technical services agreements, which are paid for by the nonfederal partner.

^gData are for new agreements only.

^hOak Ridge was unable to provide the number of technical assistance for small businesses agreements by fiscal year, but estimated that the laboratory entered into 100 of these agreements over the 10-year period.

ⁱNearly all industrially funded work at Pacific Northwest National Laboratory is conducted under Battelle's contract agreement with DOE and is not included in the work-for-others data.

Source: DOE laboratories.

Table 6: Funding Provided by Nonfederal Entities for Active Technology Partnerships with DOE Laboratories, Fiscal Years 1992 through 2001

Dollars in thousands										
Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
NNSA laboratories										
Lawrence Livermore National Laboratory										
CRADAs ^a	0	0	\$1,900	\$3,200	\$2,400	\$12,400	\$36,700	\$42,500	\$33,700	\$32,200
Work-for-others	\$4,600	\$4,000	15,500	31,800	20,600	16,400	43,800	70,500	19,600	13,400
Technology licenses	400	400	600	1,100	1,300	2,300	2,600	2,200	3,600	3,400
User facilities	0	0	0	0	0	0	0	0	0	0
Subtotal	\$5,000	\$4,400	\$18,000	\$36,100	\$24,300	\$31,100	\$83,100	\$115,200	\$56,900	\$49,000
Los Alamos National Laboratory										
CRADAs	\$6,100	\$300	\$600	\$1,500	\$1,900	\$1,900	\$2,300	\$2,300	\$2,600	\$4,400
Work-for-others	^b	8,800	4,100	8,600	12,700	16,800	13,300	16,700	14,800	14,400
Technology licenses	200	100	200	100	300	400	700	900	1,300	1,400
User facilities	200	1,600	1,600	1,100	700	2,300	800	1,000	600	200
Subtotal	\$6,500	\$10,800	\$6,500	\$11,300	\$15,600	\$21,400	\$17,100	\$20,900	\$19,300	\$20,400
Sandia National Laboratories										
CRADAs	\$4,400	\$5,800	\$10,600	\$10,600	\$12,100	\$27,200	\$32,800	\$30,100	\$38,200	\$27,650
Work-for-others	^b	^b	200	14,000	14,300	17,100	22,700	24,600	29,700	31,610
Technology licenses	100	0	100	400	700	1,700	900	1,200	2,300	3,730
User facilities	0	0	241	804	803	676	972	224	372	149
Subtotal	\$4,500	\$5,800	\$11,141	\$25,804	\$27,903	\$46,676	\$57,372	\$56,124	\$70,572	\$63,139
Office of Science laboratories										
Ames Laboratory										
CRADAs	0	\$200	0	\$77	\$174	\$150	\$130	\$111	\$122	\$842
Work-for-others	0	80	\$186	0	359	269	584	837	205	473
Technology licenses ^c	\$2	3	2	3	3	5	60	22	149	103
Subtotal	\$2	\$283	\$188	\$80	\$536	\$424	\$774	\$970	\$476	\$1,418

**Appendix I: Technology Transfer Activities of
12 DOE Laboratories**

Dollars in thousands										
Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Argonne National Laboratory										
CRADAs	\$25	\$2,500	\$5,368	\$6,262	\$3,334	\$3,023	\$3,245	\$3,602	\$3,307	\$1,797
Work-for-others	8,707	8,771	10,094	26,202	12,114	14,911	18,754	15,691	12,643	22,188
Technical services agreements ^d	96	22	19	45	44	290	320	373	835	751
Technology licenses	0	0	9	109	33	100	1,289	1,016	713	2,430
User facilities	0	0	0	0	0	3,512	1,408	3,717	3,682	3,162
Subtotal	\$8,828	\$11,293	\$15,490	\$32,618	\$15,525	\$21,836	\$25,016	\$24,399	\$21,180	\$30,328
Brookhaven National Laboratory										
CRADAs	0	0	0	\$239	\$420	\$230	\$267	\$1,756	\$972	\$4,749
Work-for-others	\$3,818	\$2,892	\$1,464	3,071	1,898	2,726	3,475	3,997	8,962	7,804
Technology licenses	539	678	853	951	889	1,350	1,650	2,800	2,100	2,400
User facilities	^b	^b	^b	^b	^b	143	172	162	296	352
Subtotal	\$4,357	\$3,570	\$2,317	\$4,261	\$3,207	\$4,449	\$5,564	\$8,715	\$12,330	\$15,305
Lawrence Berkeley National Laboratory										
CRADAs	850	\$1,504	\$1,890	\$2,448	\$3,149	\$7,469	\$7,714	\$7,198	\$5,395	\$4,329
Work-for-others	7,773	10,509	15,421	5,585	15,509	16,205	18,780	25,356	46,542	20,855
Technology licenses	31	83	65	163	133	354	561	667	881	1,107
User facilities	985	550	329	612	1,107	956	1,746	915	1,804	2,633
Subtotal	\$9,639	\$12,646	\$17,705	\$8,808	\$19,898	\$24,984	\$28,801	\$34,136	\$54,622	\$28,924
Oak Ridge National Laboratory										
CRADAs	\$1,426	\$492	\$3,065	\$2,678	\$2,267	\$6,305	\$16,263	\$14,498	\$9,077	\$11,544
Work-for-others	3,800	5,200	7,300	8,600	14,700	13,200	15,100	14,700	15,000	21,000
Technology licenses	2,919	376	520	606	888	1,228	1,423	1,480	2,412	1,902
User facilities	N/A	N/A	N/A	N/A	N/A	N/A	185	239	291	546
Subtotal	\$8,145	\$6,068	\$10,885	\$11,884	\$17,855	\$20,733	\$32,971	\$30,917	\$26,780	\$34,992
Pacific Northwest National Laboratory										
CRADAs	\$35	\$40	\$20	\$275	\$397	\$275	\$20	\$181	\$71	\$91
Work-for-others ^e	2,965	273	405	365	929	1,886	221	730	392	750
Technical assistance for small businesses ^f	0	0	0	0	600	300	0	0	50	0
Technology licenses	486	977	280	213	283	413	555	633	1,291	1,521
Subtotal	\$3,486	\$1,290	\$705	\$853	\$2,209	\$2,874	\$796	\$1,544	\$1,804	\$2,362
Other DOE laboratories										
Idaho National Engineering and Environmental Laboratory										
CRADAs	0	\$554	\$926	\$2,499	\$659	\$1,572	\$2,855	\$2,380	\$2,994	\$4,187
Work-for-others	0	0	0	3	5,373	4,476	8,306	13,765	13,577	13,804
Technology licenses	\$6	17	49	80	173	347	578	251	257	308
Subtotal	\$6	\$571	\$975	\$2,582	\$6,205	\$6,395	\$11,739	\$16,396	\$16,828	\$18,299

**Appendix I: Technology Transfer Activities of
12 DOE Laboratories**

Dollars in thousands										
Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
National Energy Technology Laboratory										
CRADAs	\$28	0	\$15	\$55	\$10	\$16	\$51	\$8	\$35	\$5
Work-for-others	0	0	0	0	0	0	75	20	0	0
Technology licenses	0	0	0	0	0	5	0	0	0	0
Subtotal	\$28	0	\$15	\$55	\$10	\$21	\$126	\$28	\$35	\$5
National Renewable Energy Laboratory										
CRADAs	^b	^b	^b	0	\$50	\$50	\$100	\$210	\$555	\$343
Work-for-others	^b	^b	^b	\$500	790	1,119	750	1,220	520	477
Technology licenses	0	0	0	20	37	31	303	690	1,600	950
Subtotal	^b	^b	^b	\$520	\$877	\$1,200	\$1,153	\$2,120	\$2,675	\$1,770
All DOE laboratories										
CRADAs	\$12,864	\$11,390	\$24,384	\$29,833	\$26,860	\$60,590	\$102,445	\$104,844	\$97,028	\$92,137
Work-for-others	31,663	40,525	54,670	98,726	99,272	105,092	145,845	188,116	161,941	146,761
Technology licenses	4,683	2,634	2,678	3,745	4,739	8,233	10,619	11,859	16,603	19,251
User facilities	1,185	2,150	2,170	2,156	2,610	7,587	5,283	6,257	7,045	7,042
Total	\$50,395	\$56,699	\$83,902	\$134,820	\$134,081	\$181,802	\$264,192	\$311,076	\$282,667	\$265,191

^aIncludes funding for four cost-shared procurement agreements under the Federal Acquisition Regulation that were used to expedite research and development contracts at Lawrence Livermore. This table does not include data on funding for cost shared procurement agreements at any other laboratory.

^bData were not readily available.

^cAmounts shown are Ames' portion of the total royalties received by Iowa State University Research Foundation per a formula in the laboratory's management and operating contract.

^dTechnical service agreements are similar to technical assistance for small business agreements; however, the nonfederal partner pays for them.

^eNearly all industrially funded work at Pacific Northwest National Laboratory is conducted under Battelle's contract agreement with DOE and is not included in the work-for-others data.

^fRepresents funding from the Tri-City Industrial Development Council, provided under section 3161 of the National Defense Authorization Act for Fiscal Year 1993, which directed DOE to provide local assistance to communities affected by the DOE Defense Nuclear Facilities Work Force Restructuring Plan. Funding for technical assistance for small businesses is not reported for the other laboratories because small businesses do not contribute funding to these agreements.

Source: DOE laboratories.

**Appendix I: Technology Transfer Activities of
12 DOE Laboratories**

Table 7: Active CRADAs at DOE Laboratories, Fiscal Years 1992 through 2001

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
NNSA laboratories										
Lawrence Livermore National Laboratory										
Newly executed CRADAs	13	42	53	67	27	30	12	14	5	10
Continuing CRADAs	0	8	43	80	125	79	62	50	41	33
Subtotal	13	50	96	147	152	109	74	64	46	43
Los Alamos National Laboratory										
Newly executed CRADAs	31	33	69	68	39	26	45	36	14	6
Continuing CRADAs	6	32	55	107	126	106	89	94	102	109
Subtotal	37	65	124	175	165	132	134	130	116	115
Sandia National Laboratories										
Newly executed CRADAs	38	69	83	65	45	33	30	52	27	37
Continuing CRADAs	17	54	112	189	208	160	120	102	126	103
Subtotal	55	123	195	254	253	193	150	154	153	140
Office of Science laboratories										
Ames Laboratory										
Newly executed CRADAs	1	0	5	11	2	1	1	1	1	3
Continuing CRADAs	0	1	0	1	4	4	2	2	3	2
Subtotal	1	1	5	12	6	5	3	3	4	5
Argonne National Laboratory										
Newly executed CRADAs	12	14	37	38	18	14	14	21	14	14
Continuing CRADAs	0	12	20	51	67	75	47	37	42	40
Subtotal	12	26	57	89	85	89	61	58	56	54
Brookhaven National Laboratory										
Newly executed CRADAs	4	12	18	33	3	11	12	13	10	13
Continuing CRADAs	0	4	5	25	28	30	15	12	15	21
Subtotal	4	16	23	58	31	41	27	25	25	34
Lawrence Berkeley National Laboratory										
Newly executed CRADAs	2	8	11	30	12	10	11	9	8	7
Continuing CRADAs	0	2	10	21	43	31	20	24	23	23
Subtotal	2	10	21	51	55	41	31	33	31	30
Oak Ridge National Laboratory										
Newly executed CRADAs	36	25	55	57	42	26	27	29	24	31
Continuing CRADAs	0	49	88	109	163	179	194	217	232	48
Subtotal	36	74	143	166	205	205	221	246	256	79
Pacific Northwest National Laboratory										
Newly executed CRADAs	11	15	30	26	13	16	14	19	7	14
Continuing CRADAs	1	11	21	44	55	37	31	28	36	24
Subtotal	12	26	51	70	68	53	45	47	43	38

**Appendix I: Technology Transfer Activities of
12 DOE Laboratories**

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Other DOE laboratories										
Idaho National Engineering and Environmental Laboratory										
Newly executed CRADAs	8	14	21	19	23	10	6	8	5	15
Continuing CRADAs	1	9	13	26	27	36	32	26	20	17
Subtotal	9	23	34	45	50	46	38	34	25	32
National Energy Technology Laboratory										
Newly executed CRADAs	8	9	11	5	18	10	17	10	5	6
Continuing CRADAs	5	3	2	6	9	21	20	13	18	9
Subtotal	13	12	13	11	27	31	37	23	23	15
National Renewable Energy Laboratory										
Newly executed CRADAs	a	a	a	5	8	3	7	11	8	10
Continuing CRADAs	a	a	a	5	6	12	10	13	14	11
Subtotal	a	a	a	10	14	15	17	24	22	21
All DOE laboratories										
Newly executed CRADAs	164	241	393	424	250	190	196	223	128	166
Continuing CRADAs	30	185	369	664	861	770	642	618	672	440
Total	194	426	762	1,088	1,111	960	838	841	800	606

^aData were not readily available.

Source: DOE laboratories.

Table 8: DOE Funding for CRADAs at DOE Laboratories, Fiscal Years 1992 through 2001

Dollars in thousands

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
NNSA laboratories										
Lawrence Livermore National Laboratory										
Energy Efficiency & Renewable Energy	0	\$300	\$400	\$900	\$700	\$200	\$1,100	\$500	\$200	\$300
Environmental Management	0	0	0	400	400	0	0	0	0	0
Environment, Safety, & Health	0	0	0	0	0	0	100	0	0	0
Defense Programs ^a	\$1,600	23,100	32,700	41,300	36,200	15,200	3,100	2,500	1,800	1,300
Other DOE funding	0	0	0	0	300	0	0	200	300	100
Subtotal	\$1,600	\$23,400	\$33,100	\$42,600	\$37,600	\$15,400	\$4,300	\$3,200	\$2,300	\$1,700
Los Alamos National Laboratory^b										
Defense Programs ^c	\$4,300	\$10,300 ^d	\$25,000 ^d	\$41,700	\$32,900	\$13,200	\$14,000	\$15,600	\$2,600	\$0
Other DOE funding	2,200	1,800	4,700	7,300	12,000	13,400	10,400	12,200	10,900	7,900
Subtotal	\$6,500	\$12,100	\$29,700	\$49,000	\$44,900	\$26,600	\$24,400	\$27,800	\$13,500	\$7,900

**Appendix I: Technology Transfer Activities of
12 DOE Laboratories**

Dollars in thousands

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Sandia National Laboratories										
Energy Efficiency & Renewable Energy	0	\$458	\$58	\$658	\$1,165	\$1,165	\$1,254	\$1,996	\$2,462	\$2,159
Defense Programs ^a	\$8,111	32,477	72,368	96,696	68,798	28,706	25,794	23,730	8,835	4,829
Defense Nuclear Nonproliferation	0	0	0	0	0	0	39	113	809	2,105
Other DOE funding	154	1,862	3,026	4,602	6,378	6,996	6,460	5,095	3,119	2,760
Subtotal	\$8,265	\$34,767	\$75,452	\$101,956	\$76,339	\$37,317	\$33,547	\$30,935	\$15,225	\$11,853
Office of Science laboratories										
Ames Laboratory										
Science ^e	0	0	\$249	\$593	\$39	0	0	\$125	\$272	\$387
Environmental Management	0	0	0	0	200	\$130	\$65	191	150	65
Environment, Safety, & Health	\$60	\$100	0	0	0	0	0	0	0	0
Subtotal	\$60	\$100	\$249	\$593	\$239	\$130	\$65	\$316	\$422	\$452
Argonne National Laboratory										
Science ^e	\$1,946	\$1,655	\$5,774	\$9,503	\$4,133	\$3,496	\$2,677	\$2,408	\$1,318	\$2,227
Fossil Energy	0	230	1,486	1,675	1,824	810	472	544	174	269
Energy Efficiency & Renewable Energy	31	28	127	787	2,050	2,207	2,139	1,106	1,597	2,414
Environmental Management	0	0	14	148	140	152	8	0	0	0
Nuclear Energy	0	0	0	39	361	307	35	0	0	0
Defense Nuclear Nonproliferation	0	0	0	54	799	1,075	878	655	0	250
Subtotal	\$1,977	\$1,913	\$7,401	\$12,206	\$9,307	\$8,047	\$6,209	\$4,713	\$3,089	\$5,160
Brookhaven National Laboratory										
Science ^e	\$394	\$300	\$3,404	\$7,623	\$2,158	\$3,634	\$2,654	\$1,756	\$2,207	\$1,826
Defense Nuclear Nonproliferation	0	0	0	0	0	0	0	0	1,540	1,265
Subtotal	\$394	\$300	\$3,404	\$7,623	\$2,158	\$3,634	\$2,654	\$1,756	\$3,747	\$3,091
Lawrence Berkeley National Laboratory										
Science ^e	\$81	\$841	\$1,725	\$4,951	\$4,551	\$2,976	\$2,073	\$2,311	\$1,851	\$1,669
Energy Efficiency & Renewable Energy	0	0	0	0	0	0	0	0	588	588
Environment, Safety, & Health	0	0	0	0	0	0	0	0	53	53
Defense Nuclear Nonproliferation	0	0	0	0	49	241	584	434	861	620
Subtotal	\$81	\$841	\$1,725	\$4,951	\$4,600	\$3,217	\$2,657	\$2,745	\$3,353	\$2,930

**Appendix I: Technology Transfer Activities of
12 DOE Laboratories**

Dollars in thousands

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Oak Ridge National Laboratory										
Science ^o	\$1,467	\$2,363	\$17,677	\$11,446	\$1,072	\$7,891	\$5,302	\$2,040	\$4,349	\$2,459
Fossil Energy	20	70	1,670	325	220	750	245	250	310	877
Energy Efficiency & Renewable Energy	5,502	5,418	4,664	8,329	7,615	17,475	8,120	3,245	16,648	26,261
Environmental Management	1,020	2,300	125	50	5,270	100	0	0	0	930
Nuclear Energy	1,075	0	0	1,000	670	1,075	0	0	0	670
Defense Programs ^a	0	30,137	13,074	3,293	352	3,090	0	0	10,182	0
Other DOE funding	0	0	205	30	90	0	20	0	357	0
Subtotal	\$9,084	\$40,288	\$37,415	\$24,473	\$15,289	\$30,381	\$13,687	\$5,535	\$31,846	\$31,197
Pacific Northwest National Laboratory										
Science ^o	\$695	\$700	\$13,536	\$6,207	\$3,376	\$3,414	\$2,485	\$2,975	\$1,726	\$2,346
Fossil Energy	0	200	400	100	75	0	0	200	1,108	2,500
Energy Efficiency & Renewable Energy	540	295	950	1,255	1,494	2,590	2,435	2,348	1,775	3,355
Environmental Management	230	1,238	100	1,565	700	0	0	0	0	0
Defense Nuclear Nonproliferation	0	0	0	100	0	72	1,051	540	922	1,201
Other DOE funding	100	0	210	0	0	0	0	0	0	0
Subtotal	\$1,565	\$2,433	\$15,196	\$9,227	\$5,645	\$6,076	\$5,971	\$6,063	\$5,531	\$9,402
Other DOE laboratories										
Idaho National Engineering and Environmental Laboratory										
Science	0	\$520	\$960	\$562	\$873	0	0	\$30	\$392	\$330
Fossil Energy	0	250	125	175	500	\$350	\$750	775	500	403
Energy Efficiency & Renewable Energy	0	525	317	1,825	1,552	1,773	255	4	456	1,211
Environmental Management	\$455	0	93	900	2,175	1,562	1,275	851	610	150
Nuclear Energy	318	0	400	0	430	50	110	0	0	0
Other DOE funding	20	20	191	1,124	655	0	279	286	300	500
Subtotal	\$793	\$1,315	\$2,086	\$4,586	\$6,185	\$3,735	\$2,669	\$1,946	\$2,258	\$2,594
National Energy Technology Laboratory										
Fossil Energy	\$1,123	\$260	\$4,486	\$1,667	\$900	\$1,102	\$925	\$1,550	\$3,022	\$1,472
National Renewable Energy Laboratory										
Energy Efficiency & Renewable Energy				\$260	\$1,800	\$2,500	\$1,350	\$1,300	\$3,700	\$4,400

**Appendix I: Technology Transfer Activities of
12 DOE Laboratories**

Dollars in thousands

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
All DOE laboratories										
Science	\$4,853	\$6,379	\$43,325	\$40,885	\$16,202	\$21,411	\$15,191	\$11,645	\$12,115	\$11,244
Fossil Energy	1,143	1,010	8,167	3,942	3,519	3,012	2,392	3,319	5,114	5,521
Energy Efficiency & Renewable Energy	6,073	7,024	6,516	14,014	16,576	28,490	16,718	10,690	27,576	40,753
Environmental Management	1,765	3,638	332	3,063	8,685	1,814	1,283	851	610	1,080
Environment, Safety & Health	0	0	0	0	0	0	100	0	53	53
Nuclear Energy	1,393	0	400	1,039	1,461	1,432	145	0	0	670
Defense Programs	14,011	95,984	143,142	182,989	138,248	60,196	42,894	41,830	23,417	6,129
Defense Nuclear Nonproliferation	0	0	0	154	848	1,388	2,552	1,742	4,132	5,441
Other DOE funding	2,474	3,682	8,332	13,056	19,423	20,396	17,159	17,781	14,976	11,260
Total	\$31,442	\$117,717	\$210,214	\$259,142	\$204,962	\$138,139	\$98,434	\$87,859	\$87,993	\$82,151

^aIncludes funding from the Technology Partnership Program.

^bLos Alamos did not have readily available data on funding from individual DOE programs.

^cTechnology Partnership Program funding only.

^dPlanned Technology Partnership Program funding. Actual data were not readily available.

^eIncludes funding from the Laboratory Technology Research Program.

^fData were not readily available.

Source: DOE laboratories.

Table 9: Funding and In-kind Support for CRADAs from Nonfederal Partners, Fiscal Years 1992 through 2001

Dollars in thousands

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
NNSA laboratories										
Lawrence Livermore National Laboratory										
Funding from partner(s)	0	0	\$1,900	\$3,200	\$2,400	\$12,400	\$28,600	\$31,300	\$20,900	\$19,200
In-kind support from partner(s)	a	a	a	a	a	a	a	a	a	a
Subtotal	a	a	a	a	a	a	a	a	a	a

**Appendix I: Technology Transfer Activities of
12 DOE Laboratories**

Dollars in thousands										
Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Los Alamos National Laboratory										
Funding from partner(s)	\$6,100	\$300	\$600	\$1,500	\$1,900	\$1,900	\$2,300	\$2,300	\$2,600	\$4,400
In-kind support from partner(s)	5,700	14,100	36,000	42,700	46,600	43,400	42,500	46,200	35,100	27,900
Subtotal	\$11,800	\$14,400	\$36,600	\$44,200	\$48,500	\$45,300	\$44,800	\$48,500	\$37,700	\$32,300
Sandia National Laboratories										
Funding from partner(s)	\$4,400	\$5,800	\$10,600	\$10,600	\$12,100	\$27,200	\$32,800	\$30,100	\$38,200	\$27,650
In-kind support from partner(s)	13,200	44,100	79,000	94,600	76,900	77,900	73,300	61,900	41,400	67,130
Subtotal	\$17,600	\$49,900	\$89,600	\$105,200	\$89,000	\$105,100	\$106,100	\$92,000	\$79,600	\$94,780
Office of Science laboratories										
Ames Laboratory										
Funding from partner(s)	0	0	0	\$77	\$174	\$150	\$130	\$111	\$122	\$16
In-kind support from partner(s)	0	\$219	\$19	51	96	74	20	125	189	826
Subtotal	0	\$219	\$19	\$128	\$270	\$224	\$150	\$236	\$311	\$842
Argonne National Laboratory										
Funding from partner(s)	\$25	\$2,500	\$5,368	\$6,262	\$3,334	\$3,023	\$3,245	\$3,602	\$3,307	\$1,797
In-kind support from partner(s)	2,109	2,860	49,334	16,844	40,999	4,573	38,550	14,922	10,895	9,328
Subtotal	\$2,134	\$5,360	\$54,702	\$23,106	\$44,333	\$7,596	\$41,795	\$18,524	\$14,202	\$11,125
Brookhaven National Laboratory										
Funding from partner(s)	0	0	0	\$239	\$420	\$230	\$267	\$1,756	\$972	\$4,749
In-kind support from partner(s)	\$400	\$1,460	\$5,329	11,800	7,767	7,616	4,332	4,205	5,163	7,600
Subtotal	\$400	\$1,460	\$5,329	\$12,039	\$8,187	\$7,846	\$4,599	\$5,961	\$6,135	\$12,349
Lawrence Berkeley National Laboratory										
Funding from partner(s)	\$850	\$1,504	\$1,890	\$2,448	\$3,149	\$7,469	\$7,714	\$7,198	\$5,395	\$4,329
In-kind support from partner(s)	0	0	3,650	8,984	6,377	5,178	5,489	6,321	5,437	3,928
Subtotal	\$850	\$1,504	\$5,540	\$11,432	\$9,526	\$12,647	\$13,203	\$13,519	\$10,832	\$8,257
Oak Ridge National Laboratory										
Funding from partner(s)	\$1,426	\$492	\$3,065	\$2,678	\$2,267	\$6,305	\$1,623	\$14,498	\$9,077	\$11,544
In-kind support from partner(s)	6,824	45,324	34,238	27,409	28,498	20,137	8,580	15,948	33,411	37,229
Subtotal	\$8,250	\$45,816	\$37,303	\$30,087	\$30,765	\$26,442	\$10,203	\$30,445	\$42,488	\$48,774

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Dollars in thousands										
Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Pacific Northwest National Laboratory										
Funding from partner(s)	\$35	\$40	\$20	\$275	\$397	\$275	\$20	\$181	\$71	\$91
In-kind support from partner(s)	1,375	2,198	14,829	8,842	5,492	6,146	6,956	6,746	5,929	8,251
Subtotal	\$1,410	\$2,238	\$14,849	\$9,117	\$5,889	\$6,421	\$6,976	\$6,927	\$6,000	\$8,342
Other DOE laboratories										
Idaho National Engineering and Environmental Laboratory										
Funding from partner(s)	0	\$554	\$926	\$2,499	\$659	\$1,572	\$2,855	\$2,380	\$2,994	\$4,187
In-kind support from partner(s)	\$618	1,353	2,557	9,821	17,702	12,634	5,001	4,501	6,775	7,016
Subtotal	\$618	\$1,907	\$3,483	\$12,320	\$18,361	\$14,206	\$7,856	\$6,881	\$9,769	\$11,203
National Energy Technology Laboratory										
Funding from partner(s)	\$28	0	\$15	\$55	\$10	\$16	\$51	\$8	\$35	\$5
In-kind support from partner(s)	252	\$369	12,328	1,571	686	816	1,318	1,035	5,297	3,857
Subtotal	\$280	\$369	\$12,343	\$1,626	\$696	\$832	\$1,369	\$1,043	\$5,332	\$3,862
National Renewable Energy Laboratory										
Funding from partner(s)	0	0	0	0	\$50	\$50	\$100	\$210	\$555	\$343
In-kind support from partner(s)	^a	^a	^a	\$250	1,700	2,500	1,350	1,300	3,500	4,341
Subtotal	^a	^a	^a	\$250	\$1,750	\$2,550	\$1,450	\$1,510	\$4,055	\$4,684
All DOE laboratories										
Funding from partner(s)	\$12,864	\$11,190	\$24,384	\$29,833	\$26,860	\$60,590	\$79,705	\$93,644	\$84,228	\$78,311
In-kind support from partner(s)	30,478	111,983	237,284	222,872	232,817	180,974	187,396	163,203	153,096	177,406
Total	\$43,342	\$123,173	\$261,668	\$252,705	\$259,677	\$241,564	\$267,101	\$256,847	\$237,324	\$255,718

^aData were not readily available

Source: DOE laboratories.

**Appendix I: Technology Transfer Activities of
12 DOE Laboratories**

Table 10: Active CRADAs by the Type of Financial Support That Nonfederal Partners Provided, Fiscal Years 1992 through 2001

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
NNSA laboratories										
Lawrence Livermore National Laboratory										
Partner(s) provides all funding	0	0	1	13	20	22	21	32	28	30
Partner(s) provides some funding	0	0	0	3	4	6	7	2	1	0
Partner(s) provides only in-kind contributions	13	50	95	131	128	81	46	30	17	13
Subtotal	13	50	96	147	152	109	74	64	46	43
Los Alamos National Laboratory										
Partner(s) provides all funding	0	0	5	5	3	1	3	7	8	7
Partner(s) provides some funding	1	2	5	10	8	8	8	11	7	7
Partner(s) provides only in-kind contributions	36	63	114	160	154	123	123	112	101	101
Subtotal	37	65	124	175	165	132	134	130	116	115
Sandia National Laboratories										
Partner(s) provides all funding	35	76	104	96	86	70	42	40	41	48
Partner(s) provides some funding	6	19	29	36	41	31	37	49	49	41
Partner(s) provides only in-kind contributions	3	16	53	102	110	77	64	53	49	37
Subtotal^a	55	123	195	254	253	193	150	154	153	140
Office of Science laboratories										
Ames Laboratory										
Partner(s) provides all funding	0	0	0	0	0	0	1	0	0	0
Partner(s) provides some funding	1	1	0	1	4	2	1	1	1	2
Partner(s) provides only in-kind contributions	0	0	5	11	2	3	1	2	3	3
Subtotal	1	1	5	12	6	5	3	3	4	5
Argonne National Laboratory										
Partner(s) provides all funding	0	2	3	5	6	6	8	10	9	8
Partner(s) provides some funding	1	1	4	5	2	3	6	6	3	6
Partner(s) provides only in-kind contributions	11	23	50	79	77	80	47	42	44	40
Subtotal	12	26	57	89	85	89	61	58	56	54

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Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Brookhaven National Laboratory										
Partner(s) provides all funding	0	0	0	1	2	0	2	2	3	9
Partner(s) provides some funding	0	0	0	2	0	2	2	5	2	1
Partner(s) provides only in-kind contributions	4	12	18	30	1	9	4	6	5	3
Subtotal^p	4	16	23	58	31	41	27	25	25	34
Lawrence Berkeley National Laboratory										
Partner(s) provides all funding	1	1	1	2	8	8	4	7	8	6
Partner(s) provides some funding	1	6	6	16	15	12	12	13	11	12
Partner(s) provides only in-kind contributions	0	3	14	33	32	21	15	13	12	12
Subtotal	2	10	21	51	55	41	31	33	31	30
Oak Ridge National Laboratory										
Partner(s) provides all funding	0	0	0	7	17	21	29	33	43	20
Partner(s) provides some funding	17	16	21	23	34	44	51	54	69	0
Partner(s) provides only in-kind	20	58	122	136	154	140	141	159	144	59
Subtotal	37	74	143	166	205	205	221	246	256	79
Pacific Northwest National Laboratory										
Partner(s) provides all funding	0	1	0	0	2	1	0	1	1	2
Partner(s) provides some funding	1	0	1	2	1	1	1	3	4	0
Partner(s) provides only in-kind	11	25	50	68	65	51	44	43	38	36
Subtotal	12	26	51	70	68	53	45	47	43	38
Other DOE laboratories										
Idaho National Engineering and Environmental Laboratory										
Partner(s) provides all funding	0	0	3	4	4	4	1	1	5	6
Partner(s) provides some funding	0	4	5	2	8	9	5	4	4	7
Partner(s) provides only in-kind contributions	9	19	26	39	38	33	32	29	16	19
Subtotal	9	23	34	45	50	46	38	34	25	32
National Energy Technology Laboratory										
Partner(s) provides all funding	0	0	0	0	0	0	0	0	0	0
Partner(s) provides some funding	2	0	2	2	1	2	5	3	6	4
Partner(s) provides only in-kind contributions	11	12	11	9	26	29	32	20	17	11
Subtotal	13	12	13	11	27	31	37	23	23	15
National Renewable Energy Laboratory										
Partner(s) provides all funding	c	c	c	0	0	0	2	3	3	3
Partner(s) provides some funding	c	c	c	0	2	2	4	6	8	8
Partner(s) provides only in-kind contributions	c	c	c	10	12	13	11	15	11	10
Subtotal	c	c	c	10	14	15	17	24	22	21

**Appendix I: Technology Transfer Activities of
12 DOE Laboratories**

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
All DOE laboratories										
Partner(s) provides all funding	36	80	117	132	146	133	111	134	146	130
Partner(s) provides some funding	30	49	73	100	120	120	137	152	163	87
Partner(s) provides only in-kind contributions	116	269	540	778	798	651	556	518	452	341
Total	195	426	762	1,088	1,111	960	838	841	800	606

^aSome agreements at Sandia did not fall into any of these categories, but are reflected in the subtotal and the total for all laboratories.

^bBrookhaven was only able to provide a breakdown by type of financial support for new agreements, but all agreements are included in the subtotal and the total for all laboratories.

^cData were not readily available.

Source: DOE laboratories.

Table 11: Types of Organizations Entering into Technology Transfer Agreements with DOE Laboratories, Fiscal Year 1999 through 2001

Facility	CRADAs			Work for others		
	Fiscal year			Fiscal year		
	1999	2000	2001	1999	2000	2001
NNSA laboratories						
Lawrence Livermore National Laboratory						
Small business	20	18	20	84	87	64
Intermediate or large business	39	23	20	65	82	78
University or other nonprofit	5	5	2	127	130	124
Consortium or multiparticipant agreement	0	0	1	0	0	0
Subtotal	64	46	43	276	299	266
Los Alamos National Laboratory						
Small business	52	46	36	6	11	5
Intermediate or large business	74	66	55	12	8	3
University or other nonprofit	2	4	3	10	8	8
Consortium or multiparticipant agreement	21	17	12	0	0	0
Subtotal	149^a	133^a	106^a	28^b	27^b	16^b
Sandia National Laboratories^c						
Small business	49	43	42	46	73	83
Intermediate or large business	111	115	101	204	268	284
University or other nonprofit	7	6	2	24	29	42
Consortium or multiparticipant agreement	30	28	17	2	4	7
Subtotal	197	192	162	276	374	416

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Facility	CRADAs			Work for others		
	Fiscal year			Fiscal year		
	1999	2000	2001	1999	2000	2001
Office of Science laboratories						
Ames Laboratory						
Small business	1	1	2	2	2	2
Intermediate or large business	1	1	1	5	3	1
University or other nonprofit	0	0	0	4	1	2
Consortium or multiparticipant agreement	1	2	2	0	0	0
Subtotal	3	4	5	11	6	5
Argonne National Laboratory						
Small business	25	24	23	13	14	17
Intermediate or large business	12	16	17	30	28	22
University or other nonprofit	3	4	2	33	29	35
Consortium or multiparticipant agreement	18	12	12	0	0	0
Subtotal	58	56	54	76	71	74
Brookhaven National Laboratory						
Small business	7	5	9	0	2	2
Intermediate or large business	3	5	3	2	0	5
University or other nonprofit	1	0	0	6	7	13
Consortium or multiparticipant agreement	0	0	0	0	0	0
Subtotal^f	11	10	12	8	9	20
Lawrence Berkeley National Laboratory						
Small business	15	12	12	14	17	21
Intermediate or large business	17	18	17	14	10	20
University or other nonprofit	0	0	0	93	31	124
Consortium or multiparticipant agreement	1	1	1	0	0	0
Subtotal	33	31	30	121	58	165
Oak Ridge National Laboratory						
Small business	8	10	9	5	11	13
Intermediate or large business	19	13	17	7	7	9
University or other nonprofit	0	0	0	10	10	18
Consortium or multiparticipant agreement	2	0	4	5	4	4
Subtotal^p	29	23	30	27	32	44
Pacific Northwest National Laboratory						
Small business	18	13	7	0	0	0
Intermediate or large business	17	20	22	2	4	8
University or other nonprofit	2	1	0	3	1	1
Consortium or multiparticipant agreement	10	9	9	0	0	0
Subtotal	47	43	38	5	5	9

**Appendix I: Technology Transfer Activities of
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Facility	CRADAs			Work for others		
	Fiscal year			Fiscal year		
	1999	2000	2001	1999	2000	2001
Other DOE laboratories						
Idaho National Engineering and Environmental Laboratory						
Small business	9	6	8	6	3	2
Intermediate or large business	12	10	13	18	48	75
University or other nonprofit	1	1	1	2	4	5
Consortium or multiparticipant agreement	12	8	10	0	0	0
Subtotal	34	25	32	26	55	82
National Energy Technology Laboratory						
Small business	13	9	3	3	1	1
Intermediate or large business	9	11	9	1	1	0
University or other nonprofit	1	3	3	1	1	0
Consortium or multiparticipant agreement	0	0	0	0	0	0
Subtotal	23	23	15	5	3	1
National Renewable Energy Laboratory						
Small business	10	9	8	13	8	12
Intermediate or large business	11	10	10	17	12	14
University or other nonprofit	2	2	2	2	1	2
Consortium or multiparticipant agreement	1	1	1	1	0	1
Subtotal	24	22	21	33	21	29
All DOE laboratories						
Small business	227	196	179	192	229	222
Intermediate or large business	325	308	285	377	471	519
University or other nonprofit	24	26	15	315	252	374
Consortium or multiparticipant agreement	96	78	68	8	8	12
Total	672	608	547	892	960	1,127

^aThe number of CRADAs for Los Alamos and Sandia National Laboratories, and the number of work for other agreements for Sandia, are greater than the totals for these laboratories reported in other tables in this report because Los Alamos and Sandia have agreements with partner types that they consider to be in more than one category.

^bData are for new agreements only.

Source: DOE laboratories.

Table 12: Active Work-for-Other Agreements at DOE Laboratories, Fiscal Years 1992 through 2001

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
NNSA laboratories										
Lawrence Livermore National Laboratory										
Newly executed agreements	a	a	a	a	a	a	a	a	a	a
Continuing agreements	a	a	a	a	a	a	a	a	a	a
Subtotal	75	55	80	104	110	192	192	276	299	266

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Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Los Alamos National Laboratory										
Newly executed agreements	11	13	8	8	22	38	39	42	35	44
Continuing agreements	9	12	13	6	17	12	22	32	46	39
Subtotal	20	25	21	14	39	50	61	74	81	83
Sandia National Laboratories										
Newly executed agreements	2	3	13	21	39	54	93	152	155	139
Continuing agreements	4	6	9	21	41	72	90	111	196	261
Subtotal	6	9	22	42	80	126	183	263	351	400
Office of Science laboratories										
Ames Laboratory										
Newly executed agreements	0	1	4	0	5	2	3	6	0	2
Continuing agreements	0	0	1	0	0	4	6	5	6	3
Subtotal	0	1	5	0	5	6	9	11	6	5
Argonne National Laboratory										
Newly executed agreements	28	21	28	26	35	57	41	33	32	45
Continuing agreements	30	24	21	24	26	25	38	43	39	29
Subtotal	58	45	49	50	61	82	79	76	71	74
Brookhaven National Laboratory										
Newly executed agreements	1	1	0	1	2	5	12	11	14	21
Continuing agreements	0	0	0	0	0	0	0	0	0	0
Subtotal	1	1	0	1	2	5	12	11	14	21
Lawrence Berkeley National Laboratory										
Newly executed agreements	35	36	37	32	67	69	84	99	91	143
Continuing agreements	47	34	42	49	71	96	115	77	160	174
Subtotal	82	70	79	81	138	165	199	176	251	317
Oak Ridge National Laboratory										
Newly executed agreements	6	4	10	8	16	17	15	27	28	39
Continuing agreements	100	138	88	102	114	122	123	143	170	201
Subtotal	106	142	98	110	130	139	138	170	198	240
Pacific Northwest National Laboratory										
Newly executed agreements	2	4	1	0	3	1	0	2	2	6
Continuing agreements	0	0	3	3	3	6	5	3	3	3
Subtotal	2	4	4	3	6	7	5	5	5	9
Other DOE laboratories										
Idaho National Engineering and Environmental Laboratory										
Newly executed agreements	0	6	7	11	16	19	34	18	36	48
Continuing agreements	0	0	2	0	0	3	4	8	19	34
Subtotal	0	6	9	11	16	22	38	26	55	82
National Energy Technology Laboratory										
Newly executed agreements	0	0	0	0	0	0	3	2	0	0
Continuing agreements	0	0	0	0	0	0	0	3	3	1
Subtotal	0	0	0	0	0	0	3	5	3	1

**Appendix I: Technology Transfer Activities of
12 DOE Laboratories**

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
National Renewable Energy Laboratory										
Newly executed agreements	a	a	a	6	14	13	13	29	16	23
Continuing agreements	a	a	a	2	3	6	5	4	5	6
Subtotal	a	a	a	8	17	19	18	33	21	29
All DOE laboratories										
Newly executed agreements	85	89	108	113	219	275	337	421	409	510
Continuing agreements	190	214	179	207	275	346	408	429	647	751
Total	350	358	367	424	604	813	937	1,126	1,355	1,527

^aData were not readily available.

Source: DOE laboratories.

Table 13: Active Licenses of DOE Laboratory Technology, Fiscal Years 1992 through 2001

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
NNSA laboratories										
Lawrence Livermore National Laboratory										
Newly executed agreements	a	a	36	57	81	64	49	35	33	36
Continuing agreements	a	a	64	101	158	196	241	277	291	306
Subtotal	a	a	100	158	239	260	290	312	324	342
Los Alamos National Laboratory										
Newly executed agreements	9	12	6	5	15	11	11	38	30	20
Continuing agreements	12	22	32	36	34	47	54	59	85	48
Subtotal	21	34	38	41	49	58	65	97	115	68
Sandia National Laboratories										
Newly executed agreements	8	17	17	27	102	64	38	49	57	69
Continuing agreements	8	15	32	50	76	176	235	264	305	360
Subtotal	16	32	49	77	178	240	273	313	362	429
Office of Science laboratories										
Ames Laboratory										
Newly executed agreements	1	0	4	1	1	4	2	4	2	1
Continuing agreements	4	5	4	8	8	7	10	12	16	17
Subtotal	5	5	8	9	9	11	12	16	18	18
Argonne National Laboratory										
Newly executed agreements	2	1	8	8	6	14	10	20	21	29
Continuing agreements	14	16	17	25	33	37	49	58	78	99
Subtotal	16	17	25	33	39	51	59	78	99	128
Brookhaven National Laboratory										
Newly executed agreements	32	27	43	27	33	52	35	63	59	80
Continuing agreements	a	a	a	a	a	a	a	202	276	303
Subtotal	a	a	a	a	a	a	a	265	335	383

**Appendix I: Technology Transfer Activities of
12 DOE Laboratories**

Facility	Fiscal year									
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Lawrence Berkeley National Laboratory										
Newly executed agreements	2	10	4	13	7	10	9	20	18	24
Continuing agreements	7	4	12	15	25	25	32	35	50	65
Subtotal	9	14	16	28	32	35	41	55	68	89
Oak Ridge National Laboratory										
Newly executed agreements	13	18	23	28	23	23	19	13	7	18
Continuing agreements	51	50	53	69	99	114	129	137	112	105
Subtotal	64	68	76	97	122	137	148	150	119	123
Pacific Northwest National Laboratory										
Newly executed agreements	2	10	4	17	10	8	9	12	6	8
Continuing agreements	22	20	25	28	42	41	50	52	65	69
Subtotal	24	30	29	45	52	49	59	64	71	77
Other DOE laboratories										
Idaho National Engineering and Environmental Laboratory										
Newly executed agreements	2	1	5	8	22	9	14	10	10	13
Continuing agreements	0	2	3	8	14	34	37	49	54	51
Subtotal	2	3	8	16	36	43	51	59	64	64
National Energy Technology Laboratory										
Newly executed agreements	0	0	0	0	0	1	2	0	0	2
Continuing agreements	0	0	0	0	0	0	1	3	3	3
Subtotal	0	0	0	0	0	1	3	3	3	5
National Renewable Energy Laboratory										
Newly executed agreements	0	0	4	6	11	1	4	6	7	2
Continuing agreements	0	0	0	3	8	6	5	6	4	2
Subtotal	0	0	4	9	19	7	9	12	11	4
All DOE laboratories										
Newly executed agreements	71	96	154	197	311	261	202	270	250	302
Continuing agreements	118	134	242	343	497	683	843	1,154	1,339	1,428
Total	189	230	396	540	808	944	1,045	1,424	1,589	1,730

*Data were not readily available.

Source: DOE laboratories.

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