Summary Report on Federal Laboratory Technology Transfer

FY 2003 Activity Metrics and Outcomes

2004 Report to the President and the Congress
under the Technology Transfer and Commercialization Act

Office of the Secretary
U.S. Department of Commerce

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Foreword

America's economy and technology sectors lead the world, thanks in large measure to our well developed capacity for innovation. Even so, the forces of economic globalization continue to gain momentum and are changing trade, technology sourcing, capital flows, and the movement of technical talent in significant ways. Our present leadership notwithstanding, we are likely in the years ahead to face more significant challenges to our innovative capacity and long-term competitiveness than ever before.

In its May 2003 report, the President's Council of Advisors on Science and Technology (PCAST) emphasized the critical role that transfer of federally funded research and development results has played in helping to move ideas from the realm of research into commerce and the marketplace. Indeed, the effective transfer of federal technology -- that is, diffusing the new knowledge and inventions created by federal research and development funds to American firms and entrepreneurs with the capabilities to translate these advances into commercially significant products and processes -- will likely continue to be essential in sustaining U.S. competitiveness and leadership in the global economy in the years ahead.

America's federal laboratory system, comprised by world-class scientists and research facilities, is a key element of the Nation's infrastructure for innovation. The federal labs offer a critical and fertile resource for early-stage, high-risk research and development -- the kind of work on basic science and basic technology that gives rise to revolutionary new know-how and technologies with the prospect of important commercial impacts.

Congress has mandated -- through several significant pieces of legislation since 1980 -- that part of the federal labs' mission be to promote the transfer of federal technology. And, indeed, federal lab technology transfer activities to date have contributed significantly to the national technology transfer success story the PCAST report describes.

Recognizing the importance of this role and national policymakers' continued interest that the Nation's technology transfer policies perform as effectively as possible, Congress has asked the Department of Commerce to regularly report on the status of technology transfer by the federal labs. This latest report edition provides current evidence that the federal labs' participation in the technology transfer process continues to grow, with numerous examples cited of transferred federal technology and industry-federal lab research and development cooperation having provided a basis for new products and processes with commercial significance and often also enhanced federal lab capabilities.

Carlos M. Gutierrez
Secretary of Commerce

Acknowledgments

This report was assembled and drafted by the Office of Technology Policy, Technology Administration, Department of Commerce.

The Office of Technology Policy appreciates the effort and cooperation of senior technology transfer personnel at the ten federal agencies whose federal lab technology transfer activities are documented in this report: the Departments of Agriculture, Defense, Energy, Health and Human Services, Interior, Transportation, and Veterans Affairs; the Environmental Protection Agency; and the National Aeronautics and Space Administration; in addition to the Department of Commerce's own federal labs.

Questions about the statistics or other content of this report should be directed to Mark Boroush, Office of Technology Policy, at 202.482.6394.

Chapter 1
Purpose and Summary of Major Findings

1.1 Background

This *Summary Report* provides an updated review and analysis of the federal laboratories'[1] utilization of the technology transfer authorities provided to them under federal law.[2] This is a new edition of the annual report series for the President and Congress established under the Technology Transfer Commercialization Act of 2000 (P.L. 106-404, signed November 1, 2000).[3] The present report covers the technology transfer activities of the federal laboratories through FY 2003.

Periodic reporting to the President and Congress on the vigor of federal laboratory technology transfer has been a statutory requirement since 1986 under the Stevenson-Wydler Technology Innovation Act of 1980.[4] From 1987 through early 2002, the Office of Technology Policy (OTP) at the Department of Commerce prepared Biennial Reports in response to this requirement.[5] In late 2000, the Technology Transfer Commercialization Act revised and enlarged the existing Stevenson-Wydler Act reporting process. This revised reporting process took effect in calendar year 2002, in conjunction with the FY 2003 federal budget cycle and agencies' reports on their FY 2001 technology transfer activities.

Under the new law, reporting responsibilities operate along two tracks. Each federal agency that operates or directs federal laboratories (or engages in patenting or licensing of federally owned inventions) is required to provide the Office of Management and Budget with an annual report on its technology transfer plans and recent achievements as part of its annual budget submission.[6] The

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[1]"Federal labs" refers to government-owned or -leased/federally staffed facilities for performing research, development, or engineering activities relevant to an agency's missions and interests. The government-owned but contractor-operated facilities with a similar purpose also fall under the "federal lab" title. The U.S. federal lab system presently encompasses more than 700 federal labs and research centers, including the Department of Energy's "national laboratories."

[2] Most notably, the Technology Innovation Act of 1980 (often referred to as the Stevenson-Wydler Act) and the University and Small Business Patent Procedures Act of 1980 (often referred to as the Bayh-Dole Act). The Stevenson-Wydler Act (P.L. 96-480, 15 U.S.C. Sec. 3701-3714) and Bayh-Dole Act (P.L. 96-517, 35 U.S.C. Sec. 200-211) remain the primary statutory moorings for technology transfer between the federal laboratories and the private sector. Since the mid-1980s, however, there has been continuing congressional review of agency experiences in implementing these laws, which has resulted in amending legislation to both Stevenson-Wydler and Bayh-Dole.

[3] The immediately prior Summary Report is U.S. Department of Commerce, *Summary Report on Federal Laboratory Technology Transfer: Agency Approaches; FY 2001 Activity Metrics and Outcomes*, September 2002 (www.technology.gov/Reports.htm).

[4] The Federal Technology Transfer Act of 1986 (P.L. 99-502) amended the Stevenson-Wydler Act in several respects, including adding a requirement for the Biennial Report.

[5] The most recent Biennial Report is Office of Technology Policy, U.S. Department of Commerce, *Recent Trends in Federal Lab Technology Transfer: FY 1999–2000 Biennial Report*, May 2002 (www.technology.gov/Reports.htm).

[6] Since July 2003, this agency technology transfer reporting has been a part of the Office of Management and Budget's *Circular A-11* guidance to federal agencies for preparation of annual budget documents (see Part 2, Section 25.5, Table 1).

Secretary of Commerce subsequently prepares an overall federal assessment for the President and Congress based on the program information in these agency reports.[7]

In its May 2003 report on the topic, the President's Council of Advisors on Science and Technology (PCAST) emphasized the critical role that transfer of federally funded research and development results has and continues to play in moving ideas from the realm of research into commerce and the marketplace.[8] The request for regular public reporting -- to which this present report responds -- reflects national policymakers' interest in ensuring that the Nation's technology transfer policies perform as effectively as possible.[9]

1.2 Scope of this Report

Ten major federal agencies have significant federal laboratory operations.[10] This *Summary Report* provides activity statistics and other performance information about each:

- Department of Agriculture (USDA)
- Department of Commerce (DOC)
- Department of Defense (DOD)
- Department of Energy (DOE)
- Environmental Protection Agency (EPA)
- Department of Health and Human Services (HHS)
- Department of the Interior (DOI)
- National Aeronautics and Space Administration (NASA)
- Department of Transportation (DOT)
- Department of Veterans Affairs (VA)

All of these agencies, together with their component divisions, bureaus and labs, have established programs for transferring the technology arising out of their ongoing lab science and technology endeavors.

This *Summary Report* draws upon the statistics and other information provided by the agencies in their individual annual reports to the Office of Management and Budget. The reporting statute

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[7] The statutory annual agency report (termed an "agency report on utilization") is described by 15 U.S.C. Sec. 3710 (f). The Secretary of Commerce's report (termed an annual "Summary Report") is described by 15 U.S.C. Sec. 3710 (g)(2).

[8] Executive Office of the President, President's Council of Advisors on Science and Technology, *Report on Technology Transfer of Federally-Funded R&D: Findings and Proposed Actions*, May 15, 2003.

[9] The "transfer of federally funded R&D" encompasses the transfer of research and development results both from the federal laboratories and from extramural recipients of federal research support such as universities. The present report focuses solely on the federal laboratories. Statistics on university technology transfer are compiled annually by the Association of University Technology Managers (AUTM); the most recent such report is for FY 2003 (see www.autm.net/index_ie.html).

[10] The National Science Foundation is not a member of this group since it primarily funds extramural (e.g., university) research and does not maintain its own federal laboratories. The Department of Homeland Security continues to rapidly evolve and has not yet become a member of the group of reporting agencies.

requests the agencies to discuss the current content of and plans for their technology transfer programs. Each is also asked to provide statistics for a set of core technology transfer activity measures (see Table 1.1), including the incidence of collaborative relationships for research and development (such as Cooperative Research and Development Agreements) and frequently cited indicators of intellectual property management such as invention disclosure, patenting, and licensing.

Table 1.1 – Overview of the Types of Information on Federal Lab Technology Transfer Collected in the Annual Reporting Process

	Category of Federal Lab Tech Transfer Activity	Tech Transfer Measures Discussed
ACTIVITIES	Collaborative research & development relationships	▪ Cooperative Research and Development Agreements (CRADAs) ▪ Other types of collaborative research and development relationships
	Intellectual property management	▪ Invention disclosure ▪ Patenting - Patent applications - Patents received ▪ Licensing: lab inventions and other intellectual property - Licensing levels - License management - Licensing income Total income Royalty income Disposition of income
	Other activity measures	▪ As identified and discussed by the agencies
DOWNSTREAM OUTCOMES		▪ Case examples provided by the agencies

The content of the agency reports -- and concomitantly this *Summary Report* -- builds on that established over the years by OTP and the agencies in preparing the (aforementioned) Biennial Reports, as well as responding to new data requirements identified by the Technology Transfer Commercialization Act. To ensure consistency across the agencies in the nature and statistical content of these reports, OTP worked closely with them throughout 2001 -- chiefly through the Interagency Working Group on Technology Transfer[11] -- to develop a common report content and

[11] The Interagency Working Group on Technology Transfer (IWGTT) is a long-standing committee that includes technology transfer principals from most of the federal science and technology agencies. The IWG's activities are coordinated by the Department of Commerce's Office of Technology Policy. The group meets monthly to discuss policy issues and related topics of significant interest to the Federal lab technology transfer community.

format.[12] The statistics on licensing have been expanded in response to the requirements of the Technology Transfer Commercialization Act to include greater detail on license management and licensing income. The agencies were again asked, in response to strong congressional and administration interest, to provide information about the "downstream outcomes" of their technology transfer activities: such as new products in the commercial marketplace, improved private industry production processes, improved capabilities and technologies that flow back into the federal labs as a result of technology transfer relationships with outside organizations.

A short summary of the report's key findings follows. Chapter 2 analyzes the trends in federal technology transfer activities within and across the federal lab agencies over the past five years. Chapter 3 is organized by agency and summarizes key information from each agency's annual report for FY 2003. These summaries tabulate key technology transfer activity statistics, and discuss the technology transfer outcome cases submitted by the agency. The Appendix comments on the agencies' recent progress in improving performance metrics for their technology transfer programs.

1.3 Principal Findings

● ***Recent Trends in Federal Lab Technology Transfer Activity Levels***

Collaborative Research and Development Relationships

Relationships for cooperative research and development (R&D) between federal laboratories and outside partners (such as private companies, universities, units of state or local government, non-profit institutions, or other non-federal organizations) are widely viewed as conducive settings for technology transfer. Beyond the new know-how and new technology that may result, these joint efforts can often confer a mutually advantageous leveraging of partners' resources and technical capabilities, as well as avenues for a partner to gain new competences and absorb a portion of the skills of its partnership colleagues.

One frequently used mechanism for establishing these joint relationships is the *Cooperative Research and Development Agreement* (CRADA), which was legislated by the Congress in the late-1980s to encourage the federal labs to participate in R&D partnerships for the purpose of advancing promising technologies toward commercialization. Although, CRADAs are not the only way through which federal labs can engage in cooperative R&D, as *other types of collaborative R&D relationships* are possible.

-- The CRADA mechanism is multifaceted and can be used to address several kinds of transfer and intellectual protection needs. Beginning this year, the statistics are presented to draw a clearer distinction between "traditional" applications of the CRADA (i.e., collaborative R&D activities between a federal lab and one or more non-federal partners) and "non-traditional" applications (i.e., use of the CRADA mechanism for special purpose applications such as to transfer materials or

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[12]The reporting guidelines include a set of core activity measures for all agencies and also provide flexibility to the agencies to include information on additional measures each may deem important in presenting the nature and current achievements of its technology transfer program. These guidelines have been updated regularly (by OTP in cooperation with the Interagency Working Group) since first drafted in 2001. They have been incorporated into OMB's *Circular A-11* since mid-2003 (see further discussion in the Appendix of this report.)

facilitate technical assistance activities that may yield information needing intellectual property protection).

-- This year's statistics for the federal labs as a whole places the level of traditional CRADAs active in FY 2003 at 2,936; the corresponding level for non-traditional CRADAs is 2,615. The total number of traditional CRADAs has been a fairly stable 2,800-3,000 active CRADAS in each of the last five years (FY 1999-2003). Furthermore, the annual flow of newly executed traditional CRADAs has remained vigorous: some 700-950 new agreements initiated each year. The most noticeable development over this period has been the sharp increase in the use of the CRADA mechanism for special purposes: around 200 active non-traditional CRADAs in FYs 1999 and 2000, but expanding sharply to levels of 2,500-2,600 in FYs 2002 and 2003.

-- DOD accounted for 52% of all active traditional CRADAs in FY 2003; DOE for 23%; HHS and USDA for 8-9% each (together totaling about 91% of all federal lab CRADAs). Only three of the agencies reported active non-traditional CRADAs: DOC was by far the most, accounting for 70% in FY 2003; DOD, 24% and HHS, 6%. (In interpreting these share figures across the agencies, it is essential to recognize that agencies like DOD, DOE, HHS, and NASA have far greater budget support for their federal lab operations than the other agencies -- accounting together for about 85% of all federal lab R&D support in recent years.[13])

-- A more varied picture emerges when the analysis delves below the aggregate, to look at agency-by-agency trends. For traditional CRADAs, the total active level has increased somewhat over the last five years at DOD, EPA, DOT, and the VA. The trend at DOE, HHS, USDA has been slow decline, and sharp decline at DOC. For non-traditional CRADAs, the standout trend has been the large increase over the last two years at DOC.

-- The revised annual reporting process starting in FY 2001 provided the agencies with an opportunity to identify collaborative R&D relationships other than CRADAs and to comment on their contributions to the agency's technology transfer program. Three agencies have, thus far, acted to provide this kind of information: USDA, DOC, and NASA. It appears that other agencies may also do so in future reporting cycles. Data collection on this topic remains at an early stage, but should improve in future cycles. Interestingly, however, the latest data tallies some 5,639 active relationships in FY 2003 -- well more than both the 2,936 and 2,615 federal lab totals reported in FY 2003 for, respectively, traditional CRADAs and non-traditional CRADAs.

Invention Disclosure and Patenting

Federal lab activities in the areas of *invention disclosure* and *patenting* (including both patents applied for and patents received) are often cited as indictors of the labs' active management of intellectual assets and technical know-how.

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[13] In reviewing the findings throughout this report, it must be recognized there are considerable differences among agencies in the levels of budget resources for federal laboratory research and development operations. In FY 2002, almost 36% of the federal total was directed toward DOD labs. Federal lab operations at DOE received 19%, and 18% at HHS, 12% at NASA, 5% at USDA, 4% at DOC, 2% at DOI and VA, 1% at EPA and DOT. These differences in resources are important considerations when comparing agencies' levels of technology transfer activities.

-- This year's statistics for the federal labs as a whole places total invention disclosures in FY 2003 at 4,348; total patent applications at 2,242; and total patent issues at 1,607. There has been a gradual increase in this aggregate level of invention disclosure throughout the last five years (FY 1999-2003). Although, the corresponding levels of patent applications and patent issues have each been more nearly flat over the same period.

-- DOD and DOE together accounted for about 65% of the federal labs' total for invention disclosures in FY 2003, 75% of the total patent applications, and 78% of the total patent issues. Adding the contributions of HHS and NASA brings these totals, respectively, to 93%, 94%, 96%. The contributions of the other six agencies (USDA, DOC, DOI, VA, EPA, and DOT) reflect the small remainder for each of these indicators. (See also footnote 13 earlier for statistics on the relative size of the budget support for these agencies' federal labs.)

-- A somewhat more varied set of trends is evident when the agencies are considered separately. For the four agencies that account for most of the activity in this realm, invention disclosures have exhibited a generally increasing trend over the last five years at DOD, HHS, and NASA -- although the trend has been more nearly flat at DOE. DOD, DOE, and HHS have exhibited some increases in annual levels of patent applications and patent issues; NASA patent applications and patent issues have been more nearly flat over the same period.

Licensing

Licensing is one the chief mechanisms through which inventions and other intellectual property resulting from agency supported R&D can be transferred to outside parties to promote further development, utilization, and commercialization.

The licensing statistics distinguish several types (and several subclasses) of licenses: "inventions" (e.g., licenses of patented inventions, material transfer licenses for inventions) and "other intellectual property" (e.g., licenses of copyrighted intellectual property, material transfer licenses for non-inventions).

-- This report's latest round of statistics for the federal labs as a whole indicates 6,443 licenses were active in FY 2003. Of these, 3,656 were invention licenses (the vast majority, patent licenses); 2,787 were other IP licenses (around two thirds, copyright licenses). The broad pattern has been substantial growth in overall federal lab licensing over the last five years (FY 1999-2003).

-- DOE licenses accounted for about 57% of the federal lab total in FY 2003; HHS, for 21%; NASA, for 8%; DOD, for 6%; USDA, for 4% (these all sum together to 96% of the federal lab total). The rest of the agencies (DOC, DOI, VA, EPA, and DOT) accounted for the small remaining fraction of the federal lab total. (See also footnote 13 earlier for statistics on the relative size of the budget support for these agencies' federal labs.)

-- In keeping the trends in other technology transfer realms, there are both similarities and differences across the agencies in emphases. For most of the agencies, the current license portfolio is overwhelmingly invention licenses, and, at that, predominantly patent licenses. Most of the agencies have small to zero levels of other IP licenses. DOE is the exception to this trend, where the current level (FY 2003) of active other IP licenses is double that of invention licenses. Beyond the already mentioned large differences between DOE, HHS and the rest of the agencies in the level of licensing, for most all of the agencies, the level of active licenses has been either growing (DOE, HHS, NASA, and USDA) or remained largely flat over the last five years (DOC, DOD, VA, EPA, and DOT).

-- Total license income for all the federal labs together in FY 2003 amounted to $96.8 million. Most all of this income arose from invention licenses ($93.9 million); only a little from other IP licenses ($3.2 million). Furthermore, the level of income has been increasing at a significant pace over the last five years. About 49% of this income came in the form of earned royalties. For the federal labs as a whole, some 62% of the 6,443 licenses active in FY 2003 were income bearing in some way. Around three quarters of these income bearing licenses were non-exclusive.

-- HHS licenses accounted for 56% of all federal lab income in FY 2003, no doubt reflecting the comparatively high economic value and strong commercialization opportunities associated with new technologies in the biosciences realm. DOE licenses accounted for 27% of total income; DOD, 10%; NASA, 3%; and USDA, 2%. The rest of the agencies represented far smaller shares.

-- Most all of the agencies derive the preponderance of their license income from invention licenses. Only DOE, HHS, and NASA indicated income from other IP licenses. DOE is exceptional in that other IP licenses accounted for as much as 8% of the agency's license income total in FY 2003. There is variability among the agencies with respect to the fraction of all licenses that are income bearing; the incidence of exclusive, partially exclusive, and non-exclusive licenses; and the extent to which annual license income results from earned royalties

-- The agencies that account for the lion's share of license income -- HHS, DOE, DOD, and NASA -- have all exhibited consistent growth in license income over the last five years. Year-to-year growth has been less consistent over the same period for most of the other agencies. In fact, the five year pattern for DOC and DOT has more nearly been one of declining license income.

● *Downstream Outcomes from Federal Lab Technology Transfer*

All of the agencies now regularly provide selected cases of downstream outcomes (success stories) from their technology transfer activities as part of their annual reporting.

Across all the agency reports this year, some 112 cases are documented -- summaries of which appear in the agency sections in Chapter 3 of this report. The cases illustrate a variety of outcome types: including new technologies and know-how resulting from cooperative research and development between federal labs and industry partners, licensing of federal lab inventions and other intellectual property to private companies for further development and commercialization, improvements in federal lab capabilities from cooperative research and development relationships and licensing activities.

This growing case record continues to indicate that federal technology transfer mechanisms are helping to move federal lab science and technology to the outside and are having useful impacts in the commercial marketplace and on the well-being of U.S. citizens.

● *Agency Progress in Improving Performance Metrics*

There have been a number of improvements since last report. Agency responsiveness to the annual reporting requirement of the Technology Transfer Commercialization Act has generally improved since the first cycle under the new process in FY 2001. Some of this is progress up the learning curve; some, stronger encouragement from the Office of Management and Budget (guidelines for the reporting are now included in OMB's Circular A-11); also, many of the agencies have been working to improve their management information systems to enable timely and reliable presentation of the data requested by the technology transfer reporting process. Incremental improvements are being made in the standardized data collection instrument which provides guidance to the agencies in preparing annual reports based on the experience of previous reporting cycles. These improvements have included expanded opportunity for agencies to include data for activity metrics in technology transfer areas beyond the conventional realms of cooperative R&D, invention disclosure/patenting, and licensing.

The outstanding performance metrics challenges remain, as they have for some time, in the areas of measuring downstream impacts from the federal labs' technology transfer activities and in identifying and using measures that can help technology transfer managers better understand the effectiveness and productivity of the programs they operate. In general, it remains far easier to assemble statistics on technology transfer activities (e.g., CRADAs established, patents received, licenses executed) than it is to measure downstream benefits and the effectiveness of implemented federal lab programs for technology transfer.

As noted just above, the agencies now regularly provide a selected set of cases that illustrate kinds of downstream impacts their technology transfer activities are having. But the analytical effort continues to emphasize case histories, with little attention to systematic quantitative measures. Likewise, there is only a little information collected currently by the federal labs that addresses technology transfer program effectiveness and productivity.

Chapter 2
Recent Trends in Federal Lab Technology Transfer

This chapter broadly highlights the major trends in federal lab technology transfer activities evident in the annual reporting data available for FY 1999-2003. The statistics address both federal lab system as a whole and comparatively across the ten agencies with federal laboratory systems.

This chapter's analysis draws on the activity and outcome information provided by the agencies in their annual reports on federal lab technology transfer for FY 2003 (summaries of which are available in Chapter 3). The discussion covers all of the principal measurement areas listed earlier in Table 1.1: cooperative R&D relationships, patenting, licensing of intellectual property, and downstream outcomes arising from these transfer relationships.

Before turning to what this information shows, several orienting points are important to remember when considering this data on a time-series and comparative cross-agency basis:

● One of the challenges in identifying valid trends in time series data for technology transfer activity measures is that single year-to-year comparisons can be misleading. Performance is influenced by complex factors, notably, the often irregular pace at which ongoing R&D yields new knowledge, inventions, and, thereby, opportunities for technology transfer. Trends evident over several years, or longer, normally will provide a sounder basis for useful conclusions.

● Considerable differences exist among the agencies in the level of budget resources to support federal lab science and technology – which ultimately influences the resources available to support lab technology transfer activities.[14]

As Table 2.1 indicates, DOD receives by far the greatest level of budget support for its federal lab operations: about 36% of all federal spending for federal lab R&D in FY 2002 (the most recent year for which published figures are available). Federal lab operations at DOE and HHS also receive sizable budget support, but both are about half the DOD level. NASA is a third of the DOD level. USDA and DOC are, respectively, a seventh and a tenth of the DOD level. The rest of the agencies (DOI, VA, EPA, and DOT) are substantially smaller.

Many of the activity statistics cited throughout this chapter indicate that DOD, DOE, HHS, and NASA dominate federal lab technology transfer by a wide margin -- accounting for 90% or more of the federal lab totals, depending on the measure. In keeping with the above, this is not surprising, since these four agencies account for about 85% of all federal lab R&D spending.

● Beyond the comparative level of budget resources, there are also some differences among the agencies in the nature and intensity of particular technology transfer activities that reflect differences in the types of technology transfer authorities allowed, the agency mission, the strategy to achieve mission, and associated program priorities.

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[14] Across the departments, budget resources for Federal lab technology transfer activities are generally not a separate budget line-item. Typically, technology transfer is funded from a lab's overhead account and usually must compete with other demands for these general resource dollars.

● A final consideration is that the new annual reporting process has continued to evolve since its first cycle in FY 2001, as have the agency responses to its needs.[15] This adds some complexity when the annual data is used for time series analysis purposes. (Although, this is not universal across the data from all agencies, and any effects on the numbers are not readily generalized.)

Table 2.1 – Estimated Budget Resources for Federal Lab R&D Spending, FY 2000-2002, Ranked by Annual Level

Department	FY 2000		FY 2001		FY 2002	
	Total Obligations (million $)	**Obligations -- Federal Labs*** (million $)	**Total Obligations** (million $)	**Obligations -- Federal Labs*** (million $)	**Total Obligations** (million $)	**Obligations -- Federal Labs*** (million $)
Defense	$33,167	$8,870	$36,334	$9,595	$34,235	$8.874
Energy	6,063	4,378	6,712	4,768	6,322	4,537
HHS	18,426	3,595	21,355	4,048	23,816	4,514
NASA	6,882	2,923	7,221	3,142	7,259	3,020
Agriculture	1,747	1,152	1,980	1,257	1,806	1,268
Commerce	1,037	755	1,112	865	1,112	912
Interior	580	506	624	538	564	497
Veterans Affairs	342	342	350	350	360	360
EPA	523	320	608	342	556	321
Transportation	467	198	609	215	585	237

Budget figures include spending for basic research, applied research, development, R&D facilities and equipment. Budget "authority" and "obligations" measure spending in different ways. "Obligations" are reported here, rather than the more frequently cited "budget authority" figures, since the latter generally do not distinguish spending on federal lab activities from extramural performers (e.g., universities).

*"FY 2000 Obligations – Federal Labs" sums spending for federal research by intramural performers and all federally funded research and development centers (FFRDCs). This sum is used as a measure of federal lab budget resources -- and is the basis for the above ranking of the departments.

Source: National Science Foundation, *Federal Obligations for Total Research and Development, by Major Agency and Performer, 1951-2002*. The figures for FY 2001 and 2002 are listed by NSF as "preliminary." FY 2002 is the most recent year for which published data is available.

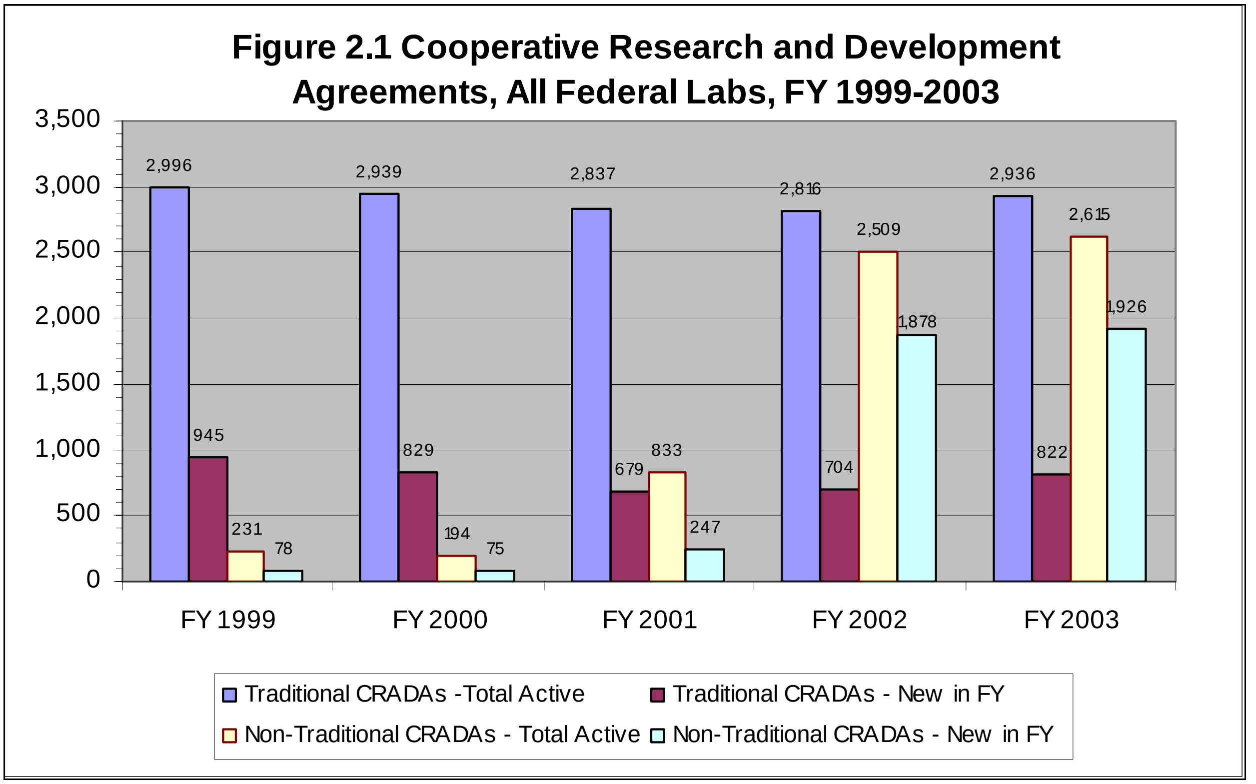
[15] The data collection framework used by the agencies in preparing reports is essentially the same for FY 2002 and 2003 -- and is not expected to significantly change over the foreseeable future. The framework for the FY 2001 is largely the same, but did not include several data categories (particularly, the expanded categories for license types) that were subsequently added. Figures reported for FY 1999 and 2000 reflect the data framework from the prior Biennial Report process under the Stevenson-Wydler Act. Many of the data definitions there are very similar to what has been used from FY 2001 onward; although, the categories of data requested then was not as extensive as at present. Another issue is that as the agencies have worked to implement the new reporting process since FY 2001, some have widened the breadth of coverage of reporting units across their agencies -- most notably DOD (which now includes a number of defense agencies, in addition to the prior principal focus on the three service branches -- Army, Navy, and Air Force).

2.1 Collaborative Research and Development Relationships

Relationships for cooperative R&D between federal laboratories and outside partners (such as private companies, universities, units of state or local government, non-profit institutions, or other non-federal organizations) are widely viewed as fertile settings for technology transfer. Beyond the new know-how and new technology that may result, these joint efforts can often confer a mutually advantageous leveraging of partners' resources and technical capabilities, as well as avenues for a partner to gain new competences and absorb a portion of the skills of its partnership colleagues.

One frequently used mechanism for establishing these joint relationships is the *Cooperative Research and Development Agreement* (CRADA), which was legislated by the Congress in the late-1980s to encourage the federal labs to participate in R&D partnerships for the purpose of advancing promising technologies toward commercialization.[16] Although, CRADAs are not the only way in which federal labs can engage in cooperative R&D, as *other types of collaborative R&D relationships* are possible.

■ *Cooperative Research and Development Agreements*



[16] CRADA authority was first established by the Federal Technology Transfer Act of 1986. This Act applied only to government-owned/government-operated (GOGO) laboratories. But only a few years later, the National Competitiveness Technology Transfer Act of 1989 enlarged the authority to government-owned/contractor-operated (GOCO) labs (most of which are part of the Department of Energy's laboratory system). The effect of both Acts together was to extend the CRADA option fully throughout the U.S. federal lab system. For a general discussion of the CRADA, see the Federal Laboratory Consortium's *Technology Transfer Desk Reference*, May 2002, Section 3 (accessible at www.federallabs.org).

Figure 2.1 and Table 2.2 provide statistics on the federal labs' use of the CRADA mechanism over the last five years (FY 1999-2003). This information addresses both the federal labs as an aggregate whole (i.e., total activity for all ten agencies summed together) and each agency separately.

These statistics also distinguish "traditional" and "non-traditional" CRADAs. The CRADA mechanism is multifaceted and can be used to address several kinds of technology transfer and intellectual property protection needs. The "traditional" category refers to the most straightforward application, namely, collaborative R&D activities between a federal lab and one or more non-federal partners. The "non-traditional" category refers to special purpose applications of the CRADA mechanism, such as to transfer materials or to facilitate technical assistance activities that may yield information needing intellectual property protection.

Table 2.2 – Collaborative Relationships for R&D, FY 1999-2003

		FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
DOD	▪ Traditional CRADAs, total active in the FY	1,350	1,364	1,418	1,376	1,523
	- New, executed in the FY	449	425	296	347	523
	▪ Non-traditional CRADAs, total active in FY	--	--	547	537	611
	- New, executed in the FY	--	--	163	102	107
	▪ Other collaborative relationships, total active in FY	--	--	0	0	0
	- New, executed in the FY			0	0	0
DOE	▪ Traditional CRADAs, total active in the FY	715	687	558	680	661
	- New, executed in the FY	240	151	204	192	140
	▪ Non-traditional CRADAs, total active in FY	0	0	0	0	0
	- New, executed in the FY	0	0	0	0	0
	▪ Other collaborative relationships, total active in FY	--	--	0	0	0
	- New, executed in the FY			0	0	0
HHS	▪ Traditional CRADAs, total active in the FY	237	244	289	261	254
	- New, executed in the FY	58	50	61	52	54
	▪ Non-traditional CRADAs, total active in FY	231	194	209	209	173
	- New, executed in the FY	78	75	76	74	48
	▪ Other collaborative relationships, total active in FY	--	--	0	0	0
	- New, executed in the FY			0	0	0
NASA	▪ Traditional CRADAs, total active in the FY	1	1	1	1	0
	- New, executed in the FY	1	0	0	0	0
	▪ Non-traditional CRADAs, total active in FY	0	0	0	0	0
	- New, executed in the FY	0	0	0	0	0
	▪ Other collaborative relationships, total active in FY	81	104	1,053	1,104	1,056
	- New, executed in the FY	n/a	30	496	537	385
USDA	▪ Traditional CRADAs, total active in the FY	298	257	217	222	223
	- New, executed in the FY	101	69	49	58	51
	▪ Non-traditional CRADAs, total active in FY	--	--	2	3	6
	- New, executed in the FY	--	--	0	1	4
	▪ Other collaborative relationships, total active in FY	--	--	3,679	3,211	2,769
	- New, executed in the FY	--	--	1,040	1,416	1,480

DOC	▪ Traditional CRADAs, total active in the FY	275	221	188	139	92
	- New, executed in the FY	67	46	26	26	12
	▪ Non-traditional CRADAs, total active in FY	--	--	59	1,744	1,811
	- New, executed in the FY	--	--	0	1,693	1,755
	▪ Other collaborative relationships, total active in FY	--	--	1,575	1,694	1,814
	- New, executed in the FY	--	--	n/a	n/a	n/a
DOI	▪ Traditional CRADAs, total active in the FY	30	40	41	n/a	n/a
	- New, executed in the FY	10	8	14	n/a	n/a
	▪ Non-traditional CRADAs, total active in FY	--	--	9	n/a	n/a
	- New, executed in the FY	--	--	7	n/a	n/a
	▪ Other collaborative relationships, total active in FY	--	--	0	n/a	n/a
	- New, executed in the FY			0	0	0
VA	▪ Traditional CRADAs, total active in the FY	1	2	2	2	10
	- New, executed in the FY	1	2	0	2	8
	▪ Non-traditional CRADAs, total active in FY	--	--	0	0	0
	- New, executed in the FY	--	--	0	0	0
	▪ Other collaborative relationships, total active in FY	--	--	0	0	0
	- New, executed in the FY			0	0	0
EPA	▪ Traditional CRADAs, total active in the FY	38	44	45	55	77
	- New, executed in the FY	13	40	18	18	27
	▪ Non-traditional CRADAs, total active in FY	--	--	3	4	14
	- New, executed in the FY	--	--	1	3	12
	▪ Other collaborative relationships, total active in FY	--	--	0	0	0
	- New, executed in the FY			0	0	0
DOT	▪ Traditional CRADAs, total active in the FY	51	79	78	80	96
	- New, executed in the FY	5	38	11	9	7
	▪ Non-traditional CRADAs, total active in FY	0	0	4	12	0
	- New, executed in the FY	0	0	0	5	0
	▪ Other collaborative relationships, total active in FY	--	--	0	0	0
	- New, executed in the FY			0	0	0
		FY 1999	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**
TOTALS	▪ Traditional CRADAs, total active in the FY	2,996	2,939	2,837	2,816	2,936
	- New, executed in the FY	945	829	679	704	822
	▪ Non-traditional CRADAs, total active in FY	231	194	833	2,509	2,615
	- New, executed in the FY	78	75	247	1,878	1,926
	▪ Other collaborative relationships, total active in FY	--	--	6,307	6,009	5,639
	- New, executed in the FY	--	--	n/a	n/a	n/a

All the federal labs taken together, the total number of traditional CRADAs (Figure 2.1) has been fairly stable over the last five years (FY 1999-2003): in the range of 2,800-3,000 CRADAs active each year. Furthermore, the annual flow of newly executed traditional CRADAs has remained vigorous: some 700-950 new agreements initiated each year.

The most visible departure over this period is the sharp increase in use of the CRADA mechanism for special purposes other than cooperative R&D. Again, for all the federal labs together, in FYs 1999 and 2000, there were around 200 active non-traditional CRADA. However, in FYs 2002 and 2003, the total active figure had reached 2,500-2,600. This represents a sharp expansion in a short period of time -- up to nearly the current level of total active traditional CRADAs.

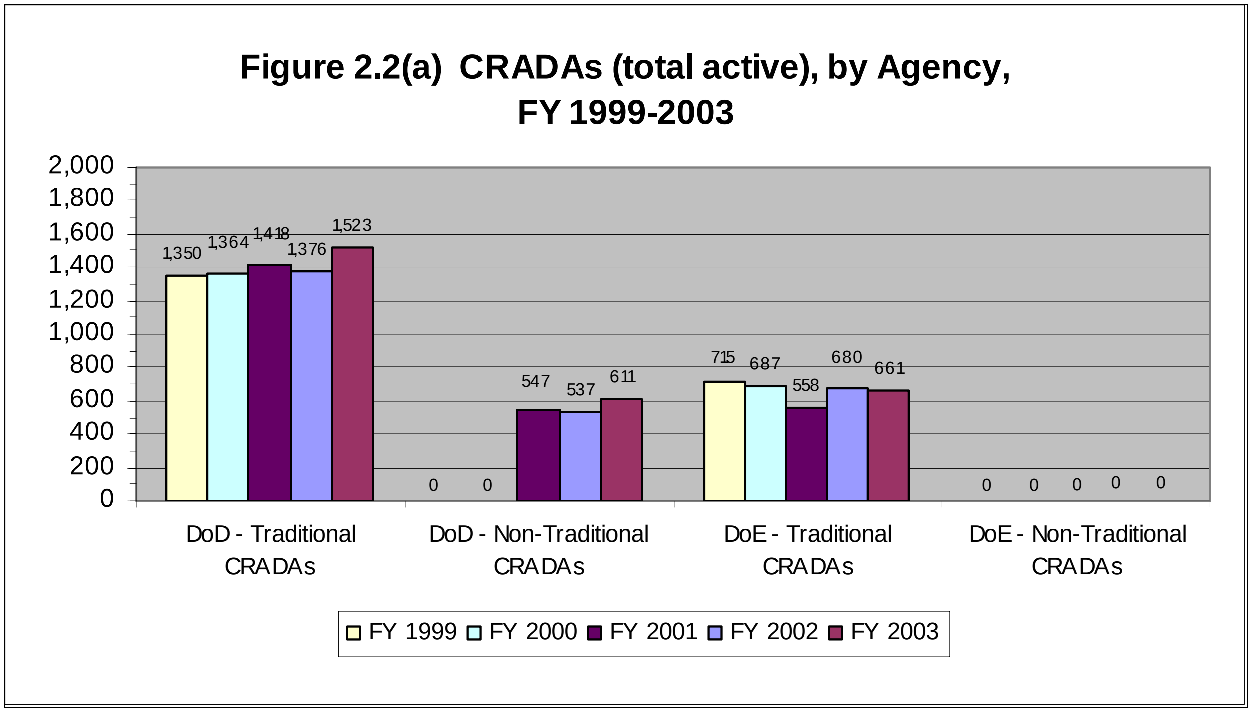


Figure 2.2(a) CRADAs (total active), by Agency, FY 1999-2003
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1,350 1,364 1,418 1,376 1,523
0 0 547 537 611
715 687 558 680 661
0 0 0 0 0
DoD - Traditional CRADAs
DoD - Non-Traditional CRADAs
DoE - Traditional CRADAs
DoE - Non-Traditional CRADAs
FY 1999 FY 2000 FY 2001 FY 2002 FY 2003

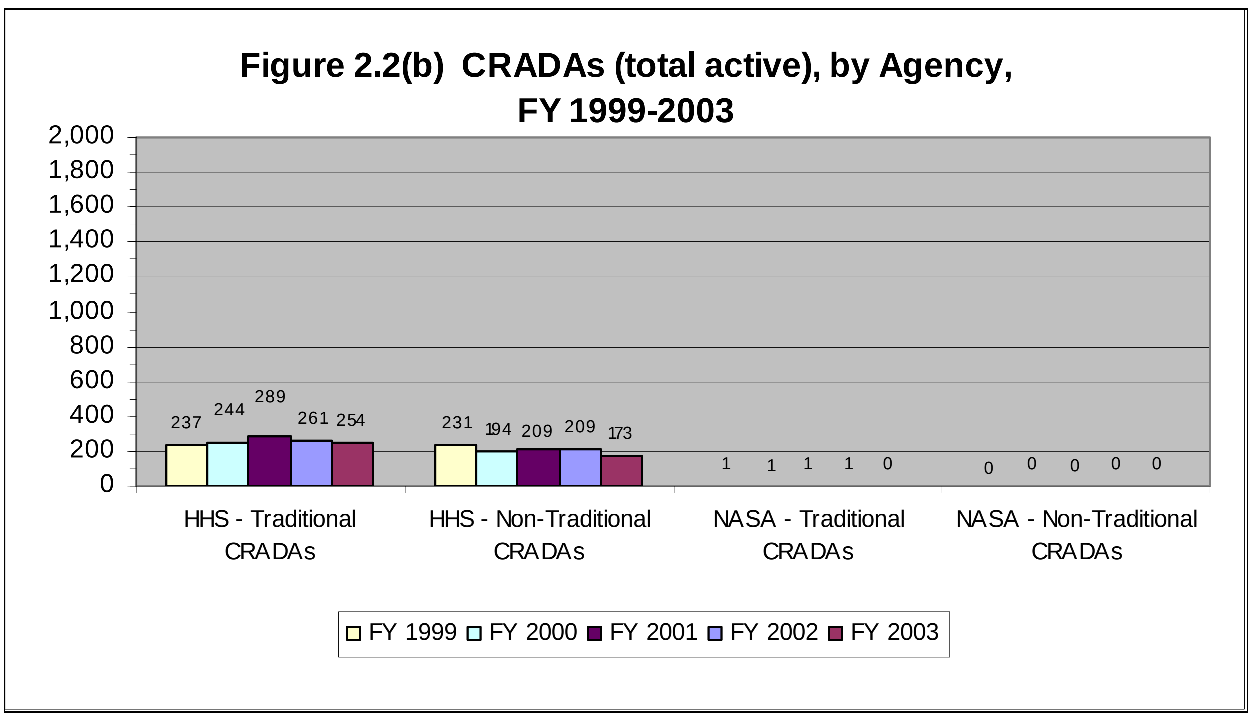


Figure 2.2(b) CRADAs (total active), by Agency, FY 1999-2003
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
237 244 289 261 254
231 194 209 209 173
1 1 1 1 0
0 0 0 0 0
HHS - Traditional CRADAs
HHS - Non-Traditional CRADAs
NASA - Traditional CRADAs
NASA - Non-Traditional CRADAs
FY 1999 FY 2000 FY 2001 FY 2002 FY 2003

Figure 2.2(c) CRADAs (total active), by Agency, FY 1999-2003

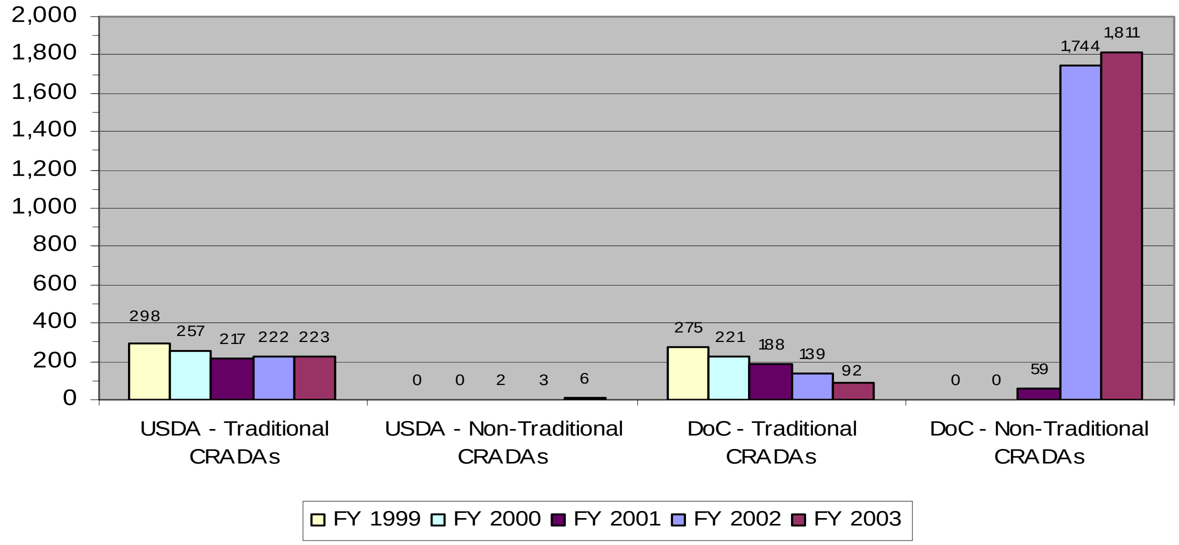
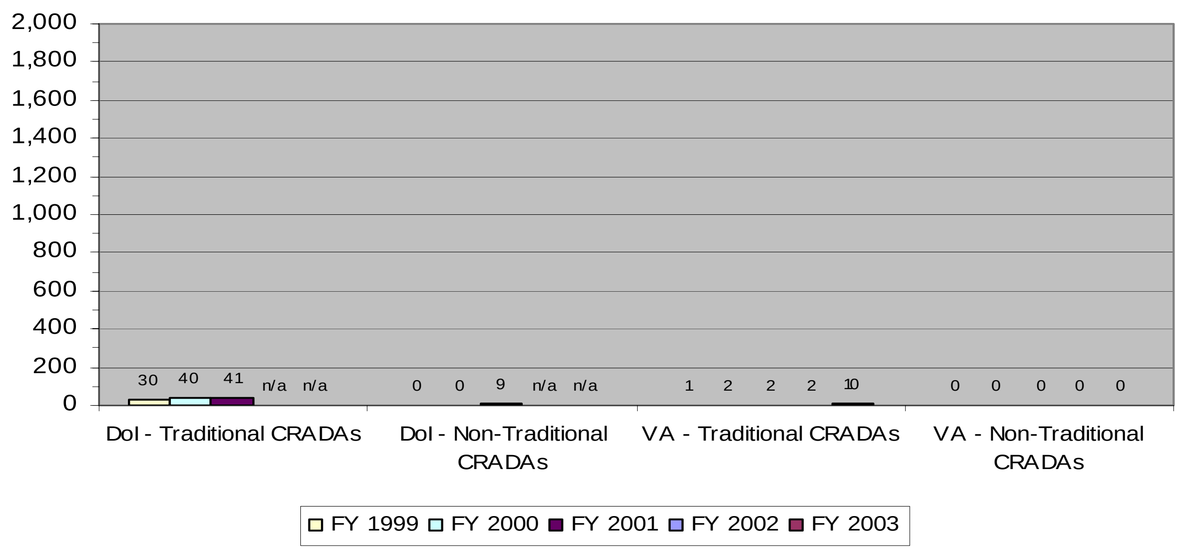
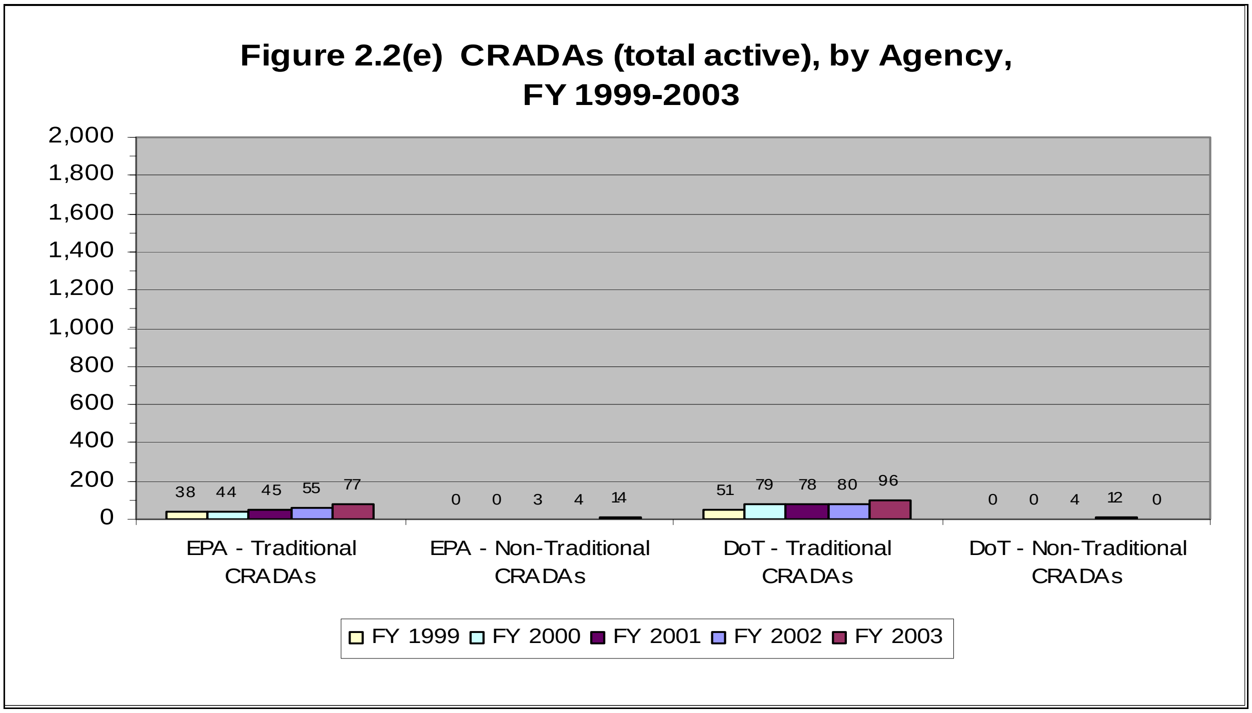


Figure 2.2(d) CRADAs (total active), by Agency, FY 1999-2003





DOD is by far the most prolific when it comes to traditional CRADAs; it accounted for 52% of all active federal lab CRADAs in FY 2003. DoE accounted for 23%; HHS and USDA, each for 8-9%. CRADA use at the other agencies (DOC, DOI, VA, EPA, and DOT) is significantly smaller. NASA is an exception among the agencies, with its lack of use of the CRADA mechanism -- although for a reason.[17] These relative shares have remained largely unchanged over the last five years.

With respect to non-traditional CRADAs, DOC accounted for almost 70% of federal lab agreements of this type active in FY 2003. DOD, 24%; HHS, 6%. The other agencies either did not use this type of CRADA (DOE, NASA, VA, DOT) or accounted for very little of the all federal lab total (EPA, USDA).

This aggregate picture masks, however, a diverse mix of year-to-year changes when each agency's CRADA use is viewed separately (Table 2.2 and Figures 2.2 a-e).

For traditional CRADAs, the total active level has increased somewhat over the recent five year period at DOD, EPA, DOT, and VA. By contrast, the trend at DOE, HHS, and USDA has been slow decline. At DOC, the total active level has declined precipitously over the five year period -- standing in FY 2003 at about a third of the total active level in FY 1999.

[17] NASA is an exception among the federal labs in its use of the CRADA mechanism. NASA continues to rely primarily on transfer authorities granted to it by the Space Act of 1958. This Act gives NASA broad authority to enter into "other agreements" with the private sector and others. These agreements are not regarded as procurements, grants, or cooperative agreements and are not subject to the rules governing such agreements. NASA believes its technology transfer objectives can be achieved with greater flexibility through use of the Space Act.

For non-traditional CRADAs, the standout trend has been the large increase in the last two years at DOC. The other noticeable trends are a slow increase over the five year period at DOD and slow decline at HHS.

■ *Other Types of Collaborative R&D Relationships*

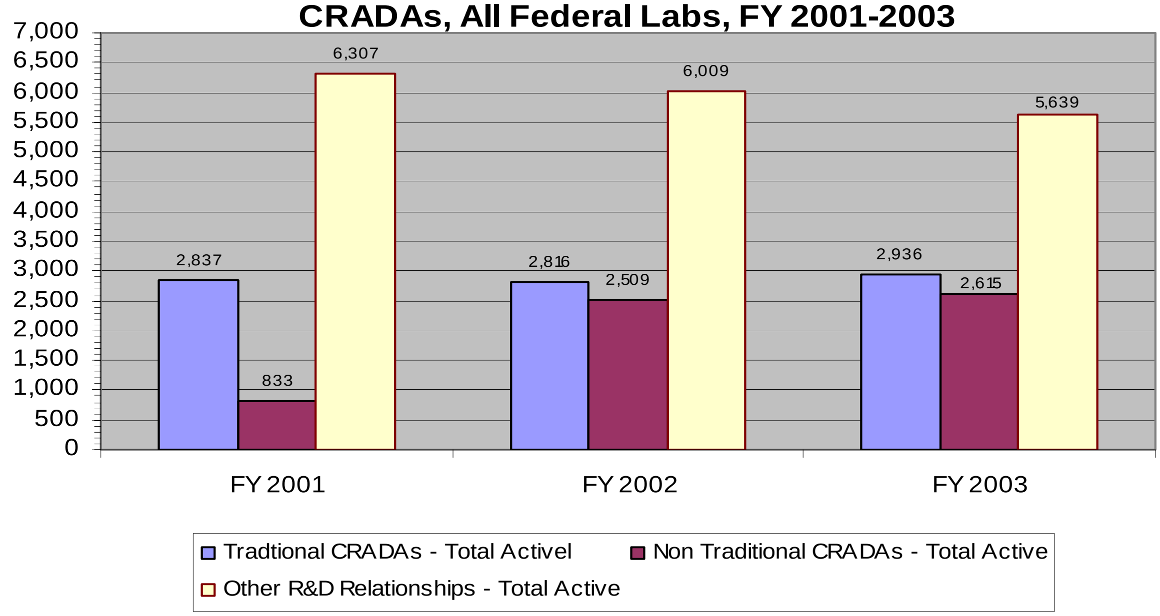
As noted earlier, CRADAs are not the only mechanism through which cooperative R&D relationships can be established between federal labs and non-federal partners. Commencing with the revised federal lab technology transfer reporting process in FY 2001, the agencies have had an opportunity to identify the use of such alternative mechanisms and to comment on their contribution to the agency's technology transfer program.

A few of the agencies now indicate their use of such alternative approaches: USDA, DOC, and NASA. Although, these reflect a wide variety in types of relationships (see tabulation below).

Figure 2.3 provides totals for these "other collaborative R&D relationships" across all the federal labs together for FY 2001-2003. (Comparable figures for traditional and non-traditional CRADAs active in those years are also provided, as points of comparison.)

Obviously, there is currently a large volume of these "other cooperative R&D relationships" -- well beyond the totals of active CRADAs. On the other hand, it is difficult to yet discern trends in these reported statistics, since it is presently unclear that all the agencies are reporting comprehensively on the level of use of these mechanisms (several additional cycles of reporting will likely be needed to develop a data record that can be a basis for analysis).

Figure 2.3 Other Collaborative R&D Relationships vs. CRADAs, All Federal Labs, FY 2001-2003



● *Department of Agriculture (Agricultural Research Service)*
- Trust fund agreements
- Reimbursable agreements
- Material transfer agreements

A *Trust Fund Cooperative Agreement* involves cooperative research between the Agricultural Research Service (ARS) and another party in which ARS is paid in advance to conduct research and the exclusivity of resulting intellectual property is not a priority for the cooperating party. This agreement may also request the private-sector partner to share in the cost of a research project conducted by ARS. The agreement can also be used to allow private-sector partners the use of laboratory facilities, which in some cases may require a formal lease. A *Reimbursable Cooperative Agreement* is like a Trust Fund Agreement in arrears; the private-sector partner pays ARS the difference. For either agreement, both the private-sector partner and ARS should be actively engaged in the cooperative effort, mutually contribute resources to the research effort, and specifically state mutual interest in the agreement's objectives. *Material transfer agreements* established by ARS also provide a basis for cooperative R&D with outside partners.

● *Department of Commerce (National Institute of Standards and Technology)*
- Facility use agreements
- Guest scientists and engineers
- Collaborative standards contributions

Each year, numerous researchers visit NIST to participate in collaborative projects and/or to use NIST's research facilities. NIST makes its facilities available for limited periods to domestic guest researchers to collaborate with NIST staff on R&D projects of mutual interest or to transfer NIST techniques, procedures, and best practices. NIST provides neither direct salary nor subsistence support to domestic guest researchers. NIST's Foreign Guest Researcher Program offers scientists from around the world the opportunity to work collaboratively with researchers in the NIST laboratories. Foreign guest researchers enter into clearly defined Guest Researcher Agreements that describe the proposed research project and its mutual benefit to the guest researcher and the NIST host. The majority of foreign guest researchers receive no stipend from NIST. However, NIST has the authority to pay financial assistance to foreign guest researchers when such payment would facilitate a NIST program.

● *National Aeronautics and Space Administration*
- Space Act agreements
- Jet Propulsion Laboratory tasks
- Software usage agreements

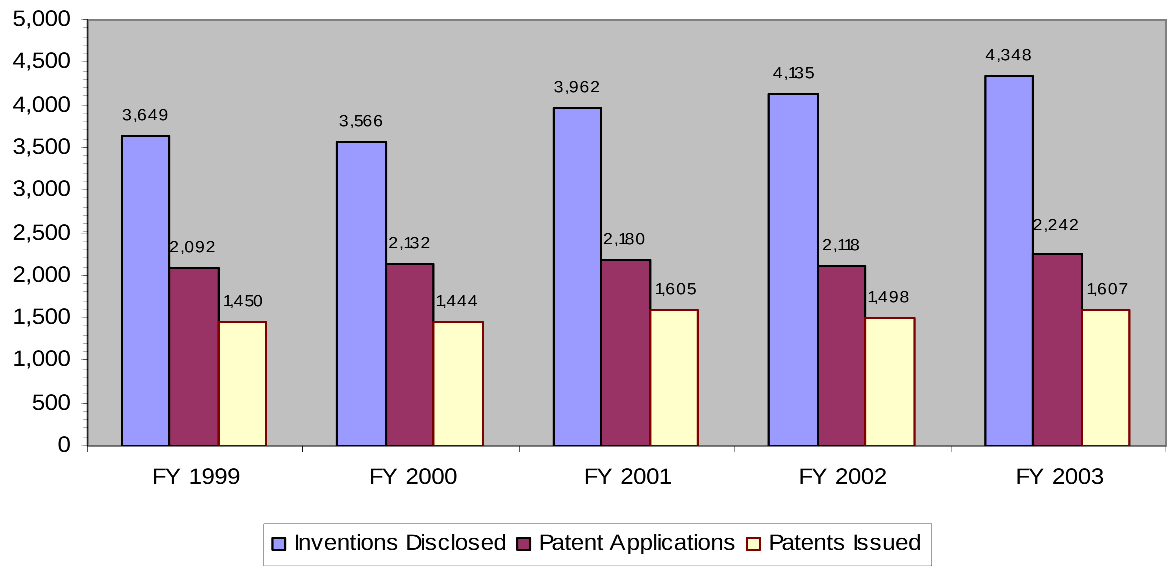
NASA enters into collaborative R&D relationships through the use of *Space Act agreements*. Collaborative R&D also occurs through certain *Jet Propulsion Lab contracts* and through *software agreements* executed with industry.

Numerical statistics on all these measures appear in the respective agency sections in Chapter 3 of this report.

2.2 Invention Disclosure and Patenting

Federal lab activities in the areas of *invention disclosure* and *patenting* (including patents applied for and patents received) are often cited as indicators of the labs' active management of intellectual assets and technical know-how.[18]

Figure 2.4 Invention Disclosure and Patenting, All Federal Labs, FY 1999-2003



For all of the federal labs totaled together, there has been a gradual increase over the last five years (FY 1999-2003) in the level of invention disclosure (Figure 2.4). Although, the levels of patent applications and patent issues have been more nearly flat over the same period. The FY 2003 figures place total invention disclosures at 4,348; total patent applications at 2,242; and total patent issues at 1,607 (Figure 2.4). All are at the highest levels for these indicators reported over the last five years.

Unsurprisingly, the agencies with the larger federal laboratory systems dominate these activity categories (Table 2.3). DOD and DOE account by far for most of these totals: 31% and 34%, respectively, of all invention disclosures that year; 36% and 39% of all patent applications; and of 39% and 39% of patent issues. HHS and NASA activities are also sizable, although at levels well below those of DOD and DOE: 11% and 17%, respectively, of all invention disclosures; 12% and 7% of all patent applications; and 9% and 9% of all patent issues. The modest remainder in each case includes the other six agencies (USDA, DOC, DOI, VA, EPA, and DOT). These agency shares

[18]For a background discussion see the Federal Laboratory Consortium's *Technology Transfer Desk Reference*, May 2002, Section 4.3-4.4 (accessible at www.federallabs.org). Also, care must particularly be taken in identifying valid trends in time series data for these activity measures. Single year-to-year comparisons can be misleading. A lab's activities in this realm particularly are influenced by complex factors, notably the typically irregular pace at which ongoing R&D yields new knowledge and inventions.

Table 2.3 – Invention Disclosure and Patenting, FY 1999-2003

		FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
DOD	• New inventions disclosed in the FY	1,060	991	1,005	1,122	1,332
	• Patent applications filed in the FY	703	774	809	829	810
	• Patents issued in the FY	547	553	619	617	619
DOE	• New inventions disclosed in the FY	1,474	1,371	1,527	1,498	1,469
	• Patent applications filed in the FY	850	788	792	711	866
	• Patents issued in the FY	525	515	605	551	627
HHS	• New inventions disclosed in the FY	328	375	434	431	472
	• Patent applications filed in the FY	241	263	255	262	279
	• Patents issued in the FY	180	132	119	116	136
NASA	• New inventions disclosed in the FY	525	574	696	775	736
	• Patent applications filed in the FY	129	158	152	166	163
	• Patents issued in the FY	87	148	159	128	136
USDA	• New inventions disclosed in the FY	162	109	118	151	121
	• Patent applications filed in the FY	84	78	83	90	60
	• Patents issued in the FY	74	64	64	53	64
DOC	• New inventions disclosed in the FY	38	34	26	17	21
	• Patent applications filed in the FY	30	20	12	12	5
	• Patents issued in the FY	28	18	21	20	9
DOI	• New inventions disclosed in the FY	8	16	6	n/a	n/a
	• Patent applications filed in the FY	3	5	22	n/a	n/a
	• Patents issued in the FY	1	4	2	n/a	n/a
VA	• New inventions disclosed in the FY	48	85	131	125	183
	• Patent applications filed in the FY	37	35	38	34	36
	• Patents issued in the FY	0	1	4	4	8
EPA	• New inventions disclosed in the FY	5	11	17	16	14
	• Patent applications filed in the FY	15	10	14	14	23
	• Patents issued in the FY	8	6	12	9	8
DOT	• New inventions disclosed in the FY	1	0	2	0	0
	• Patent applications filed in the FY	0	1	3	0	0
	• Patents issued in the FY	0	3	0	0	0
TOTALS	• New inventions disclosed in the FY	3,649	3,566	3,962	4,135	4,348
	• Patent applications filed in the FY	2,092	2,132	2,180	2,118	2,242
	• Patents issued in the FY	1,450	1,444	1,605	1,498	1,607

have remained roughly the same throughout the last five years.

The trends over this period are more diverse when each agency is examined separately (Table 2.3 and Figures 2.5 a-e). Invention disclosures have been generally increasing at DOD, HHS, NASA, and VA over the last five years. The level has been generally flat or somewhat declining at the other agencies. Over the same period, DOD, DOE, and HHS have exhibited some increases in annual levels of patent applications and/or patent issues. The trends are, for the most, flat or declining at the other agencies.

Figure 2.5(a) Invention Disclosure and Patenting, by Agency, FY 1999-2003

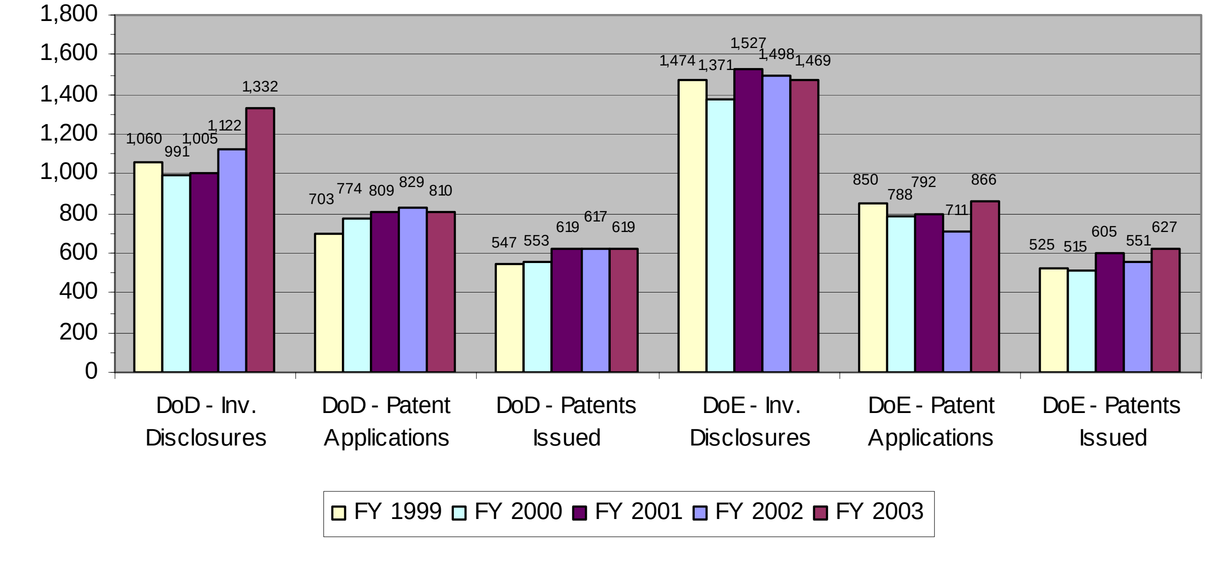


Figure 2.5(b) Invention Disclosure and Patenting, by Agency, FY 1999-2003

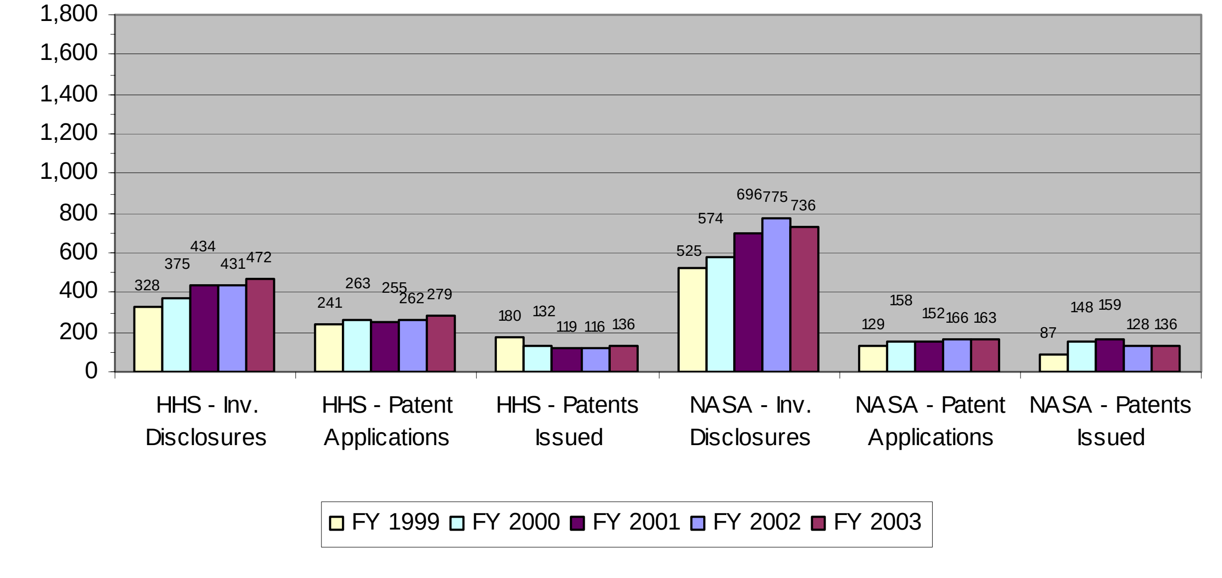


Figure 2.5(c) Invention Disclosure and Patenting, by Agency, FY 1999-2003

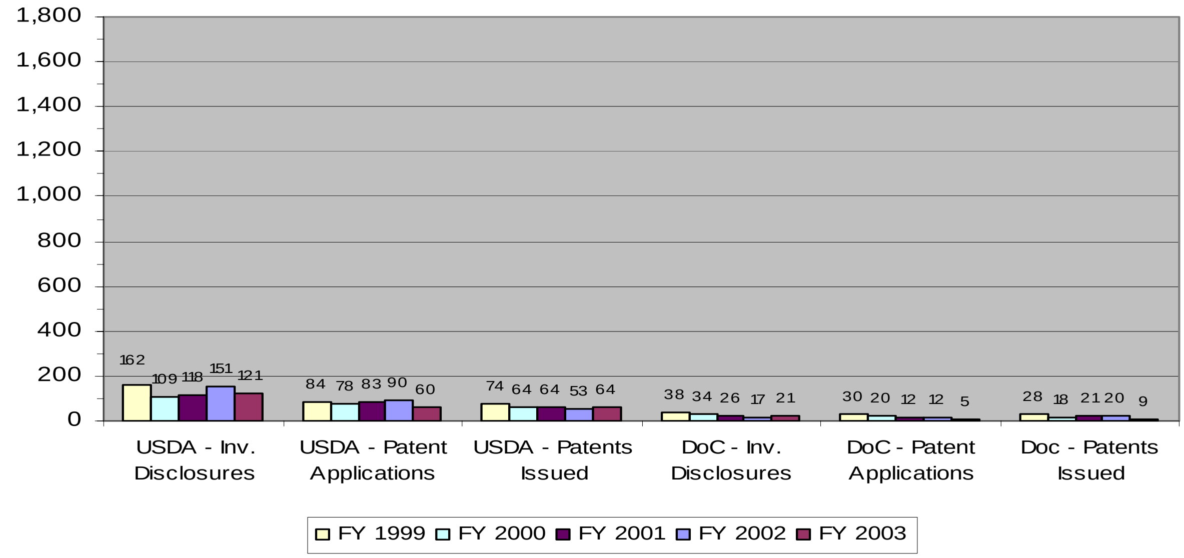
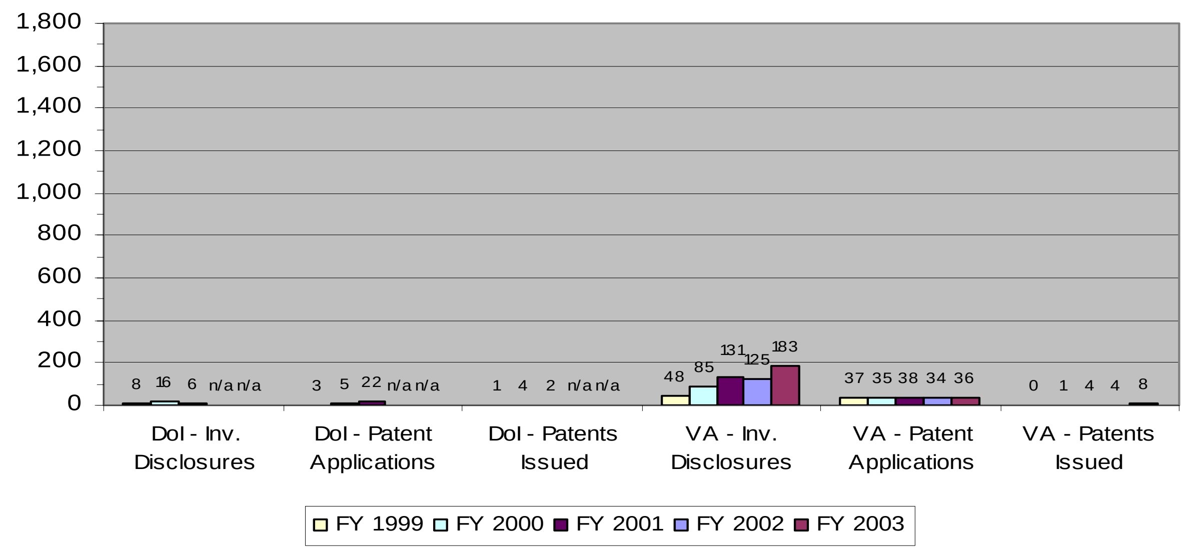


Figure 2.5(d) Invention Disclosure and Patenting, by Agency, FY 1999-2003



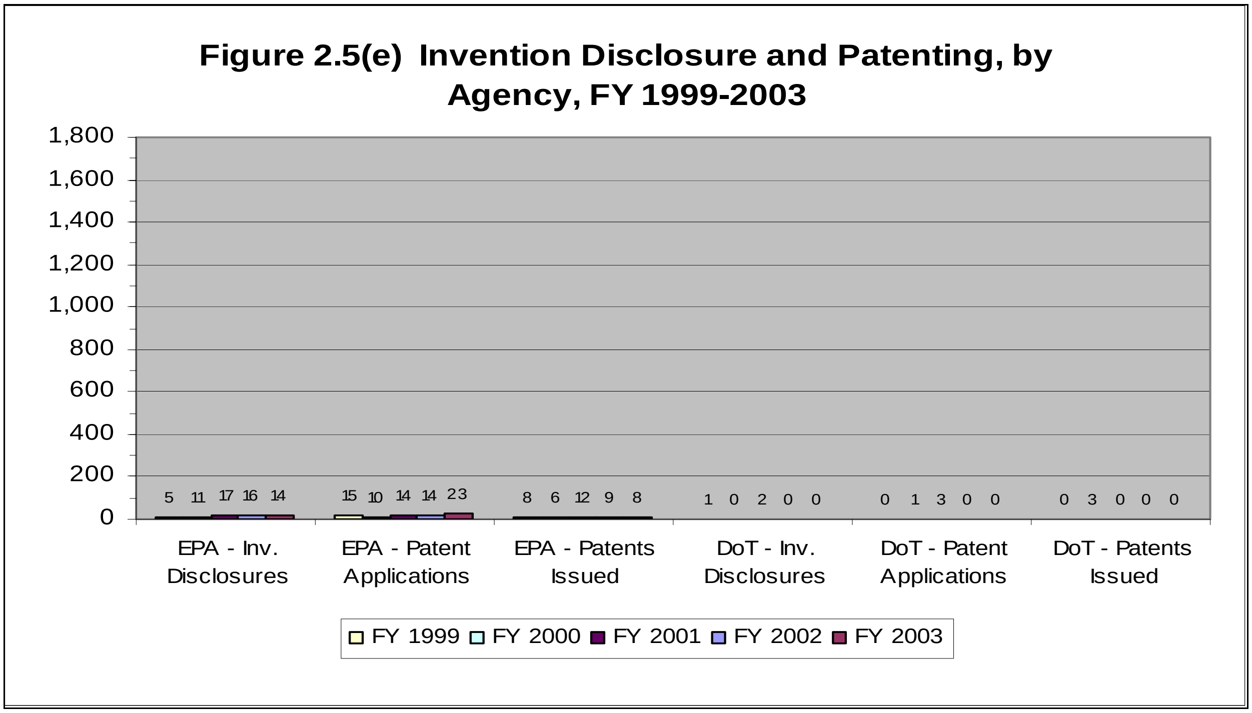


Figure 2.5(e) Invention Disclosure and Patenting, by Agency, FY 1999-2003
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
5 11 17 16 14
15 10 14 14 23
8 6 12 9 8
1 0 2 0 0
0 1 3 0 0
0 3 0 0 0
EPA - Inv. Disclosures
EPA - Patent Applications
EPA - Patents Issued
DoT - Inv. Disclosures
DoT - Patent Applications
DoT - Patents Issued
FY 1999 FY 2000 FY 2001 FY 2002 FY 2003

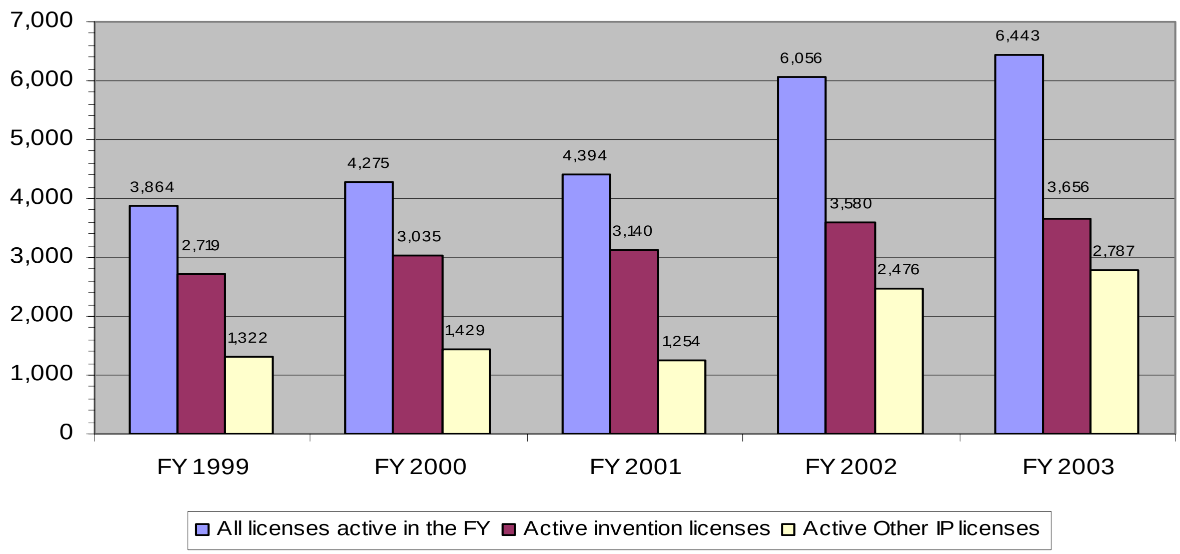
2.3 Licensing – Lab Inventions and Other Intellectual Property

Licensing is one the main mechanisms through which inventions and other intellectual property resulting from agency supported R&D can be transferred to outside parties to promote commercialization and utilization.[19] Licensing is widely employed by the federal labs as a technology transfer tool.

The tables and charts below provide several perspectives on the level of the federal labs' licensing activities, the types of licenses in place, and the annual income derived (if any) from these licenses. In keeping with current convention, the licensing statistics distinguish *inventions* and *other intellectual property*.[20] Several subclasses of licenses are also distinguished under each of these two basic categories.[21]

■ *Licensing Levels*

Figure 2.6 Active Licenses, Inventions and Other Intellectual Property, All Federal Labs, FY 1999-2003



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[19] For a background discussion see the Federal Laboratory Consortium's *Technology Transfer Desk Reference*, May 2002, Section 4.5 (accessible at www.federallabs.org).

[20] The "inventions" and "other intellectual property" distinction follows language in current federal statute. "Invention" refers to any invention or discovery that is or may be patentable or otherwise protectable under federal statute. "Other intellectual property" refers to intellectual property other than inventions or discoveries that may nonetheless be protectable, such as through copyright.

[21] For "invention" licenses: patent (including patent application) licenses, material transfer licenses, other kinds of invention licenses. For "other intellectual property" licenses: copyright licenses, material transfer licenses for non-inventions, other kinds of other IP licenses.

For the federal labs together, these statistics (Figure 2.6) indicate there were 6,443 licenses active in FY 2003. Of these, 3,656 are invention licenses (the vast majority are patent licenses); 2,787 are other IP licenses (around two thirds of these are copyright licenses). The general pattern has been substantial growth in licensing over the last five years. (Although, some of the year-to-year growth evident in the chart, particularly in the last several years, reflects more comprehensive reporting by the agencies and the inclusion of a wider set of license categories since FY 2002).

Again, a few of the agencies dominate the overall federal lab picture. DOE licenses accounted for about 57% of the federal lab total in FY 2003. HHS accounted for 21%; NASA for 8%; DOD for 6%; USDA for 4%. The rest of the agencies (DOC, DOI, VA, EPA, and DOT) accounted for only a small fraction of the federal lab total.

As with the other technology transfer activity areas, there are both similarities and differences across the agencies in emphases (Table 2.4, Table 2.5, Figures 2.7a-e).

For most of the agencies, the current license portfolio is overwhelmingly invention licenses -- and, at that, predominantly patent licenses (Table 2.5). Most of the agencies have small to zero levels of other IP licenses. DOE is the exception to this trend, where the current level (FY 2003) of active other IP license is double that of invention licenses.[22]

Beyond the already mentioned large differences between DOE, HHS and the rest of the agencies in the level of licensing, for most all of the agencies, the level of active licenses has either growing or remained stable over the last five years (Figure 2.7a-e).

Table 2.4 – Active Licenses, Inventions and Other Intellectual Property, FY 1999-2003

		FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
DOD	● **All licenses**, number total active in the FY	--	--	288	471	364
	▫ New, executed in the FY	--	--	--	n/a	n/a
	▪ **Invention licenses**, total active in the FY	177	189	283	350	361
	▫ New, executed in the FY	61	67	49	39	49
	▪ **Other IP licenses**, total active in the FY	--	--	5	121	3
	▫ New, executed in the FY	--	--	--	n/a	n/a
DOE	● **All licenses**, number total active in the FY	1,922	2,070	2,005	3,459	3,687
	▫ New, executed in the FY	202	169	226	694	711
	▪ **Invention licenses**, total active in the FY	981	1,094	1,162	1,327	1,223
	▫ New, executed in the FY	202	169	226	206	172
	▪ **Other IP licenses**, total active in the FY	941	976	843	2,132	2,464
	▫ New, executed in the FY	--	--	--	488	539
HHS	● **All licenses**, number total active in the FY	1,364	1,608	1,367	1,357	1,380
	▫ New, executed in the FY	--	--	--	220	211
	▪ **Invention licenses**, total active in the FY	1,041	1,222	1,007	1,213	1,298
	▫ New, executed in the FY	208	192	212	198	199
	▪ **Other IP licenses**, total active in the FY	323	386	360	144	82
	▫ New, executed in the FY	--	--	--	22	12

[22] The majority of these other IP licenses are copyright licenses for software; the agency also cites a substantial number of non-invention material transfer licenses. In contrast to other agencies, many of DOE's federal labs are government owned-contractor operated (GOCO), where the staff are not federal employees and, thereby, may copyright work products (such as computer software) developed through lab activities.

NASA	● **All licenses**, number total active in the FY	288	305	328	357	521
	▫ New, executed in the FY	58	67	65	62	267
	▪ **Invention licenses**, total active in the FY	230	238	292	290	295
	▫ New, executed in the FY	46	46	42	52	66
	▪ **Other IP licenses**, total active in the FY	58	67	36	67	226
	▫ New, executed in the FY	12	21	23	10	201
USDA	● **All licenses**, number total active in the FY	218	225	255	267	270
	▫ New, executed in the FY	29	24	32	26	27
	▪ **Invention licenses**, total active in the FY	218	225	255	267	270
	▫ New, executed in the FY	29	24	32	26	27
	▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
	▫ New, executed in the FY	0	0	0	0	0
DOC	● **All licenses**, number total active in the FY	43	43	40	41	101
	▫ New, executed in the FY	8	4	5	5	59
	▪ **Invention licenses**, total active in the FY	43	43	40	41	101
	▫ New, executed in the FY	8	4	5	5	59
	▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
	▫ New, executed in the FY	0	0	0	0	0
DOI	● **All licenses**, number total active in the FY	12	6	8	n/a	n/a
	▫ New, executed in the FY	0	2	2	n/a	n/a
	▪ **Invention licenses**, total active in the FY	12	6	8	n/a	n/a
	▫ New, executed in the FY	0	2	2	n/a	n/a
	▪ **Other IP licenses**, total active in the FY	0	0	0	n/a	n/a
	▫ New, executed in the FY	0	0	0	n/a	n/a
VA	● **All licenses**, number total active in the FY	--	--	86	81	88
	▫ New, executed in the FY	--	--	--	5	7
	▪ **Invention licenses**, total active in the FY	--	--	76	69	76
	▫ New, executed in the FY	47	3	5	3	7
	▪ **Other IP licenses**, total active in the FY	0	0	10	12	12
	▫ New, executed in the FY	0	0	--	2	0
EPA	● **All licenses**, number total active in the FY	17	18	16	23	32
	▫ New, executed in the FY	2	3	4	9	9
	▪ **Invention licenses**, total active in the FY	17	18	16	23	32
	▫ New, executed in the FY	2	3	4	9	9
	▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
	▫ New, executed in the FY	0	0	0	0	0
DOT	● **All licenses**, number total active in the FY	0	0	1	0	0
	▫ New, executed in the FY	0	0	1	0	0
	▪ **Invention licenses**, total active in the FY	0	0	1	0	0
	▫ New, executed in the FY	0	0	1	0	0
	▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
	▫ New, executed in the FY	0	0	0	0	0
		FY 1999	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**
TOTALS	● **All licenses**, number total active in the FY	3,864	4,275	4,394	6,056	6,443
	▫ New, executed in the FY	299	269	335	1,021	1,291
	▪ **Invention licenses**, total active in the FY	2,719	3,035	3,140	3,580	3,656
	▫ New, executed in the FY	603	510	578	538	588
	▪ **Other IP licenses**, total active in the FY	1,322	1,429	1,254	2,476	2,787
	▫ New, executed in the FY	12	21	23	522	752

Table 2.5 – Active Licenses, by Type, FY 1999-2003

		FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
DOD	● **All licenses**, number total active in the FY	--	--	288	471	364
	▪ **Invention licenses**, total active in the FY	177	189	283	350	361
	- Patent licenses, total active in FY	177	189	283	350	361
	- Material transfer (inventions), tot active in FY	0	0	--	0	0
	- Other invention licenses, total active in FY	0	0	--	0	0
	▪ **Other IP licenses**, total active in the FY	--	--	5	121	3
	- Copyright licenses (fee bearing)	0	0	--	n/a	n/a
	- Material transfer (non-inv.), total active in FY	0	0	--	n/a	n/a
	- Other	0	0	--	n/a	n/a
DOE	● **All licenses**, number total active in the FY	1,922	2,070	2,005	3,459	3,687
	▪ **Invention licenses**, total active in the FY	981	1,094	1,162	1,327	1,223
	- Patent licenses, total active in FY	--	--	1,162	1,327	1,223
	- Material transfer (inventions), tot active in FY	--	--	0	0	0
	- Other invention licenses, total active in FY	--	--	0	0	0
	▪ **Other IP licenses**, total active in the FY	941	976	843	2,132	2,464
	- Copyright licenses (fee bearing)	--	--	--	1,525	1,823
	- Material transfer (non-inv.), total active in FY	--	--	--	581	604
	- Other	--	--	--	26	37
HHS	● **All licenses**, number total active in the FY	1,364	1,608	1,367	1,357	1,380
	▪ **Invention licenses**, total active in the FY	1,041	1,222	1,007	1,213	1,298
	- Patent licenses, total active in FY	--	--	--	736	765
	- Material transfer (inventions), tot active in FY	--	--	--	n/a	n/a
	- Other invention licenses, total active in FY	--	--	--	n/a	n/a
	▪ **Other IP licenses**, total active in the FY	323	386	360	144	82
	- Copyright licenses (fee bearing)	--	--	--	n/a	n/a
	- Material transfer (non-inv.), total active in FY	--	--	--	n/a	n/a
	- Other	--	--	--	144	82
NASA	● **All licenses**, number total active in the FY	288	305	328	357	521
	▪ **Invention licenses**, total active in the FY	230	238	292	290	295
	- Patent licenses, total active in FY	230	238	292	290	295
	- Material transfer (inventions), tot active in FY	0	0	0	0	0
	- Other invention licenses, total active in FY	0	0	0	0	0
	▪ **Other IP licenses**, total active in the FY	58	67	36	67	226
	- Copyright licenses (fee bearing)	52	60	36	67	29
	- Material transfer (non-inv.), total active in FY	0	0	0	0	0
	- Other	6	7	0	0	197
USDA	● **All licenses**, number total active in the FY	218	225	255	267	270
	▪ **Invention licenses**, total active in the FY	218	225	255	267	270
	- Patent licenses, total active in FY	--	--	255	267	269
	- Material transfer (inventions), tot active in FY	--	--	0	0	1
	- Other invention licenses, total active in FY	--	--	0	0	0
	▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
	- Copyright licenses (fee bearing)	0	0	0	0	0
	- Material transfer (non-inv.), total active in FY	0	0	0	0	0
	- Other	0	0	0	0	0

DOC	● **All licenses**, number total active in the FY	43	43	40	41	101
	▪ **Invention licenses**, total active in the FY	43	43	40	41	101
	- Patent licenses, total active in FY	43	43	40	41	101
	- Material transfer (inventions), tot active in FY	0	0	0	0	0
	- Other invention licenses, total active in FY	0	0	0	0	0
	▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
	- Copyright licenses (fee bearing)	0	0	0	0	0
	- Material transfer (non-inv.), total active in FY	0	0	0	0	0
	- Other	0	0	0	0	0
DOI	● **All licenses**, number total active in the FY	12	6	8	n/a	n/a
	▪ **Invention licenses**, total active in the FY	12	6	8	n/a	n/a
	- Patent licenses, total active in FY	--	--	--	n/a	n/a
	- Material transfer (inventions), tot active in FY	--	--	--	n/a	n/a
	- Other invention licenses, total active in FY	--	--	--	n/a	n/a
	▪ **Other IP licenses**, total active in the FY	0	0	0	n/a	n/a
	- Copyright licenses (fee bearing)	0	0	0	n/a	n/a
	- Material transfer (non-inv.), total active in FY	0	0	0	n/a	n/a
	- Other	0	0	0	n/a	n/a
VA	● **All licenses**, number total active in the FY	--	--	86	81	88
	▪ **Invention licenses**, total active in the FY	--	--	76	69	76
	- Patent licenses, total active in FY	0	0	--	n/a	n/a
	- Material transfer (inventions), tot active in FY	0	0	--	n/a	n/a
	- Other invention licenses, total active in FY	0	0	--	n/a	n/a
	▪ **Other IP licenses**, total active in the FY	0	0	10	12	12
	- Copyright licenses (fee bearing)	0	0	--	n/a	n/a
	- Material transfer (non-inv.), total active in FY	0	0	--	n/a	n/a
	- Other	0	0	--	n/a	n/a
EPA	● **All licenses**, number total active in the FY	17	18	16	23	32
	▪ **Invention licenses**, total active in the FY	17	18	16	23	32
	- Patent licenses, total active in FY	--	--	16	23	32
	- Material transfer (inventions), tot active in FY	--	--	0	0	0
	- Other invention licenses, total active in FY	--	--	0	0	0
	▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
	- Copyright licenses (fee bearing)	0	0	0	0	0
	- Material transfer (non-inv.), total active in FY	0	0	0	0	0
	- Other	0	0	0	0	0
DOT	● **All licenses**, number total active in the FY	0	0	1	0	0
	▪ **Invention licenses**, total active in the FY	0	0	1	0	0
	- Patent licenses, total active in FY	0	0	1	0	0
	- Material transfer (inventions), tot active in FY	0	0	0	0	0
	- Other invention licenses, total active in FY	0	0	0	0	0
	▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
	- Copyright licenses (fee bearing)	0	0	0	0	0
	- Material transfer (non-inv.), total active in FY	0	0	0	0	0
	- Other	0	0	0	0	0
		FY 1999	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**
TOTALS	● **All licenses**, number total active in the FY	3,864	4,275	4,394	6,056	6,443
	▪ **Invention licenses**, total active in the FY	2,719	3,035	3,140	3,580	3,656
	- Patent licenses, total active in FY	450	470	2,049	3,034	3,046
	- Material transfer (inventions), total active in FY	--	--	--	0	1
	- Other invention licenses, total active in FY	--	--	--	0	0
	▪ **Other IP licenses**, total active in the FY	1,322	1,429	1,254	2,476	2,787
	- Copyright licenses (fee bearing)	--	--	--	1,592	1,852
	- Material transfer (non-inv.), total active in FY	--	--	--	581	604
	- Other	--	--	--	170	316

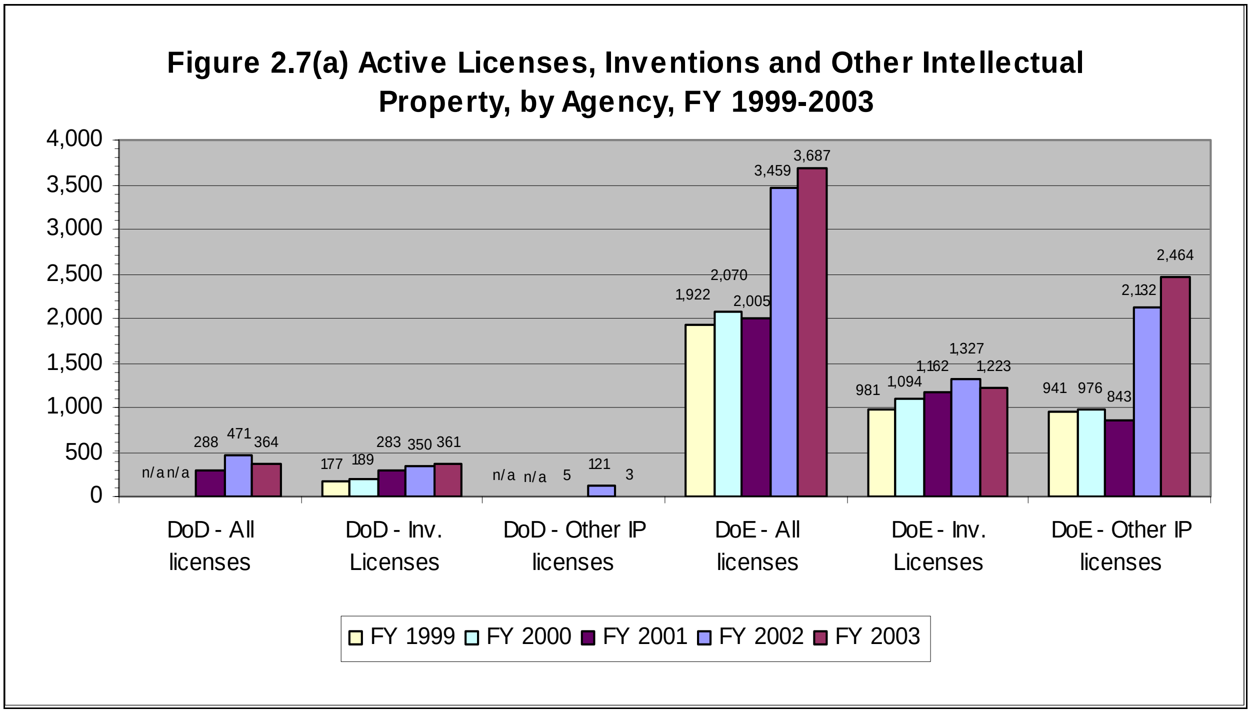


Figure 2.7(a) Active Licenses, Inventions and Other Intellectual Property, by Agency, FY 1999-2003
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
n/a n/a 288 471 364
177 189 283 350 361
n/a n/a 5 121 3
1,922 2,070 2,005 3,459 3,687
981 1,094 1,162 1,327 1,223
941 976 843 2,132 2,464
DoD - All licenses
DoD - Inv. Licenses
DoD - Other IP licenses
DoE - All licenses
DoE - Inv. Licenses
DoE - Other IP licenses
FY 1999 FY 2000 FY 2001 FY 2002 FY 2003

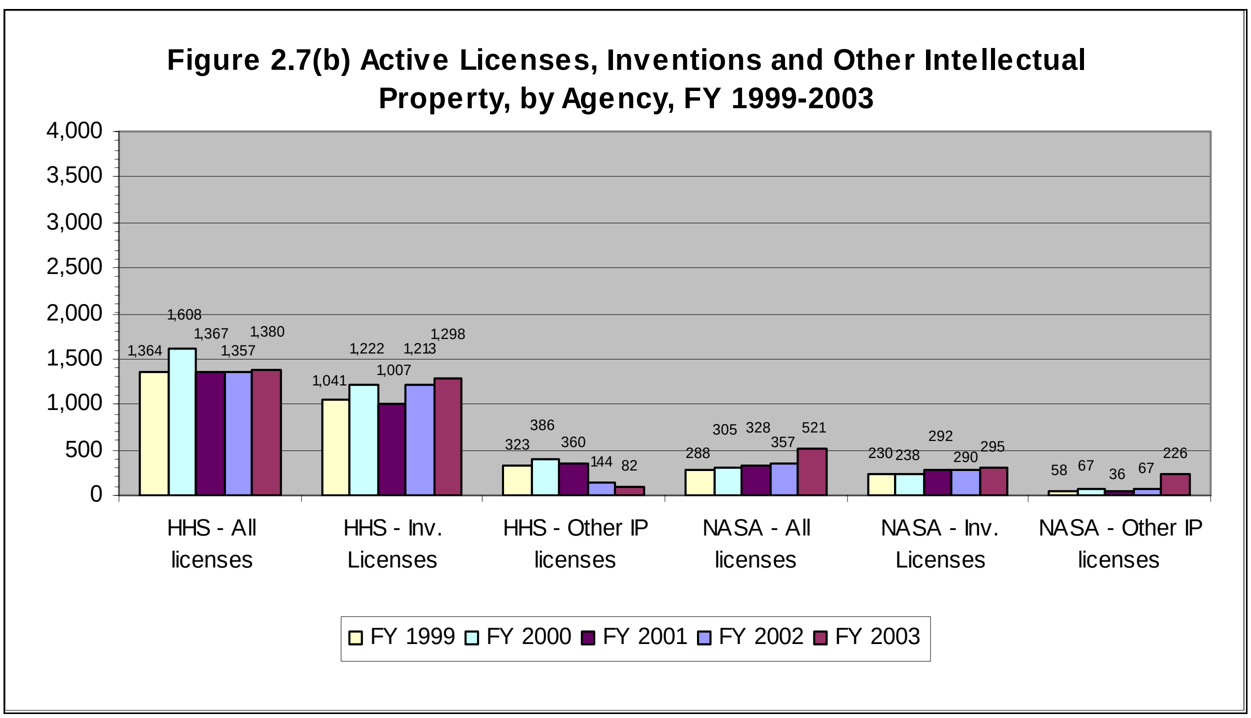


Figure 2.7(b) Active Licenses, Inventions and Other Intellectual Property, by Agency, FY 1999-2003
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1,364 1,608 1,367 1,357 1,380
1,041 1,222 1,007 1,213 1,298
323 386 360 144 82
288 305 328 357 521
230 238 292 290 295
58 67 36 67 226
HHS - All licenses
HHS - Inv. Licenses
HHS - Other IP licenses
NASA - All licenses
NASA - Inv. Licenses
NASA - Other IP licenses
FY 1999 FY 2000 FY 2001 FY 2002 FY 2003

Figure 2.7(c) Active Licenses, Inventions and Other Intellectual Property, by Agency, FY 1999-2003

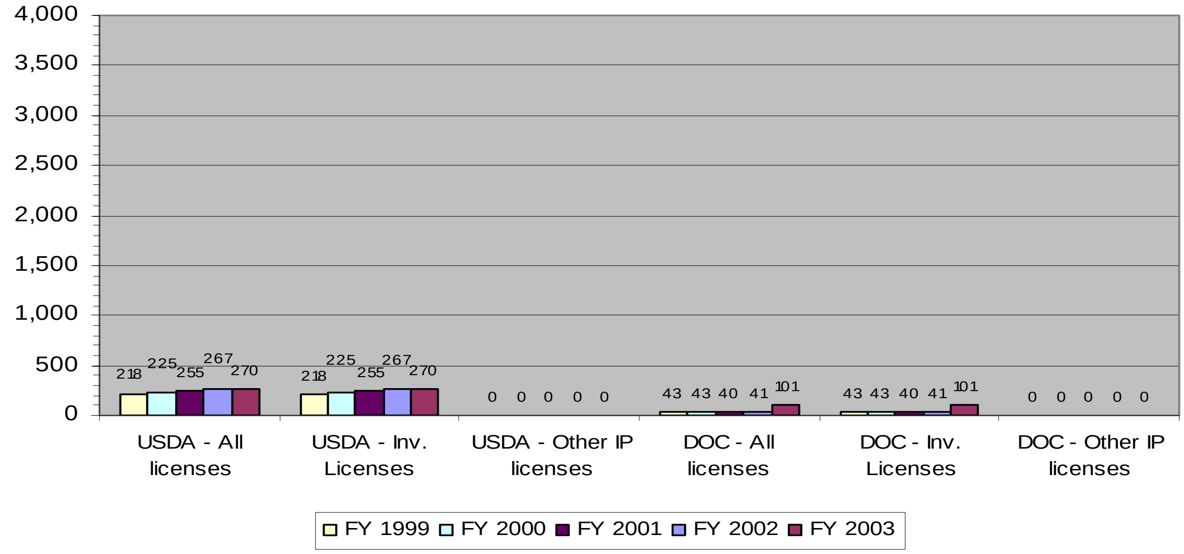


Figure 2.7(d) Active Licenses, Inventions and Other Intellectual Property, by Agency, FY 1999-2003

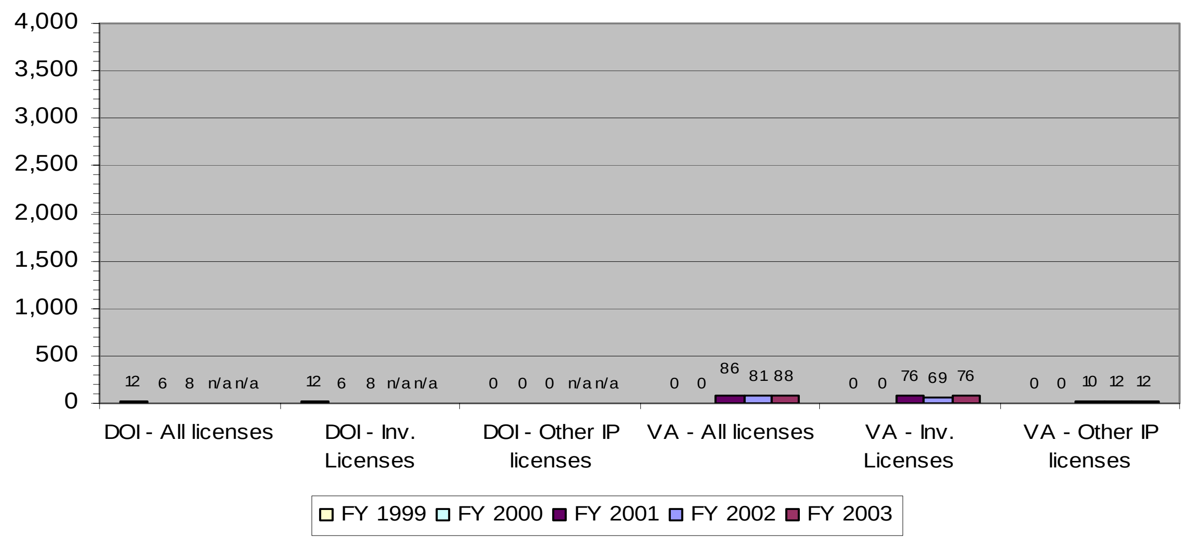
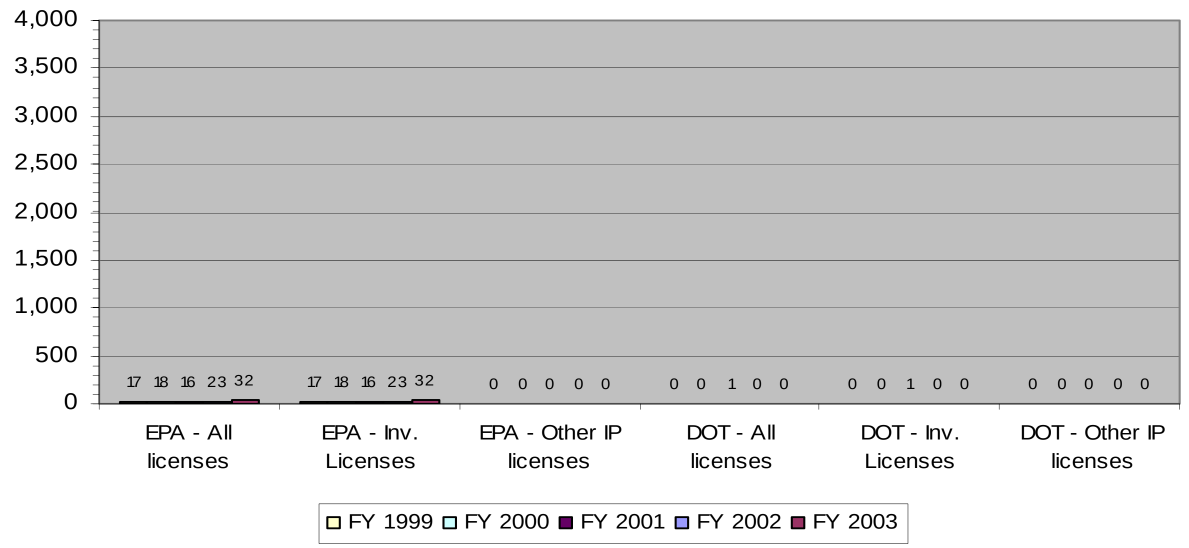


Figure 2.7(e) Active Licenses, Inventions and Other Intellectual Property, by Agency, FY 1999-2003



■ *Income from Licensing*

Figure 2.8 Annual Income from Licenses, All Federal Labs, FY 1999-2003

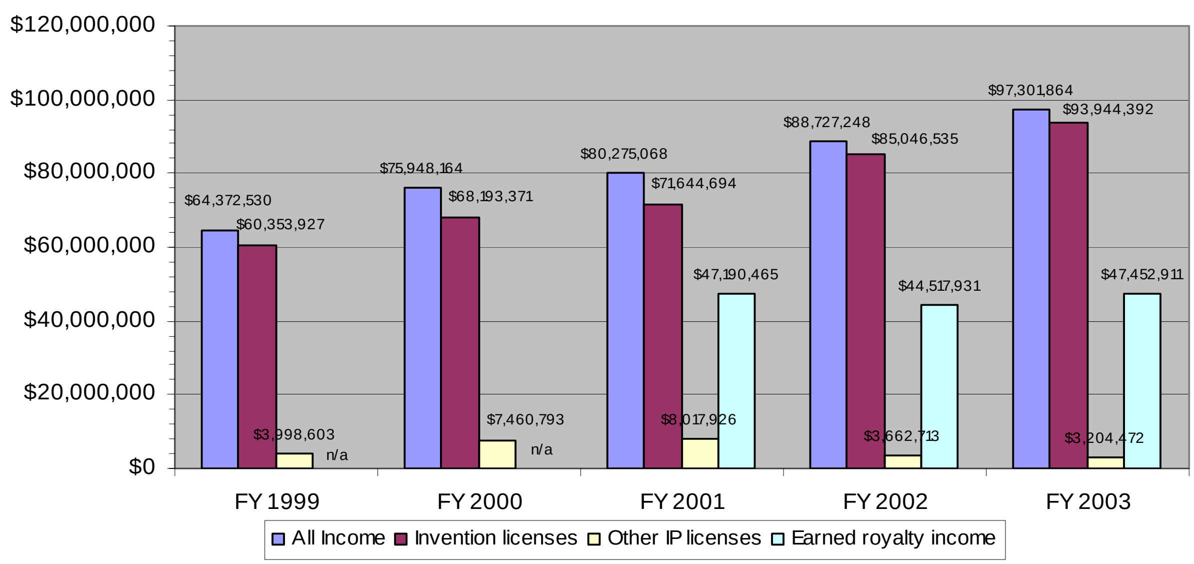


Figure 2.8, Tables 2.6 and 2.7, Figures 2.9a-e provide several perspectives on the income the federal

labs have received annually from active licenses over the last several years.[23]

For the federal labs as a whole, some 62% of the 6,443 licenses active in FY 2003 were income bearing in some way. Around three quarters of these income bearing licenses were non-exclusive (Table 2.7).

Total license income for all the federal labs together in FY 2003 amounted to $96.8 million (Figure 2.8, Table 2.6). Nearly all of this income arose from invention licenses ($93.9 million); only a little ($3.2 million) from other IP licenses (Table 2.6). Furthermore, the level of this income has been expanding at a significant pace over the last five years (Figure 2.8). About 49% of this income came in the form of earned royalties.

There are both similarities and differences when the circumstances of the separate agencies are considered.

HHS licenses accounted for 56% of all Fed lab income in FY 2003 -- reflecting comparatively high economic value and strong commercialization opportunities associated with new technologies in the biosciences realm. DOE licenses accounted for 27% of total income; DOD, 10%; NASA, 3%; and USDA, 2%. The rest of the agencies represented far smaller shares. This pattern of relative agency roles has remained largely the same over the last several years.

Most all of the agencies derive most of their license income from invention licenses. Only DOE, HHS, and NASA report income from other IP licenses (Table 2.6). DOE is exceptional in that other IP licenses accounted for as much as 8% of the agency's license income total in FY 2003 (similar figures have prevailed in previous years).

There is variability among the agencies with respect to the fraction of all licenses that are income bearing; the incidence of exclusive, partially exclusive, and non-exclusive licenses; and the extent to which annual license income results from earned royalties (Table 2.6)

The agencies that account for most of the license income -- HHS, DOE, DOD, and NASA -- have all exhibited consistent growth in license income over the last five years (Table 2.6, Figures 2.9a-e). Year to year growth has been less consistent over the same period for the other agencies. In fact, the five year pattern has been nearly one of declining license income for DOC and DOT.

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[23] Several definitions (used currently by the agencies in reporting) regarding income from licenses are useful to mention here. In general, license income can arise in one or more of several ways: license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

"Income/royalty-bearing license" = a license whose negotiated terms provide for receipt of income (or royalties) by the licensor.

"Total income from license" = income of any form (see above), paid to licensor (in a given year), that arises from an active license.

"Earned royalty income" = royalty payment to a licensor that is based on the use of a licensed invention (usually, a percentage of sales or of units sold); not a license issue fee or a minimum royalty. Such payments are earned income from the commercial marketplace, which can be taken as a measure of a lab's active management and successful transfer of its intellectual property.

Table 2.6 – Income from Licensing, FY 1999-2003

		FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
DOD	● **Total income**, all licenses active in FY	$2,005,000	$2,213,000	$6,465,468	$6,715,597	$9,965,586
	▪ **Invention licenses**	$2,005,000	$2,213,000	$6,383,468	$6,713,679	$9,965,586
	▪ **Other IP licenses**, total active in the FY	$0	$0	$82,000	$1,918	$0
	● **Total Earned Royalty Income** (ERI)	--	--	n/a	n/a	n/a
DOE	● **Total income**, all licenses active in FY	$11,764,000	$15,840,000	$21,403,362	$23,476,716	$25,805,498
	▪ **Invention licenses**	$10,199,000	$12,710,000	$18,921,843	$21,253,279	$23,669,908
	▪ **Other IP licenses**, total active in the FY	$1,545,000	$2,836,000	$1,870,071	$2,223,437	$2,135,590
	● **Total Earned Royalty Income** (ERI)	$1,975,000	$2,228,000	$7,832,481	$5,604,774	$6,611,568
HHS	● **Total income**, all licenses active in FY	$44,821,000	$52,547,000	$46,722,000	$52,882,331	$55,198,722
	▪ **Invention licenses**	$42,599,000	$48,592,000	$41,322,000	$51,868,102	$54,570,939
	▪ **Other IP licenses**, total active in the FY	$2,222,000	$3,955,000	$5,400,000	$1,014,229	$627,783
	● **Total Earned Royalty Income** (ERI)	$34,599,000	$43,892,000	$36,612,000	$36,012,005	$38,338,328
NASA	● **Total income**, all licenses active in FY	$1,360,061	$1,756,796	$1,970,739	$2,498,167	$2,852,985
	▪ **Invention licenses**	$1,128,458	$1,087,003	$1,318,884	$2,075,038	$2,411,886
	▪ **Other IP licenses**, total active in the FY	$231,603	$669,793	$651,855	$423,129	$441,099
	● **Total Earned Royalty Income** (ERI)	$183,294	$116,490	$521,164	$554,769	$814,624
USDA	● **Total income**, all licenses active in FY	$2,377,000	$2,555,000	$2,622,000	$2,571,378	$2,290,903
	▪ **Invention licenses**	$2,377,000	$2,555,000	$2,622,000	$2,571,378	$2,290,903
	▪ **Other IP licenses**, total active in the FY	$0	$0	$0	$0	$0
	● **Total Earned Royalty Income** (ERI)	$1,843,000	$1,843,000	$1,409,252	$1,569,877	$1,560,825
DOC	● **Total income**, all licenses active in FY	$405,469	$186,368	$268,568	$164,622	$127,566
	▪ **Invention licenses**	$405,469	$186,368	$268,568	$164,622	$127,566
	▪ **Other IP licenses**, total active in the FY	$0	$0	$0	$0	$0
	● **Total Earned Royalty Income** (ERI)	$405,279	$186,368	$263,568	$99,152	$127,566
DOI	● **Total income**, all licenses active in FY	$1,640,000	$850,000	$235,000	n/a	n/a
	▪ **Invention licenses**	$1,640,000	$850,000	$235,000	n/a	n/a
	▪ **Other IP licenses**, total active in the FY	$0	$0	$0	n/a	n/a
	● **Total Earned Royalty Income** (ERI)	$1,640,000	$850,000	$220,000	n/a	n/a
VA	● **Total income**, all licenses active in FY	--	--	$38,000	$18,000	$153,000
	▪ **Invention licenses**	--	--	$23,000	n/a	n/a
	▪ **Other IP licenses**, total active in the FY	--	--	$14,000	n/a	n/a
	● **Total Earned Royalty Income** (ERI)	--	--	$17,000	n/a	n/a
EPA	● **Total income**, all licenses active in FY	--	--	$544,431	$400,437	$907,604
	▪ **Invention licenses**	--	--	$544,431	$400,437	$907,604
	▪ **Other IP licenses**, total active in the FY	--	--	$0	$0	$0
	● **Total Earned Royalty Income** (ERI)	--	$533,906	$315,000	$677,354	$0
DOT	● **Total income**, all licenses active in FY	$0	$0	$5,500	$0	$0
	▪ **Invention licenses**	$0	$0	$5,500	$0	$0
	▪ **Other IP licenses**, total active in the FY	$0	$0	$0	$0	$0
	● **Total Earned Royalty Income** (ERI)	$0	$0	n/a	$0	$0
		FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
TOTALS	● **Total income**, all licenses active in FY	$64,372,530	$75,948,164	$80,275,068	$88,727,248	$97,301,864
	▪ **Invention licenses**	$60,353,927	$68,193,371	$71,644,694	$85,046,535	$93,944,392
	▪ **Other IP licenses**, total active in the FY	$3,998,603	$7,460,793	$8,017,926	$3,662,713	$3,204,472
	● **Total Earned Royalty Income** (ERI)	--	--	n/a	n/a	n/a
	● **Total income**, all licenses active in FY	--	--	--	--	--
	▪ **Invention licenses**	93.8%	89.8%	89.2%	95.9%	96.5%
	▪ **Other IP licenses**, total active in the FY	6.2%	9.8%	10.0%	4.1%	3.3%
	● **Total Earned Royalty Income** (ERI)	--	--	n/a	n/a	n/a

Table 2.7 – Characteristics of Income Bearing Licenses, FY 1999-2003

		FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
DOD	● **All licenses**, number total active in the FY	--	--	288	471	364
	● **All income bearing licenses**, number	--	--	--	n/a	n/a
	▫ Exclusive	--	--	--	n/a	n/a
	▫ Partially exclusive	--	--	--	n/a	n/a
	▫ Non-exlusive	--	--	--	n/a	n/a
DOE	● **All licenses**, number total active in the FY	1,922	2,070	2,005	3,459	3,687
	● **All income bearing licenses**, number	--	--	1,012	2,523	2,523
	▫ Exclusive	--	--	174	301	246
	▫ Partially exclusive	--	--	112	136	235
	▫ Non-exlusive	--	--	726	2,086	2,042
HHS	● **All licenses**, number total active in the FY	1,364	1,608	1,367	1,357	1,380
	● **All income bearing licenses**, number	--	--	--	751	821
	▫ Exclusive	0	0	0	115	121
	▫ Partially exclusive	0	0	0	11	9
	▫ Non-exlusive	0	0	0	625	691
NASA	● **All licenses**, number total active in the FY	288	305	328	357	521
	● **All income bearing licenses**, number	163	171	105	131	247
	▫ Exclusive	87	99	53	64	139
	▫ Partially exclusive	14	13	13	17	19
	▫ Non-exlusive	62	59	39	50	89
USDA	● **All licenses**, number total active in the FY	218	225	255	267	270
	● **All income bearing licenses**, number	--	--	241	265	268
	▫ Exclusive	--	--	n/a	179	183
	▫ Partially exclusive	--	--	n/a	37	41
	▫ Non-exlusive	--	--	n/a	49	44
DOC	● **All licenses**, number total active in the FY	43	43	40	41	101
	● **All income bearing licenses**, number	20	18	22	39	37
	▫ Exclusive	--	--	16	19	20
	▫ Partially exclusive	--	--	5	2	0
	▫ Non-exlusive	--	--	4	18	17
DOI	● **All licenses**, number total active in the FY	12	6	8	n/a	n/a
	● **All income bearing licenses**, number	11	5	6	n/a	n/a
	▫ Exclusive	--	--	0	n/a	n/a
	▫ Partially exclusive	--	--	0	n/a	n/a
	▫ Non-exlusive	--	--	6	n/a	n/a
VA	● **All licenses**, number total active in the FY	--	--	86	81	88
	● **All income bearing licenses**, number	--	--	58	60	67
	▫ Exclusive	--	--	3	4	8
	▫ Partially exclusive	--	--	2	2	2
	▫ Non-exlusive	--	--	53	54	57
EPA	● **All licenses**, number total active in the FY	17	18	16	23	32
	● **All income bearing licenses**, number	--	--	16	23	32
	▫ Exclusive	0	0	6	7	7
	▫ Partially exclusive	0	0	2	2	2
	▫ Non-exlusive	0	0	8	14	23

DOT	• **All licenses**, number total active in the FY			0	0	1	0	0
	• **All income bearing licenses**, number			0	0	1	0	0
	▫ Exclusive			0	0	0	0	0
	▫ Partially exclusive			0	0	0	0	0
	▫ Non-exlusive			0	0	1	0	0
				FY 1999	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**
TOTALS	• **All licenses**, number total active in the FY			3,864	4,275	4,394	6,056	6,443
	• **All income bearing licenses**, number			--	--	--	3,792	3,995
	▫ Exclusive			--	--	--	689	724
	▫ Partially exclusive			--	--	--	207	308
	▫ Non-exlusive			--	--	--	2,896	2,963
	• **All licenses**, number total active in the FY			--	--	--	--	--
	• **All income bearing licenses**, number			--	--	--	62.6%	62.0%
	▫ Exclusive			--	--	--	18.2%	18.1%
	▫ Partially exclusive			--	--	--	5.5%	7.7%
	▫ Non-exlusive			--	--	--	76.4%	74.2%

Figure 2.9(a) Income from Licenses, by Agency, FY 1999-2003

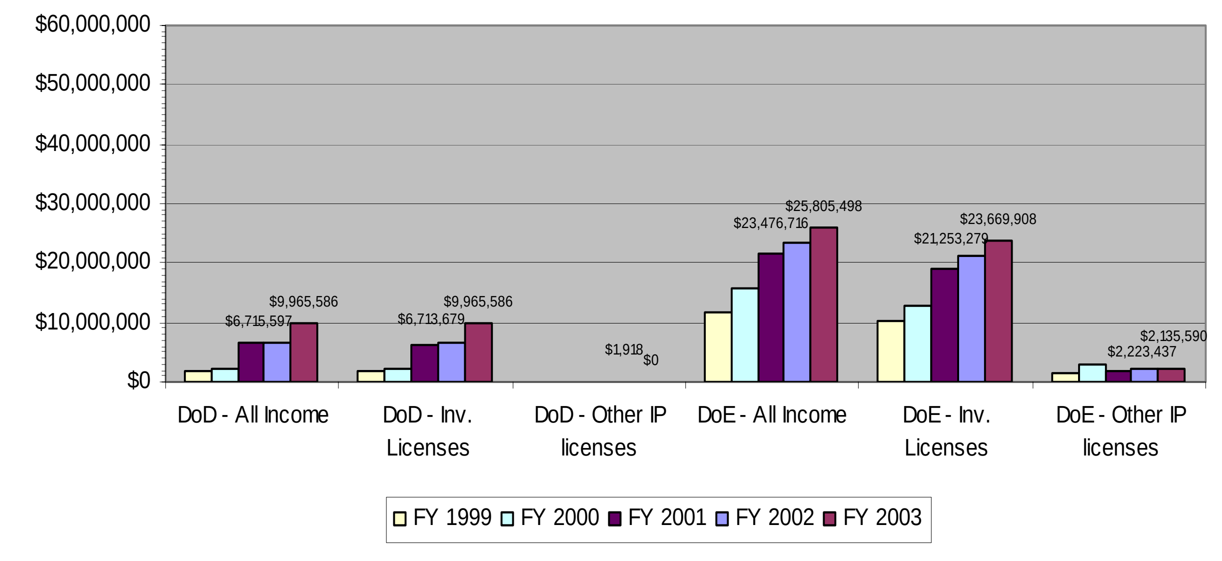


Figure 2.9(b) Income from Licenses, by Agency, FY 1999-2003

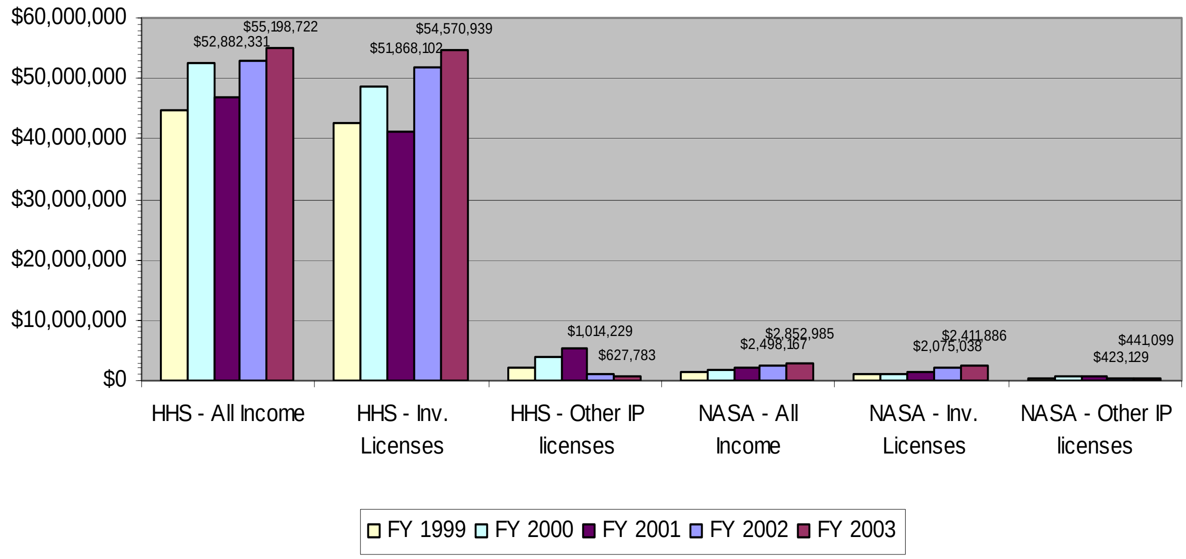


Figure 2.9(c) Income from Licenses, by Agency, FY 1999-2003

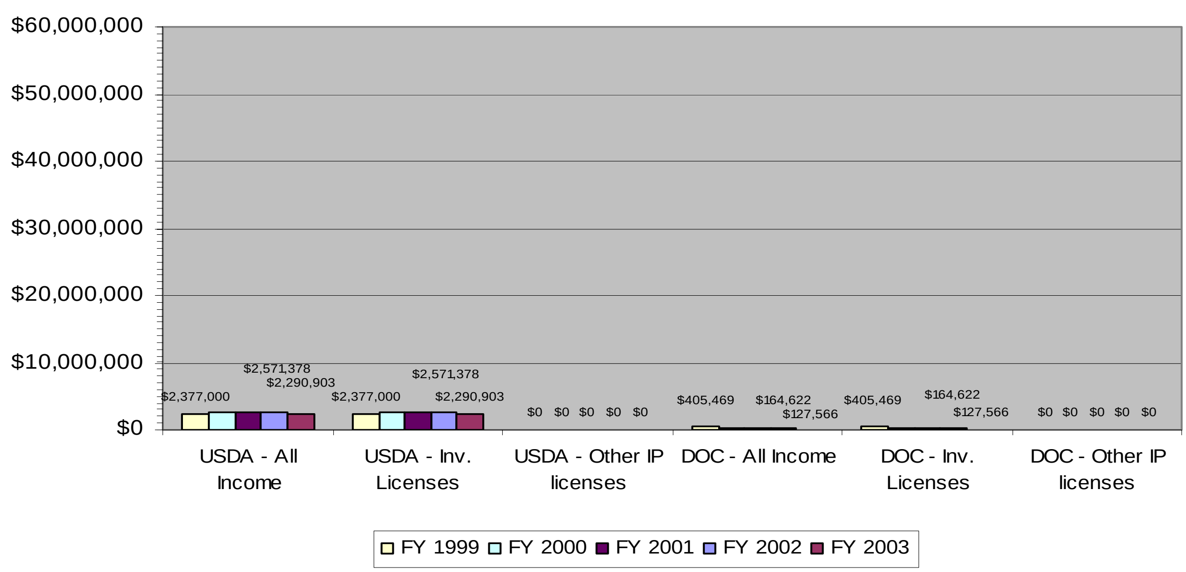


Figure 2.9(d) Income from Licenses, by Agency, FY 1999-2003

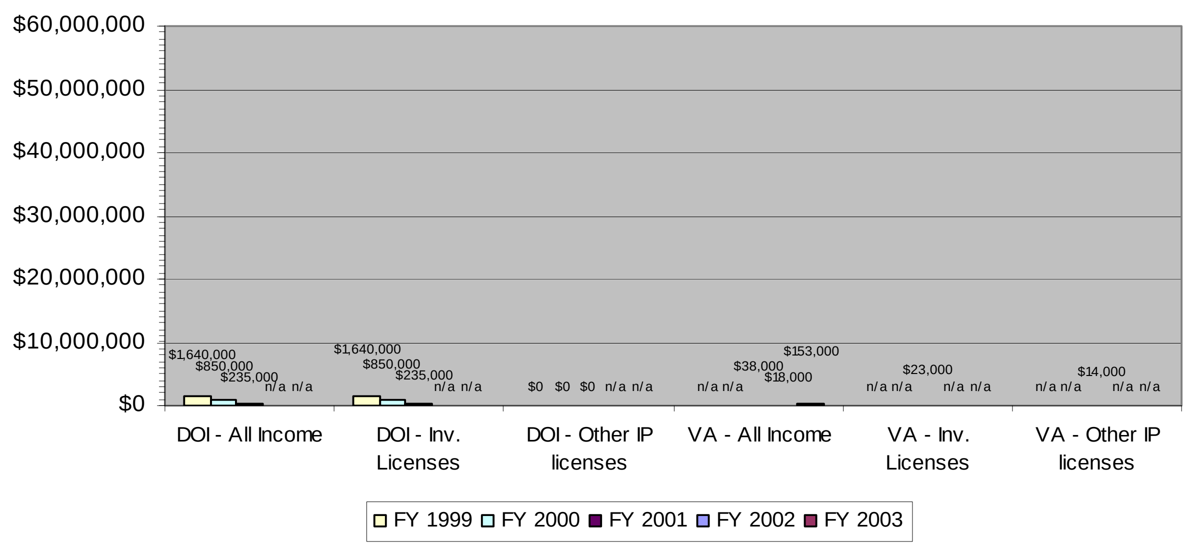
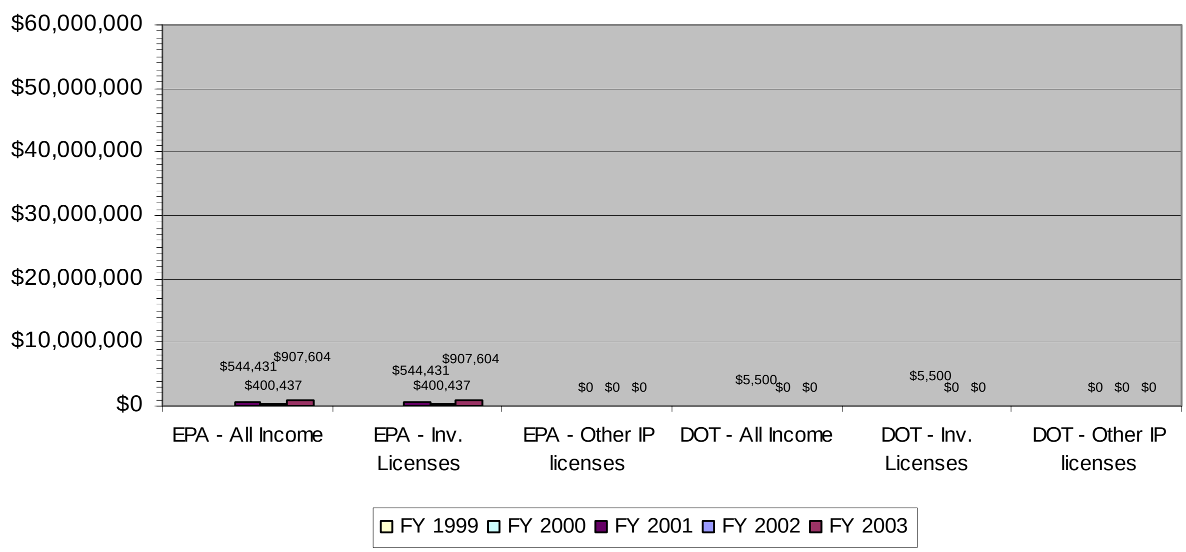


Figure 2.9(e) Income from Licenses, by Agency, FY 1999-2003



■ *Disposition of License Income*

As part of the revised annual reporting process under the Technology Transfer Commercialization Act, the federal labs (starting with the FY 2001 reporting), the federal labs were asked to provide data on their disposition of income derived from invention licenses active in the fiscal year -- that is, license income dollars distributed to various types of recipients (e.g., inventors, within-agency uses).

Nine of the ten reporting agencies provided data for FY 2003 on the issue. The fraction of license income distributed "to inventors" continues to vary widely across the agencies: from zero to 68% (among the reporting agencies). And, for most of the agencies, the remainder of disposed income was directed to internal purposes such as "additional R&D," "patent filing expenses," or "other fees."

Agency by agency details on these measures can be found in the agency sections of Chapter 3.

■ *License Management Issues*

The revised annual reporting process established under the Technology Transfer Commercialization Act requested the federal labs (starting with the FY 2001 reporting) to provide annual performance information on some license management issues. The specific items are:

● *Elapsed time for licenses executed in the fiscal year*

● *Licenses terminated for cause in the fiscal year*

Most of the agencies now provide this information (with a focus on invention licenses). Agency by agency figures for FY 2001-2003 can be found in the agency summary sections of Chapter 3.

In general, there are wide differences in the agency experiences: e.g., the <u>average</u> elapsed time for execution (among the agencies reporting) in FY 2003 ranged from 1.4 to 10.1 months; the minimum time was only a few days, the maximum was 39.3 months; there is little suggestion of a trend change in these times over the three fiscal years for which data is now available.

2.4 Other Activity Measures

The revised reporting process in place since FY 2001 provides the federal labs with opportunity to include data on activity measures additional to the core items (cooperative R&D, patenting, and licensing) that thus far have been the focus of this chapter. The labs are free to identify and discuss such "other" measures, to the extent they are deemed important for characterizing the overall technology transfer program.

In the last several years, a growing number of agencies have made a point of discussing such additional activities. Thus far, however, only two agencies have incorporated metrics for these "other activities" in their annual reporting:

● *Department of Commerce*
  - Standard Reference Materials available

- Standard Reference Materials sold
- Standard Reference Data titles available
- Number of Items Calibrated
- Technical publications produced

● *Department of Energy*
- Work-for-Others agreements
- User facility agreements, projects

A concise account of these activity measures and the FY 1999-2003 statistics provided can be found in each agency's individual section in Chapter 3 of this report.

The nature and annual level of these activities vary widely. But, in most cases, the annual volume is quite large -- at levels similar to or greater than those of core technology transfer activities -- and has remained so for a number of years.

2.5 Outcomes from Technology Transfer

To better understand what outcomes are being achieved from federal lab technology transfer, the agencies have been invited as part of the overall annual reporting process (starting with the Department of Commerce's *Biennial Report* published in May 2002 and continuing on in the present report) to submit current examples of successful downstream technology transfer outcomes.

More than 110 such outcome cases were included by the federal labs in their annual technology transfer reports for FY 2003. These cases are listed and described later in this *Summary Report* (see the agency summary sections of Chapter 3).

The agencies were requested to provide a selected set of illustrative outcome cases. Accordingly, the cases reported in Chapter 3 are not an exhaustive tally of all downstream technology transfer outcomes achieved by the federal labs in FY 2003.

It is often difficult to analytically demonstrate direct connections between federal lab technology transfer actions and eventual commercial products/processes, because many actors and actions may be involved after transfer from a federal lab. Moreover, the actual development and commercialization of an idea often involves a number of years, so that tangible results can take some time before becoming apparent. Despite these challenges to analysis and long term downstream data collection, many agency technology transfer professionals and other knowledgeable analysts regard downsteam outcome cases as much better evidence of technology transfer program performance than the quantitative activity statistics described earlier in this chapter.

The transfer of federal lab know-how and technology to private industry partners can provide benefits to the partners and to society in numerous ways. For example, (1) new technology developed by a federal lab's scientists and engineers (and protected as intellectual property) might be licensed to one or more private industry partners that develop and successfully commercialize new products and processes based on that technology; (2) new technology or know-how developed as the result of a cooperative R&D partnership between a federal lab and an industrial partner may provide new ways for the industrial partner to improve a product line or production processes; or (3) the same kind of cooperative federal lab/industry partnership can yield new technology and know-how that may improve the federal lab's capabilities for its mission-related work.

All of these kinds of outcomes are illustrated in agency outcome cases described in Chapter 3.

Chapter 3
Summary of Statistics on Technology Transfer Activities and Outcomes Provided by the Agencies in their FY 2003 Annual Reports

The primary source of data on federal lab technology transfer activities for this *Summary Report* is each agency's *Annual Utilization Report* submitted earlier this year in accordance with 15 USC Sec. 3710(f). As noted in Chapter 1 of this report, each agency is directed to discuss in these annual documents the agency's present plans for technology transfer by its federal labs, along with information about recent program activities.

This chapter seeks to provide a comparable summary of the content of these ten agency reports. Three main topic areas are addressed:

- Statistical data on the agency's technology transfer activity levels for a number of measures (e.g., cooperative research and development relationships, invention disclosure and patenting, and intellectual property licensing) for the most recently closed fiscal year (FY 2003) and several prior years (chiefly, FY 1999-2002).

- Reported examples of successful downstream outcomes arising from the agency's technology transfer activities (such as new products or improved industrial processes available in the marketplace that arise from the transfer and commercialization of federal lab inventions).

This chapter is not intended to provide an exhaustive account of the information submitted in the agencies' individual reports.[24] For greater detail, reader should consult each agency's primary document; citations are provided in the sections below.

page

[24] Given the summary nature of this report, the technology transfer statistics in this chapter are provided only at the aggregate department/agency level. A number of the agencies' individual reports provide disaggregated figures for agency bureaus/divisions/services/offices and should be consulted for additional detail.

3.1 Department of Agriculture

This section summarizes the statistics and other data provided by the department in its annual reports on the technology transfer activities and outcomes of its federal laboratories. Currently, these reports provide data through FY 2003. This information covers the activities of the Agricultural Research Service (ARS) and other federal lab technology transfer across the department (unless otherwise noted in the tables below). For additional details, readers should consult the department's full report.[25]

■ Collaborative Relationships for Research and Development

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **CRADAs**, total active in the FY[(1)]			--	--	219	225	229
- New, executed in the FY			--	--	49	59	55
▪ Traditional CRADAs,[(2)] total active in the FY	128	229	298	257	217	222	223
- New, executed in the FY			101	69	49	58	51
▪ Non-traditional CRADAs,[(3)] total active in FY			--	--	2	3	6
- New, executed in the FY			--	--	0	1	4
● **Other collaborative R&D relationships**							
▪ Material transfer agreements, total at end of FY			--	--	--	n/a	n/a
- New, executed in the FY			--	--	--	436	355
▪ Reimbursable agreements, totat at end FY			--	--	2,192	1,896	1,625
- New, executed in the FY			--	--	518	510	623
▪ Trust agreements, total at end FY			--	--	1,487	1,315	1,144
- New, executed in the FY			--	--	522	470	502

CRADA = Cooperative Research and Development Agreement
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of past years.

(1) "Active" = legally in force at any time during the FY. "Total active" includes all agreements executed under CRADA authority (15 USC 3710a).
(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.
(3) CRADAs used for special purposes -- such as material transfer or technical assistance that may result in protected information.

■ Invention Disclosure and Patenting

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● New inventions disclosed in the FY[(1)]	158	133	162	109	118	151	121
● Patent applications filed in the FY[(2)]	76	80	84	78	83	90	60
● Patents issued in the FY			74	64	64	53	64

(1) Inventions arising at the federal lab.
(2) Tally includes: U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes: provisional, continuation, duplicate foreign, and PCT applications.

[25] U.S. Department of Agriculture, *FY 2003 Annual Reporting on Agency Technology Transfer*, TT2003.USDA, November 10, 2003. Report prepared in response to 15 USC Sec. 3710(f) (requiring an annual "agency report on utilization" for agencies with federal laboratories) and submitted to OMB (consistent with Circular A-11 guidelines).

■ Licensing

Profile of Active Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All licenses**, number total active in the FY[1]			218	225	255	267	270
▫ New, executed in the FY			29	24	32	26	27
▪ **Invention licenses**, total active in the FY			218	225	255	267	270
▫ New, executed in the FY	33	21	29	24	32	26	27
- Patent licenses,[2] total active in FY			--	--	255	267	269
▫ New, executed in the FY			--	--	32	26	26
- Material transfer (inventions), tot active in FY			--	--	0	0	1
▫ New, executed in the FY			--	--	0	0	1
- Other invention licenses,[3] total active in FY			--	--	0	0	0
▫ New, executed in the FY			--	--	0	0	0
▪ **Other IP licenses**, total active in the FY			0	0	0	0	0
▫ New, executed in the FY			0	0	0	0	0
- Copyright licenses (fee bearing)							
▫ New, executed in the FY							
- Material transfer (non-inv.), total active in FY							
▫ New, executed in the FY							
- Other [4]							
▫ New, executed in the FY							

Forest Service/USDA included in the data starting in FY 2002.

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (i.e., hybrid licenses) are reported as patent licenses -- and not included in the count of copyright licenses.

-- = Data not requested from agency in reports of past years.

(1) "Active" = legally in force at any time during the FY.
(2) Patent license tally includes patent applications that are licensed.
(3) No licenses of this type indicated as active.
(4) No licenses of this type indicated as active.

Licensing Management

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Elapsed execution time,[1] licenses granted in FY**							
▪ **Invention licenses**							
▫ average months			--	--	3.5	6.5	7.0
▫ minimum			--	--	2.0	1.9	2.8
▫ maximum			--	--	6.1	11.5	13.3
- Patent licenses[2]							
▫ average months			--	--	3.5	6.5	7.1
▫ minimum			--	--	2.0	1.9	2.8
▫ maximum			--	--	6.1	11.5	13.3
● **Number of licenses terminated for cause in FY**							
▪ **Invention licenses**			--	--	1	3	0
- Patent licenses[2]			--	--	1	3	0

Data included in this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a subclass.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)
(2) Patent license tally includes patent applications which are licensed.

Characteristics of Licenses Bearing Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All income bearing licenses**, number			--	--	241	265	268
▫ Exclusive			--	--	n/a	179	183
▫ Partially exclusive			--	--	n/a	37	41
▫ Non-exclusive			--	--	n/a	49	44
▪ **Invention licenses**, income bearing			--	--	241	265	267
▫ Exclusive			--	--	n/a	179	183
▫ Partially exclusive			--	--	n/a	37	41
▫ Non-exclusive			--	--	n/a	49	43
- Patent licenses,(1) income bearing			--	--	241	265	267
▫ Exclusive			--	--	n/a	179	183
▫ Partially exclusive			--	--	n/a	37	41
▫ Non-exclusive			--	--	n/a	49	43
▪ **Other IP licenses**, income bearing			--	--	0	0	0
▫ Exclusive			--	--			
▫ Partially exclusive			--	--			
▫ Non-exclusive			--	--			
- Copyright licenses (fee bearing)			--	--			
▫ Exclusive			--	--			
▫ Partially exclusive			--	--			
▫ Non-exclusive			--	--			
● **All royalty bearing licenses**,(2) number			--	--	56	67	75
▪ **Invention licenses**, royalty bearing, number			--	--	56	67	75
- Patent licenses,(1) royalty bearing			--	--	56	67	75
▪ **Other IP licenses**, royalty bearing			--	--	0	0	0
- Copyright licenses (fee bearing)							

Forest Service/USDA included in the data starting in FY 2002.

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalites, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of past years.

(1) Patent license tally includes patent applications that are licensed.
(2) Note that royalties are one component of total license income.

Income (annual) from Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Total income**, all licenses active in FY (1)			$2,377,000	$2,555,000	$2,622,000	$2,571,378	$2,290,903
▪ **Invention licenses**	$559,000	$1,635,000	$2,377,000	$2,555,000	$2,622,000	$2,571,378	$2,290,903
- Patent licenses (2)			$2,377,000	$2,555,000	$2,622,000	$2,571,378	$2,290,903
▪ **Other IP licenses**, total active in the FY			$0	$0	$0	$0	$0
- Copyright licenses							
● **Total Earned Royalty Income** (ERI) (3)			$1,843,000	$1,843,000	$1,409,252	$1,569,877	$1,560,825
▫ Median ERI			--	--	$5,723	$5,096	$3,102
▫ Minimum ERI			--	--	$78	$79	$159
▫ Maximum ERI			--	--	$563,320	$569,265	$236,306
▫ ERI from top 1% of licenses			--	--	dw	dw	dw
▫ ERI from top 5% of licenses			--	--	$723,167	$794,418	$696,532
▫ ERI from top 20% of licenses			--	--	$1,109,051	$1,254,545	$1,292,383
▪ **Invention licenses**			$1,843,000	$1,843,000	$1,409,252	$1,569,877	$1,560,825
▫ Median ERI			--	--	$5,723	$5,096	$3,102
▫ Minimum ERI			--	--	$78	$79	$159
▫ Maximum ERI			--	--	$563,320	$569,265	$236,306
▫ ERI from top 1% of licenses			--	--	dw	dw	dw
▫ ERI from top 5% of licenses			--	--	$723,167	$794,418	$696,532
▫ ERI from top 20% of licenses			--	--	$1,109,051	$1,254,545	$1,292,383
- Patent licenses (2)			$1,843,000	$1,843,000	$1,409,252	$1,569,877	$1,560,825
▫ Median ERI					$5,723	$5,096	$3,102
▫ Minimum ERI					$78	$79	$159
▫ Maximum ERI					$563,320	$569,265	$236,306
▫ ERI from top 1% of licenses					dw	dw	dw
▫ ERI from top 5% of licenses					$723,167	$794,418	$696,532
▫ ERI from top 20% of licenses					$1,109,051	$1,254,545	$1,292,383
▪ **Other IP licenses**			$0	$0	$0	$0	$0
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							
- Copyright licenses							
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							

Forest Service/USDA included in the data starting in FY 2002.

-- = Data not requested from agency in reports of earlier years. dw = Data withheld to protect proprietary information.

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

(2) Patent license tally includes patent applications that are licensed.

(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or units sold). Not a license fee or minimum royalty.

Disposition of License Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Income distributed** (1)							
▪ **Invention licenses**, total distributed			--	--	$2,621,900	$2,463,240	$2,586,583
- To inventors			--	--	$681,700	$543,336	$540,399
					26%	22%	21%
-To other(2)			--	--	$1,940,200	$1,919,904	$2,046,184
					74%	78%	79%
- Patent licenses,(3) total distributed			--	--	$2,621,900	$2,463,240	$2,586,583
- To inventors			--	--	$681,700	$543,336	$540,399
					26%	22%	21%
-To other(2)			--	--	$1,940,200	$1,919,904	$2,046,184
					74%	78%	79%

Forest Service/USDA included in the data starting in FY 2002.

Invention licenses are the chief policy interest regarding distribution of income; content of this table reflects this focus.

-- = Data not requested from agency in reports of earlier years.

(1) Income includes royalties and other payments received during the FY.

(2) Salaries of (some) technology transfer staff; patent filing preparation fees and patent annuity payments; other technolgy transfer expenses.

(3) Patent license tally includes patent applications that are licensed.

■ Other Performance Measures

None cited.

■ Downstream Outcomes

USDA's FY 2003 report provided the following selected examples of downstream outcomes arising from the technology transfer activities of the department's federal laboratories:

● **An ARS-developed rapid avian influenza diagnostic test** was used to help control a disease outbreak of this virus in an emergency situation. This rapid, sensitive, polymerase chain reaction (PCR) test was used in March 2002 during an avian influenza outbreak in turkeys and chickens in Virginia. This is the first time a PCR diagnostic test was used to help control a major animal disease outbreak in the United States. Concerns about the virus becoming highly pathogenic and potentially disrupting poultry trade led the state to make a decision to eradicate the virus by identifying and destroying infected flocks.

The existing detection method used to identify infected birds was time consuming, and required daily handling of eggs. The emergency situation called for a more efficient alternative. ARS's real-time PCR test, which allowed for quick testing of birds versus eggs, was compared to the other method through a cooperative effort with Animal and Plant Health Inspection Service staff and animal health officials from Virginia. Results showed that ARS's test provided similar sensitivity and specificity for the particular strain of avian influenza as the other test. With the ARS PCR test, results could be obtained within 3 to 24 hours, compared to several days with the old test method. The Virginia situation generated widespread interest nationwide, and ARS scientists have facilitated the use of this test by veterinary diagnostic labs in more than 10 states. In addition, ARS researchers are working with international partners in Chile, Hong Kong, Canada, Peru, Mexico, and South Korea to teach them how to use and implement the test to help control the virus in those countries.

- **NWAC103**, the first USDA fish germplasm release, is making a huge splash with commercial catfish producers. Catfish producers have long awaited development of a new higher performing catfish variety. Now, thanks to this joint release effort between ARS and Mississippi Agricultural and Forestry Experiment Station researchers, producers are now stocking NWAC103 fingerlings. In 2002, 141 million catfish fry were produced, which was an increase of 281 percent over the amount produced during 2001. Other catfish varieties usually require 18 to 24 months to reach market size, but the new catfish line grows up to 20 percent faster in the pond so it can be marketed sooner. NWAC103 catfish consume 10 to 20 percent more feed and can grow 9 percent faster than other commercial catfish lines currently in use. They also tend to mature earlier and produce more eggs. The NWAC103 catfish are the first line to be certified using DNA fingerprinting methods developed by ARS scientists.

- **100% Natural Fruit Bars.** ARS researchers have patented (Patent Number 6,027,758) and transferred technology for forming 100% fruit bars. Fruit puree is the primary ingredient used in forming these fruit products. One fruit bar is the equivalent of two servings of fruit. The bars are flavorful, nutritious and convenient. For these reasons, ARS's technology should help consumers meet USDA daily dietary recommendations. The invention has been licensed to HR Mountain Sun, Hood River, Oregon. The company has constructed a manufacturing plant in North Bonneville, Washington—an area with 30 percent unemployment. Ninety new jobs have been created. They are selling three types of pear bar products—a plain pear bar, a blueberry bar, and a cranberry bar. Several grocery chains are selling the Gorge Delights™ bars, including Rosauer's, Albertsons, Thrifty, and some U.S. Commissaries. The bars are now being sold in over 400 Albertsons stores and have received international interest from businesses in Malaysia, South Korea, Jamaica, South Africa, Italy, and many other foreign countries. They are also being distributed through the Washington school lunch program.

This technology started from a grass roots effort for pear growers to add-value and create new markets for pear products and has recently expanded beyond pears into other fruits and vegetables. This research is part of an overall ARS effort to develop technologies that will permit year round processing of seasonal crops by making value-added products from bulk processed ingredients such as fruit and vegetable purees. Fruit and vegetable products are limited because the technology for processing them is restricted to relatively few forms (canning or freezing), which must be done immediately after harvest. Processing systems such as this enable large amounts of materials to be partially processed into stable forms within the short harvest season, and then made into a variety of products throughout the year.

- **VerifEYE™,** a new optical detection system that inspects meat for fecal contamination, should help the industry meet Pathogen Reduction and Hazard Analysis and Critical Control Point (HAACP) regulations. These regulations require meat and poultry plants to implement a system to improve the safety of their products, and ultimately prevent fecal contamination of meat food products. Fecal contamination can carry pathogenic bacteria such as *Escherichia coli* 0157:H7, and these bacteria can cause foodborne illness in people. The new technology, developed cooperatively by ARS and Iowa State University researchers, uses specific color wavelengths to detect even minute amounts of fecal matter on meat during processing. Light emitted from the carcass is electronically analyzed to check for contamination. If contamination is detected, the carcass is identified for further sanitization. Current inspection methods rely heavily upon visual inspections, but fecal matter undetected by the human eye may still be present.

This new technology offers the industry a more reliable method for ensuring a safe food product. The patented (Patent Number 5,914,247) technology is licensed to eMerge Interactive Inc., a technology company located in Sebastian, Florida. The company is currently marketing a hand-held version of the technology in North America and distributors in the United Kingdom and New Zealand are marketing the technology in the European and Australian market. A full-carcass scanning device has also been developed and tested in collaboration with Excel Corporation. Excel has leased the system for installation in their beef processing plants. Additional patents on variations of the technology are also being sought.

• **A safe, effective alternative to broadcast fumigation** could help reduce an over reliance on methyl bromide, which is scheduled to be phased out in the United States in 2005 due to its status as an ozone depleting compound. Soil fumigants are used to disinfest agricultural soils of pathogens, nematodes, and weeds; and they have traditionally been applied by injecting them directly into the soil. Some alternative fumigants do not move as readily through the soil as methyl bromide when injected into the soil, thus reducing efficacy. A team of ARS scientists developed methods for applying soil fumigants using drip irrigation systems, which enhance the distribution of the alternative fumigants in the soil. This makes the alternative fumigants more acceptable as methyl bromide replacements and helps reduce the potential for alternative fumigants to escape into the atmosphere. ARS scientists entered into a Cooperative Agreement with the California Strawberry Commission to conduct tests and demonstrate the effectiveness of ARS's drip irrigation technology for strawberry production. Because of the team's success in communicating their results, manufacturers quickly developed suitable new chemicals and registered these products with federal and state agencies.

Western growers of fruits and vegetable such as strawberries, melons, tomatoes, and peppers have rapidly adopted this technology and are benefiting significantly from it. Growers were able to adopt the technology without changing their production systems. EPA label registrations have been granted for three drip-applied fumigant formulations—Telone EC, InLine, and Chloropicrin. In 2002, nearly 10 percent of U.S. commercial strawberry crops were grown on land using ARS's technology, as well as nearly 2,000 acres of tomatoes, peppers, and melons. In addition to U.S. growers, the technology is receiving international interest from growers in Italy and Spain.

• **National Phosphorus Indexing (P Index).** A national effort that includes ARS scientists, as well as scientists from other USDA agencies, the Environmental Protection Agency, various universities, and extension specialists has led to the development and implementation of a standard for managing and assessing the risk of phosphorus loss on agricultural fields and water ways. Phosphorus is an essential nutrient for crop and animal production, but excess phosphorus runs off into nearby water systems—degrading water quality. The team developed scientific standards for a Phosphorus Index, which addresses real world environmental concerns in an effective and practical way. The tool helps users to identify and prioritize alternative management options available to them, thereby providing flexibility in developing remedial strategies for managing phosphorus loss.

Team members are working extensively with federal, state, and local government agencies; agricultural organizations; and environmental organizations to educate them on the issues involved, and on how best to implement this strategy. More than 1000 field agents and nutrient management consultants across the United States have received training on how to use the P Index. In addition, overseas researchers and advisors from Brazil, Finland, Ireland, New Zealand, Norway, and the United Kingdom have adopted and modified versions of the P Index to apply the approach to their own countries' needs. This work will benefit all Americans because it will help maintain a cleaner, healthier environment.

- **NuSun**, a new ARS-developed sunflower germplasm, has had a profound impact on the sunflower industry. NuSun is a hybrid sunflower plant that produces higher amounts of oleic acid than traditional sunflower plants. Oleic acid is believed by some scientists to have substantial health benefits, including lowering blood cholesterol levels. ARS scientists worked closely with representatives from the snack food industry, oil refiners, crushers, seed company breeders, public researchers, and growers to develop and test the NuSun plants. Favorable test results led to rapid industry acceptance of NuSun oil, which is now being used by restaurants and the snack food industry. Earlier this year, Frito-Lay announced it would use NuSun oil in its new "All Natural" line of snack food products; and the products are now in stores.

In 2002, U.S. production of NuSun oil seed sunflower was approximately 850,000 acres, which accounted for 40 percent of the total U.S. oilseed sunflower production. The oil from the plant has superior cooking qualities and lasts longer in frying vats. In addition, NuSun oil does not require hydrogenation—a process that produces trans fatty acids, which are known to be detrimental to human cardiovascular health. Recent Food and Drug Administration industry requirements to label food products containing trans fatty acids underscores the importance of NuSun and its continued impact on the food industry and health-conscious consumers.

- **Honeybees resistant to *Varroa destructor* (*V. destructor*)**, a parasitic mite of honeybees, are now available to beekeepers. *V. destructor* infestations have been devastating to the U.S. beekeeping industry. Since its arrival in the United States in 1987, beekeepers have fought the mite—which can wipe out an entire bee colony, sometimes during the course of the summer—using miticides. Over the years, however, the mites have developed resistance to each new chemical control. In addition to *V. destructor*, *Acarapis woodi,* another parasitic honeybee mite, has become a problem for the bee industry. This mite infests the trachea or breathing tubes of honeybees resulting in colony losses, reduced pollination ability, and reduced colony production. This mite has also developed resistance to chemical control methods.

A team of ARS researchers led the effort to select, test and breed Russian honeybees that would be naturally resistant to both mites. The team also selected for high honey production to assure the value of the stock. ARS scientists entered into a Cooperative Research and Development Agreement with a beekeeper to breed and gather information on honeybee queens for commercial production. Now, thanks to ARS's efforts, it is estimated that nearly 40 percent of the Nation's 2.5 million commercial honeybee colonies are currently stocked with Russian honeybees—producing an annual honey crop valued at about $85 million, and pollinating crops valued at $6 to $8 billion. The Russian honeybees typically produce about 10 percent more honey per colony and can survive northern winters. Treatment savings using the new bees totals about $17 million a year.

- **ARS-developed cropping system technologies** are improving economic and environmental sustainability of agriculture in the Palouse region of Washington, Oregon, and Idaho**.** These integrated systems include continuous reduced tillage and no-tillage, direct-seed organic systems, perennial polyculture, and restoration of native prairies. ARS scientists have transferred these research results directly to growers at a major industry tradeshow, annual field days, workshops, and during field research tours organized by ARS. A survey conducted by an ARS researcher documented that 61percent of the growers surveyed are currently using technologies from ARS, yielding significant benefits to them and to the region's environment.

- **Hop Powdery Mildew Infection Risk Forecaster.** Currently, 75 percent of hop acreage in the Pacific Northwest is using this ARS-developed forecasting model for detecting powdery mildew, an important hop disease in that region. Four years of research culminated in the public release of this model on the Internet, which provides growers with a two-week history of infection risk, the current day's risk, and a forecast of infection risk for the next five days. ARS research defined critical temperatures influencing infection frequency and host susceptibility. Once ARS researchers created and validated the infection risk model, they partnered with FieldWise and Fox Weather to develop 5-day forecasts for each weather station using proprietary algorithms and historical site-specific weather data. This increased the risk index's utility. In 2001 and 2002, growers using ARS's model to assist in fungicide applications reported using 1.5 fewer fungicide applications, while suffering 55 percent less powdery mildew infection in their hop crops. Combining the model with other cultural practices has helped reduce hop production costs related to powdery mildew control from $460 per acre to $196 per acre.

- **A new method for collecting ram semen.** This method has a worldwide impact on preserving animal germplasm. The method uses a vial, which is placed in the ewe's vagina to collect semen, allowing for easy semen recovery. The semen can then be extended, frozen, transported, and used to artificially inseminate large numbers of ewes or stored in germplasm banks. This innovation has the potential to replace the artificial-vagina method for collecting semen, which has been in use for more than 60 years and requires a considerable training period for rams. ARS researchers transferred this technology to scientists and technicians at the U.S. Meat Animal Research Center (USMARC). USMARC personnel have used the procedure to collect semen from large numbers of untrained rams that represent defined genetic lines of sheep. Approximately 10,000 units of semen from these rams have been added to the Animal Germplasm Preservation Program in Fort Collins, Colorado.

- **Conservation system technologies.** ARS researchers in the southern U.S. region have played an active role both nationally and internationally in promoting conservation tillage systems using a combination of face-to-face farmer interactions, publications, Web site development, personal interactions, meetings, and conferences. Statistics indicate that no-tillage cotton in the Southern states grew from 627,000 acres in 1998 to more than 1,938,000 acres in 2002, a threefold increase. A 2003 National Cotton Council of America survey reported that 57 percent of the total cotton acres in the Southeast was in no-tillage. Annually, conversion of over 1.31 million acres of cotton in the Southeast to no-tillage saves 10.6 million tons of soil worth $198 million in on-farm and off-site impacts, and $39 million in fuel and labor costs.

- **Cotton gin schools.** As part of a unique technology transfer effort, ARS annually participates and helps sponsor gin schools, which are designed to transfer ginning technology directly to the users. At these schools, cotton ginners learn firsthand from ARS scientists and our Cotton Technology Transfer Extension Coordinator the latest information about preserving fiber quality and increasing gin efficiency using the latest ARS-research results. In addition, ARS hosts a Textile Manufacturing Symposium and a Cotton Ginning Symposium at gin and textile labs to benefit county extension agents in cotton producing states.

3.2 Department of Commerce

This section summarizes the statistics and other data provided by the department in its annual reports on the technology transfer activities and outcomes of its federal laboratories. Currently, these reports provide data through FY 2003. This information covers the activities of the department's following bureaus: National Institute of Standards and Technology (NIST -- Technology Administration), the National Oceanic and Atmospheric Administration (NOAA), and the Institute for Telecommunications Science (ITS -- National Telecommunications and Information Administration). Unless otherwise noted, the figures below are totals across all these branches. For additional details, readers should consult the department's full report.[26]

■ Collaborative Relationships for Research and Development

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **CRADAs**, total active in the FY(1)			--	--	247	1,883	1,903
- New, executed in the FY			--	--	26	1,719	1,767
▪ Traditional CRADAs,(2) total active in the FY			275	221	188	139	92
- New, executed in the FY			67	46	26	26	12
▪ Non-traditional CRADAs,(3) total active in FY			--	--	59	1,744	1,811
- New, executed in the FY			--	--	0	1,693	1,755
● **Other collaborative R&D relationships**							
▪ Facility use agreements NIST			--	--	372	391	512
▪ Guest scientists and engineers NIST			--	--	1,200	1,300	1,300
▪ Collaborative standards contributions ITS			--	--	3	3	2

CRADA = Cooperative Research and Development Agreement
-- = Data not requested from agency in reports of earlier years.

(1) "Active" = legally in force at any time during the FY. "Total active" includes all agreements executed under CRADA authority (15 USC 3710a).
(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.
(3) CRADAs used for special purposes -- such as material transfer or technical assistance that may result in protected information.

■ Invention Disclosure and Patenting

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● New inventions disclosed in the FY(1)	46	65	38	34	26	17	21
● Patent applications filed in the FY(2)	28	35	30	20	12	12	5
● Patents issued in the FY			28	18	21	20	9

(1) Inventions arising at the federal lab.
(2) Tally includes: U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes: provisional, continuation, duplicate foreign, and PCT applications.

[26] U.S. Department of Commerce, *Annual Report on Technology Transfer: Approach and Plans, FY 2003 Activities and Achievements,* January 5, 2004. Report prepared in response to 15 USC Sec. 3710(f) (requiring an annual "agency report on utilization" for agencies with federal laboratories) and submitted to OMB (consistent with Circular A-11 guidelines). (Report available on the Internet at www.technology.gov/Reports.htm)

■ Licensing

Profile of Active Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All licenses**, number total active in the FY[(1)]			43	43	40	41	101
▫ New, executed in the FY	0	4	8	4	5	5	59
▪ **Invention licenses**, total active in the FY			43	43	40	41	101
▫ New, executed in the FY			8	4	5	5	59
- Patent licenses,[(2)] total active in FY			43	43	40	41	101
▫ New, executed in the FY			8	4	5	5	59
- Material transfer (inventions), tot active in FY			0	0	0	0	0
▫ New, executed in the FY			0	0	0	0	0
- Other invention licenses,[(3)] total active in FY			0	0	0	0	0
▫ New, executed in the FY			0	0	0	0	0
▪ **Other IP licenses**, total active in the FY			0	0	0	0	0
▫ New, executed in the FY			0	0	0	0	0
- Copyright licenses (fee bearing)							
▫ New, executed in the FY							
- Material transfer (non-inv.), total active in FY							
▫ New, executed in the FY							
- Other [(4)]							
▫ New, executed in the FY							

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (i.e., hybrid licenses) are reported as patent licenses -- and not included in the count of copyright licenses.

(1) "Active" = legally in force at any time during the FY.
(2) Patent license tally includes patent applications that are licensed.
(3) No licenses of this type indicated as active.
(4) No licenses of this type indicated as active.

Licensing Management

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Elapsed execution time,[(1)] licenses granted in FY**							
▪ **Invention licenses**							
▫ average months			--	--	5.4	5.8	1.4
▫ minimum			--	--	2.0	2.5	1.0
▫ maximum			--	--	8.0	8.0	10.0
- Patent licenses[(2)]							
▫ average months			--	--	5.4	5.8	1.4
▫ minimum			--	--	2.0	2.5	1.0
▫ maximum			--	--	8.0	8.0	10.0
● **Number of licenses terminated for cause in FY**							
▪ **Invention licenses**			--	--	7	3	1
- Patent licenses[(2)]			--	--	7	3	1

Data included in this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a subclass.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)
(2) Patent license tally includes patent applications which are licensed.

Characteristics of Licenses Bearing Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All income bearing licenses**, number			20	18	22	39	37
▫ Exclusive			--	--	16	19	20
▫ Partially exclusive			--	--	5	2	0
▫ Non-exclusive			--	--	4	18	17
▪ **Invention licenses**, income bearing			20	18	22	39	37
▫ Exclusive			--	--	16	19	20
▫ Partially exclusive			--	--	5	2	0
▫ Non-exclusive			--	--	4	18	17
- Patent licenses,[1] income bearing			20	18	22	39	37
▫ Exclusive			--	--	16	19	20
▫ Partially exclusive			--	--	5	2	0
▫ Non-exclusive			--	--	4	18	17
▪ **Other IP licenses**, income bearing			0	0	0	0	0
▫ Exclusive							
▫ Partially exclusive							
▫ Non-exclusive							
- Copyright licenses (fee bearing)							
▫ Exclusive							
▫ Partially exclusive							
▫ Non-exclusive							
● **All royalty bearing licenses**,[2] number			20	18	22	36	34
▪ **Invention licenses**, royalty bearing, number			20	18	22	36	34
- Patent licenses,[1] royalty bearing			20	18	22	36	34
▪ **Other IP licenses**, royalty bearing			0	0	0	0	0
- Copyright licenses (fee bearing)							

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalites, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of past years.

(1) Patent license tally includes patent applications that are licensed.
(2) Note that royalties are one component of total license income.

Income (annual) from Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Total income**, all licenses active in FY [1]			$405,469	$186,368	$268,568	$164,622	$127,566
▪ **Invention licenses**	$52,000	$42,000	$405,469	$186,368	$268,568	$164,622	$127,566
- Patent licenses [2]			$405,469	$186,368	$268,568	$164,622	$127,566
▪ **Other IP licenses**, total active in the FY			$0	$0	$0	$0	$0
- Copyright licenses							
● **Total Earned Royalty Income** (ERI) [3]			$405,279	$186,368	$263,568	$99,152	$127,566
▫ Median ERI			--	--	n/a	$3,633	$696
▫ Minimum ERI			--	--	$1,100	$800	$1,060
▫ Maximum ERI			--	--	$137,427	$27,969	$39,716
▫ ERI from top 1% of licenses			--	--	n/a	$20,094	$35,472
▫ ERI from top 5% of licenses			--	--	n/a	$20,470	$35,236
▫ ERI from top 20% of licenses			--	--	n/a	$51,800	$45,943
▪ **Invention licenses**			$405,279	$186,268	$263,568	$99,152	$127,566
▫ Median ERI			--	--	n/a	$3,633	$696
▫ Minimum ERI			--	--	$1,100	$800	$1,060
▫ Maximum ERI			--	--	$137,427	$27,969	$39,716
▫ ERI from top 1% of licenses			--	--	n/a	$20,094	$35,472
▫ ERI from top 5% of licenses			--	--	n/a	$20,470	$35,236
▫ ERI from top 20% of licenses			--	--	n/a	$51,800	$45,943
- Patent licenses [2]			$405,279	$186,268	$263,568	$99,152	$127,566
▫ Median ERI			--	--	n/a	$3,633	$696
▫ Minimum ERI			--	--	$1,100	$800	$1,060
▫ Maximum ERI			--	--	$137,427	$27,969	$39,716
▫ ERI from top 1% of licenses			--	--	n/a	$20,094	$35,472
▫ ERI from top 5% of licenses			--	--	n/a	$20,470	$35,236
▫ ERI from top 20% of licenses			--	--	n/a	$51,800	$45,943
▪ **Other IP licenses**			$0	$0	$0	$0	$0
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							
- Copyright licenses							
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in previous

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).
(2) Patent license tally includes patent applications that are licensed.
(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or units sold). Not a license fee or minimum royalty.

Disposition of License Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Income distributed** [1]							
▪ **Invention licenses**, total distributed			$405,469	$186,368	$268,568	$164,622	$127,565
- To inventors			$146,957	$77,931	$106,440	$67,387	$52,903
			36%	42%	40%	41%	41%
-To other[2]			$258,512	$108,437	$162,128	$97,235	$74,662
			64%	58%	60%	59%	59%
- Patent licenses,[3] total distributed			$405,469	$186,368	$268,568	$164,622	$127,565
- To inventors			$146,957	$77,931	$106,440	$67,387	$52,903
			36%	42%	40%	41%	41%
-To other[2]			$258,512	$108,437	$162,128	$97,235	$74,662
			64%	58%	60%	59%	59%

Invention licenses are the chief policy interest regarding distribution of income; content of this table reflects this focus.

(1) Income includes royalties and other payments received during the FY.
(2) To internal purposes at NIST, NOAA, ITS
(3) Patent license tally includes patent applications that are licensed.

■ Other Performance Measures

				FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
Standard Reference Materials available	NIST			1,288	1,292	1,335	1,353	1,214
Standard Reference Materials sold	NIST			33,347	34,020	31,985	30,996	29,527
Standard Reference Data titles available	NIST			60	63	65	90	106
Number of items calibrated	NIST			3,118	2,969	3,192	2,924	3,459
Technical publications produced	NIST			2,270	2,250	2,207	2,236	1,918
Technical publications produced	ITS			32	20	17	17	20

<u>Standard Reference Materials</u>. Standard Reference Materials (SRMs) are the definitive source of measurement traceability in the United States. NIST produces and disseminates (sells) SRMs to a large and diverse group of customers, including private-sector laboratories, universities, and other federal agencies. NIST SRMs support industrial materials production and analysis, environmental analysis, health measurements, and basic measurements in science and metrology.

<u>Standard Reference Data</u>. Standard Reference Data titles (SRDs) provide numeric data to scientists and engineers for use in technical problem solving, research, and development. NIST produces and makes available SRDs through sales or free distribution. NIST's SRD databases cover many areas of science, including analytical chemistry, atomic and molecular physics, biotechnology, and materials science.

<u>Calibration Services</u>. NIST laboratories provide physical measurement services for their customers, including calibration services, special tests, and measurement assurance programs (MAPs). Calibration services and special tests are characterizations of particular instruments, devices, and sets of standards with respect to international and national standards. NIST's calibration services are designed to help the makers and users of precision instruments achieve the highest possible levels of measurement quality and productivity. NIST offers more than 500 different types of physical calibrations covering the following measurement areas: dimensional; mechanical, including flow, acoustic, and ultrasonic; thermodynamic; optical radiation; ionizing radiation; electromagnetic; and time and frequency.

Technical Publications. NIST uses publications as one mechanism to transfer the results of its work to the U.S. private sector and to other government agencies that need cutting-edge measurements and standards. Many of these results appear in prestigious scientific journals and withstand peer review by the scientific community. Others appear in technological forums where measurement standards and technologies developed by NIST staff (at times in collaboration with private-sector partners) are disseminated.

■ Downstream Outcomes

DOC's FY 2003 report provided the following selected examples of downstream outcomes arising from the technology transfer activities of the department's federal laboratories:

National Institute of Standards and Technology

- **NIST helping prepare an 'out of this world' atomic clock.** Setting the world's clocks from a timepiece far above the Earth someday may be the norm if the National Institute of Standards and Technology (NIST)-led program to put an atomic clock aboard the International Space Station (ISS) proves successful. This effort is part of the NASA-funded Primary Atomic Reference Clock in Space (PARCS) mission, scheduled to fly on the ISS in early 2006. PARCS will be used to test gravitational theory, study laser-cooled atoms in microgravity and explore ways to improve the accuracy of timekeeping on Earth. Atoms in microgravity can be slowed to speeds significantly below those used in atomic clocks on Earth, providing a predicted 10-fold improvement in clock accuracy. (The current U.S. standard, the NIST-F1 clock, is accurate to within one second in 30 million years.) The PARCS space clock will be compared continuously to the hydrogen maser, a fundamentally different clock, to provide a test of an Einstein theory that predicts that two different kinds of clocks in the same environment will keep the same time. To measure gravitational frequency shift, comparisons will be made between the space clock and a clock on Earth. Signals conveyed to the ground from such space clocks someday might serve as an international time standard available to anyone around the world. PARCS is a cooperative effort involving NASA's Jet Propulsion Laboratory (JPL), NIST, Harvard-Smithsonian Center for Astrophysics, the University of Colorado at Boulder, and the University of Torino in Italy. JPL is leading the actual development of the space package.

- **Peanut butter standard spreads quality.** The National Institute of Standards and Technology (NIST) recently issued Standard Reference Material (SRM) 2387, a peanut butter sample characterized with state-of-the-art measurement methods to provide values for fat, protein, vitamins, minerals, and other substances it contains. It can be used by food manufacturers to validate production and quality control procedures, as well as to ensure accurate labeling of product content. The new SRM is the first NIST food-matrix reference material with values assigned for 18 individual amino acids -- the building blocks of proteins -- and for aflatoxins, carcinogenic substances produced by mold in crops. It also is the only SRM that is high in both fat content and protein, making it useful in evaluating the fat and protein content of other food products. SRM 2387 already has found a scientific use in evaluating allergen test kits. Even a trace of peanut protein can cause serious reactions, including death, if someone is highly allergic.

- **New NIST facility soon will be 'reflecting' on safer signs.** Roadways should get safer in the future, now that the National Institute of Standards and Technology (NIST) has developed a way to accurately and reliably measure how light reflects off stop signs and other road markings. Road signs and markings are designed to be visible at night by retroreflectivity -- that is, they reflect some of the light emitted by a vehicle's headlights back toward the driver's eyes. However, measurements of retroreflectivity have varied so much among different devices and laboratories that federal transportation officials have been unable to define minimum standards for this congressionally mandated characteristic. Recently, NIST established a facility, funded by the Transportation Research Board of the National Cooperative Research Program, that resolves numerous measurement problems and improves accuracy. Inside the facility, one finds a long black tunnel with a set of tracks on which sits an instrumented platform. Signs or materials are mounted on the platform, which can be moved 3 to 30 meters (10 to 100 feet) from a light source at one end of the tunnel. Using custom software, scientists precisely control all of the components and measure the characteristics of light reflected from the sign to a detector located close to the source. NIST expects that the facility will begin providing calibration services early in 2004.

- **Standard improves tests of male DNA.** Mother Goose tells us that boys are made of "snips and snails and puppy dog tails." She was clearly misinformed about the snails and tails, but she was on to something with the snips. What you really need to build a boy is a "Y" chromosome, and it turns out that SNPs (single nucleotide polymorphisms), known by the biotech cognoscenti as simply "snips," can be helpful in sorting out who fathered the boy. If DNA can be thought of as an instruction book for building a specific person, then SNPs are single letters at an exact location in that book that tend to vary among individuals. A new Standard Reference Material (SRM) issued by the National Institute of Standards and Technology (NIST) uses both SNPs and STRs (sections where three to five DNA "letters" form repeating patterns) to help improve the reliability of laboratory analyses of male DNA. The result of several years of research, the standard consists of six vials of very carefully analyzed DNA. Five are male samples, and one is female. Laboratories that perform forensics or paternity DNA analyses can use the SRM to double check the accuracy of their equipment and test procedures for analyzing the Y chromosome. It also may be helpful for population studies that study whether the human race evolved from one or many "Adams." Each vial comes with certified DNA sequences for 22 different STR locations and 42 different SNPs.

- **System helps ensure reliability of military communications.** The Army, Navy, and Air Force use thousands of miles of optical fibers on ships, planes and land-based installations to transmit voice and data. They needed a simple, effective, and highly accurate way to measure the amount of light delivered by these glass "wires" at key points in the transmission system. Power degradation along the network can cause communication failure. Working with ILX Lightwave Corp.of Bozeman, Montana, the National Institute of Standards and Technology (NIST) came up with a system capable of world-class optical measurements with push-button convenience. The system consists of a NIST-designed optical detector and an optical multimeter -- designed by ILX Lightwave -- that measures light emitted from a fiber over a wide range of wavelengths. There are two versions of the novel detector: one using silicon-based sensors and the other using germanium-based sensors. The sensors connect directly to an optical fiber without any additional optics and with barely measurable light loss. Measurement uncertainty is half that of previous optical fiber power detectors. The new systems are now being shipped to military calibration centers where they will be used to annually check the accuracy of optical fiber power systems utilized in the field.

- **Standards to help manufacturers measure micromachine properties.** When a car collides with another car, a tiny device called an accelerometer detects the change in motion and sets off an air bag, an innovation that has saved many lives. The accelerometer is one of the most common uses of microelectromechanical systems (MEMS), but scientists and engineers also are starting to use them in devices ranging from angioplasty pressure sensors and pacemakers to optical disk drives. MEMS, also known as micromachines, are a relatively new technology that uses existing microelectronics manufacturing methods to create complex machines with micrometer feature sizes. MEMS devices represent a rapidly growing component of the semiconductor industry. Many micromachines contain moving parts that are combined with integrated circuits. Like most high-tech devices, they must be made with precise dimensions and materials properties to operate properly. To help manufacturers ensure that their devices meet these exacting specifications, National Institute of Standards and Technology (NIST) scientists and engineers helped develop three ASTM International standard test methods for the thin films used to make micromachines. The test procedures, which are the first such standards in the world, will be published in The Annual Book of ASTM International Standards this month. The standards are expected to facilitate global commerce in MEMS technologies by enabling measurements that will lead to the development of more reliable and reproducible MEMS devices. The three standards provide detailed instructions for measuring thin-film dimensions and "strain," a property related to the stress in the thin film. NIST researchers have created a Web site to help semiconductor manufacturers perform the complex mathematical calculations required by the new standard test methods. For further information, see www.eeel.nist.gov/812/test-structures.

- **NIST helps chip industry measure features by counting atoms.** The quest to develop the nanotechnology equivalent of ruler length measurement references based on the spacing of atoms in a perfectly ordered crystal has inspired a burst of innovation at the National Institute of Standards and Technology (NIST). Progress to date has yielded a novel device that can resolve distances smaller than the radius of an atom and a reliable method for writing 10 nanometer sized features on silicon. NIST researchers are packaging the new technology and know-how into a scanning tunneling microscope (STM) system designed to write patterns with dimensions determined by counting the atoms that make up the patterns' structural features. Ultimately aiming for an accuracy of better than 1 nanometer, the team intends to supply the semiconductor industry with benchmark references to calibrate measurement tools used in research and production. To measure exceedingly small distances, members of the "atom-based artifacts project" developed a novel diode laser-based interferometer. The new, compact instrument incorporates elements of two types of existing interferometers -- devices that determine the distance between two objects on the basis of light interference patterns -- but achieves much higher levels of resolution. To date, the team has measured distances in increments smaller than 10 picometers, or less than one hundredth of a nanometer. Efforts to produce durable, silicon-based measurement references have paid off with a method for reliably writing patterns with 10 nanometer line widths -- equivalent to about 30 silicon atoms across. These STM-written patterns are long-lived, even outside of a vacuum, and recent work suggests that reactive ion etching can increase their three dimensional relief.

- **Tooth, heal thyself**. "Smart materials" invented at the National Institute of Standards and Technology (NIST) soon may be available that stimulate repair of defective teeth. Laboratory studies show that these composites, made of amorphous calcium phosphate embedded in polymers, can efficiently promote re-growth of tooth structures. In the presence of saliva-like solutions the material releases calcium and phosphate ions, forming a crystalline calcium phosphate similar to the mineral found naturally in teeth and bone. Developed through a long-standing partnership between NIST and the American Dental Association (ADA), initial applications for these bioactive, biocompatible materials include adhesive cements for orthodontic braces and anti-cavity liners underneath conventional fillings. NIH and NIST entered into an interagency agreement whereby NIST took the lead on prosecuting and licensing the smart dental material. After further development, NIST exclusively licensed the invention to the ADA, which has signed one commercialization license to date. This activity is an example of increasingly close ties between federal agencies, non-profit organizations, and the private sector.

- **Hairs' to better drug testing.** There's a relatively new weapon in the battle against illicit drug use -- hair. Unlike urine or other body fluids, hair tissue retains traces of cocaine and other drugs for at least 90 days (not just two or three). Hair also is easier to collect and harder to switch or contaminate. As a result, hair analysis increasingly is used to screen job applicants, athletes, and others for illicit drug use. The accuracy of such tests now can be checked through the use of two new National Institute of Standards and Technology (NIST) Standard Reference Materials (SRM's). The standards consist of human hair segments that have been soaked in solutions containing target drugs and then carefully measured for drug concentrations. SRM 2379 is designed for calibrating tests of stimulants ("uppers") such as cocaine and PCP, while SRM 2380 helps check tests for depressants ("downers"), such as codeine and THC (the active ingredient in marijuana). Drugs usually are not detectable in hair samples until 10 days after use, so hair analysis is likely to complement rather than completely replace traditional screening methods.

- **Device lets blind feel images.** A new technology developed by National Institute of Standards and Technology (NIST) researchers allows people who are blind or visually impaired to feel electronic images. Called a tactile graphic display, the device uses an array of more than 3,000 rounded pins that can be raised in any pattern and then locked into place. The inspiration for the tactile graphic display came from a "bed of nails" toy found in a novelty store. The NIST researchers just needed a way to connect an array of moveable pins with electric signals. The answer came in the form of outdated technology. The researchers took a 20-year-old scientific pen plotter and made it work upside down. Instead of pushing a pen down to draw images on paper, the device now pushes pins up to form an image. Unlike embossed images on paper, the tactile display can be used over and over again. Each image is sent electronically to the device, which uses software to determine how to create a tactile display that matches the image. The display converts scanned illustrations, photographs, map outlines, or other graphical images into raised patterns and can translate images displayed on Internet Web pages or in electronic books. After the pins are "viewed" with the fingertips, they can be withdrawn to form a flat surface ready to be reset into a new image. NIST is working with the private sector to apply the technology under a non-exclusive research license. In addition, several patents are pending on the technology and commercialization licenses are available.

- **Finding dirty bombs and other radiation threats.** In an age of terrorism, law enforcement agents and other first responders need to be prepared for a wide range of threats, including so-called "dirty bombs" and other radiation hazards. To help ensure the performance of devices used to detect such threats, National Institute of Standards and Technology (NIST) researchers are working with the Institute of Electrical and Electronics Engineers (IEEE) and the American National Standards Institute (ANSI) to develop new standards for a variety of radiation detectors and monitors. With partial funding from the Department of Homeland Security (DHS) and NIST's Office of Law Enforcement Standards, NIST researchers are investigating a wide variety of detection devices, ranging from 3-meter-high portal towers that scan truck trailers while they move through checkpoints to small, pager-size monitors that serve as personal dosimeters. Many of these devices originally were designed for monitoring workers in factories and laboratories. The new standards under development will ensure that the devices work as intended under the new conditions now encountered in homeland security related tasks. For example, some devices work differently in the rain or high humidity conditions, as well as in wide temperature ranges. So far, the NIST researchers also have found that the calibration of some detectors depends a lot on the exposure rate and energy of the radiation detected. The accuracy of 19 different hand-held detectors ranged within plus or minus 5 percent of the actual radiation value to plus or minus 40 percent depending on whether they were measuring high, medium, or low energy radiation sources.

- **Ensuring the safety of first responder gas masks.** Firefighters and other first responders faced with a terrorist attack soon will breathe a little easier knowing that their gas masks have been tested to ensure they work properly under emergency response conditions. Air purifying respirators, commonly known as gas masks, protect workers from hazards associated with chemical, biological, radiological, and nuclear (CBRN) agents. The National Institute of Standards and Technology (NIST) has teamed up with the National Institute for Occupational Safety and Health (NIOSH) and the U.S. Army Soldier and Biological Chemical Command to develop a full suite of gas mask standards for civilian workers. Scientists will soon begin live agent testing of masks at the Army's Aberdeen Proving Grounds in Maryland, one of only a few nationwide laboratories that can do such tests safely. The tests will ensure that the masks protect workers from a mustard blistering agent and from the nerve gas sarin. The tests are done on specially designed mannequins that can precisely measure minute amounts of vapor that may penetrate through the masks. Masks worn by first responders must meet different standards from those designed for troops. Most military uses involve outdoor attacks where air currents would naturally disperse chemicals or other hazardous agents. The civilian testing procedures address release of a hazardous agent inside buildings or other closed environments. The standard will include a maximum penetration rate for hazardous substances and methods for testing the fit of gas masks for individuals.

- **Helping consumers choose among house repair options.** House maintenance is a never-ending and costly task. Roofing, siding, windows and even garage doors wear out. Now researchers at the National Institute of Standards and Technology (NIST) have developed a software program that takes the guesswork out of replacement decisions. The free program, called NEST (for National Economic Service-life Tools), allows homeowners to select the most cost-effective replacement material for roofing, siding, windows, and garage doors. It also provides, for the user's own zip code, cost estimates for replacements, including the cost of local labor and local materials, as well as the cost of maintenance. NEST currently consists of two software tools. "NEST Builder" and "Durability Doctor." NEST Builder asks homeowners to specify the house layout and size, as well as various kinds of materials used for roofing, siding, windows, and garage doors. The software program uses the information to build a virtual or graphic model of a user's home. "Durability Doctor" then combines the house model data with information on material cost and service life of the selected housing component. It estimates the installation and maintenance cost as well as the monthly financing cost of each alternative over the product's lifetime. Consumers then can compare costs for nine different types of roofing, four garage door materials, six types of windows and eight varieties of siding. "Durability Doctor" also reports which replacements are the most durable, have the lowest installation cost and lowest life-cycle cost for each housing component. NIST developed NEST with funds from the Partnership for Advancing Technology in Housing, a government-industry initiative led by the Department of Housing and Urban Development to modernize the homebuilding industry.

- **Designing efficient cooling systems for the dog days of summer.** New software developed by National Institute of Standards and Technology (NIST) can help cooling system manufacturers meet Department of Energy goals calling for a 20 percent increase in energy efficiency of residential air conditioners by 2006. Manufacturing engineers can use the software, called EVAP-COND, to improve evaporators and condensers, two types of heat exchangers that are essential components of every air conditioner. Improved heat exchangers mean increased energy efficiency. The software simulations depict the performance of evaporators and condensers working with any one of 10 cooling agents, including new generation atmospheric ozone-safe hydrofluorocarbon fluids and "natural refrigerants," such as carbon dioxide or propane. The software's computer graphics package enables engineers to observe and to understand refrigerant behavior throughout the simulated heat exchanger. Different designs can be tested to achieve desired environmental results. According to the software developer, "EVAP-COND can increase design engineer productivity and can reduce laboratory testing, thus shortening design-to-production time. This software can save manufacturers time and money, while it is helping to conserve energy." NIST developed the software with funds from the 21st Century Research Program of the Air-conditioning and Refrigeration Technology Institute and the U.S. Department of Energy. The Windows-based program can be downloaded from www2.bfrl.nist.gov/software/evap-cond/.

National Oceanic and Atmospheric Administration

- **Hurricane Isabel**. Without NOAA's excellent forecasts and end-to-end teamwork, Hurricane Isabel's toll on lives and property would have been even more devastating. NOAA's track forecast was outstanding. Isabel swept over the East Coast some 38 hours after well-positioned hurricane warnings and track forecasts had been issued. This is 14 possibly life-saving hours ahead of NOAA's 24-hour lead time goal. The Director and Deputy Director of NOAA's National Hurricane Center gave 180 broadcast interviews. National Hurricane Center staff handled an additional 280 phone interviews, plus another 45 in Spanish. On the Monday after, the Center Director briefed President Bush and several governors via video teleconference as they reviewed Isabel's wrath in a number of states.

- **Improved hurricane forecasts**. NOAA's National Weather Service (NWS) announced it will begin issuing five-day hurricane forecasts, extending the three-day forecasts issued since 1964. NWS cited customer needs for longer-range forecasts and major improvements in track forecasting skill over the past few decades as reasons for lengthening the forecasts. The new forecast is to move resources out of harms way, such as U.S. Navy ships. The decision to extend the forecasts came after two years of successful testing with data from the 2001 and 2002 seasons, indicating the five-day track forecast will be as accurate as the three-day forecast was 15 years ago.

- **Tornado warnings save lives**. NOAA and our Nation owe a heartfelt thanks to the many dedicated men and women in the National Weather Service who worked tirelessly during the May 4-10 outbreak of severe weather. Early reports indicated that about 400 tornadoes hit 10 central and southern U.S. states during this record-breaking week. The preliminary average lead time provided for all tornado events is about 19 minutes - well above our current 11 minute performance goal. During this period, NOAA staff residing in these hard-hit communities literally lived in their offices, working to save lives rather than returning home to their own families. Undoubtedly the tragic loss of life would have been even higher without the front-line commitment of so many NOAA staff. On May 8, for example, a severe weather forecast briefing was broadcast live over NOAA Weather Radio transmitters in the Oklahoma City area – nearly three hours before tornadoes hit. Heavily promoted among local media and emergency managers, the briefing carried up-to-the-minute information on timing, location, and expected impact. Tornado safety rules and preparedness were highlighted in the briefing. Then, as an F4 tornado tore through heavily populated areas in and around Oklahoma City, our forecasters broadcast continuing live updates of the storm's track on NOAA Weather Radio. Listeners phoned and e-mailed our Norman Forecast Office with thanks for outstanding service, and Oklahoma Governor Henry issued praise for the advance notice that saved lives. Missouri Governor Holden expressed appreciation as well.

• **Electronic commerce and print-on-demand for nautical charts**. The Office of Coast Survey, National Ocean Service and OceanGrafix collaborated in a CRADA to build Print on Demand/e-commerce for NOAA's suite of 1,000+ nautical charts. This technology prints charts only when ordered, and from digital files that NOAA updates daily. Electronic commerce software controls the automatic assembly and printing of ordered charts from digital files. The CRADA furthered NOAA's mission by providing mariners with nautical charts that are up-to-date with all critical corrections, a federal requirement for regulated vessels. Further, the transferred technology permits the customization of charts; eliminates inventory, warehouses, and the wasteful disposal of obsolete charts, thus reducing costs; and eliminates labor and errors in order taking and fulfilling. The most important result will be improved safety and efficiency of marine transportation, and the protection of life, property, and the marine environment.

• **Public release of atmosphere and ocean models and model output**. The Geophysical Fluid Dynamics Laboratory (GFDL) has released several Earth System model components and model data to the public and university collaborators. A new Atmospheric Model (AM2) has been released to university collaborators the latest versions of the Modular Ocean Model (MOM4), an ocean model expressed in isopycnal coordinates (HIM), and the Flexible Modeling System (FMS) infrastructure on which these models are based have been released and are available at http://nomads.gfdl.noaa.gov/. Model output from several experimental programs at GFDL, including Decadal-Centennial Coupled Climate and Ocean Data Assimilation are also available. There have been downloads to over 10,000 distinct hosts, including over 720 for MOM, almost 600 for HIM, and almost 800 for the FMS infrastructure. Nearly a terabyte of data has been requested.

• **Web-based access to distributed data sets**. The Pacific Marine Environmental Laboratory (PMEL) has transferred Live Access Server (LAS) software for web-based browsing (visualization) and downloading (subsetting) of earth science data sets to a broad scientific community. LAS presents geographically distributed data sets as a unified virtual data base. It is compatible with scientific data networking provided by the Open Source Project for a Network Data Access Protocol (OPeNDAP, formerly known as DODS). PMEL promoted the use of LAS throughout the Nation and the world. There are approximately 50 installations of LAS in research institutions spanning, NOAA, NASA, the U. S. Navy, Department of Energy, and national and international research institutions, such as the National Center for Atmospheric Research, the Monterey Bay Aquarium, the British Atmospheric Data Center, and the Centre National de la Recherche Scientifique.

• **Scientific Graphics Toolkit and ncBrowse**. The Pacific Marine Environmental Laboratory (PMEL) has developed Java-based tools to more easily visualize oceanographic (and other) data for both Web-based and desktop applications. The Scientific Graphics Toolkit (SGT) is designed to aid developers in producing scientific graphics applications. SGT has found a large international audience with over 5,800 sites from 70 countries having downloaded the toolkit. The ncBrowse is a general purpose Java desktop application designed to enable users to interactively browse and visualize data from netCDF files and OPeNDAP resources. NetCDF is a file format that is commonly used by the oceanographic community to store both observations and model results. The ncBrowse has also found an international and cross-discipline audience with users from over 4,000 sites from 60 countries downloading the application. The ncBrowse is included with the Precision Agricultural-Landscape Modeling System (PALMS) distribution from the University of Wisconsin-Madison and the International Oceanographic Data and Information Exchange (IODE) Ocean Teacher Data Management Resource Kit.

National Telecommunications and Information Administration

- **Video quality metric.** ITS developed a superior method of measuring video quality objectively by machine that closely predicts the quality that subjective human views would perceive. The technology is covered by three patents owned by ITS/NTIA. In FY 2003, the ITS method was adopted by the ANSI as a U.S. national standard. In addition, the ITU tested a number of proposed video quality metrics from around the world and found the ITS method superior. It is anticipated that ITS' method will soon be an international standard.

ITS targeted this technology for commercial development, with the potential of producing a royalty income for the laboratory within one year. More than 200 copies of software implementing the method have been requested this FY for purposes of evaluation. Negotiations for a commercial license have begun with a U.S. corporation.

- **Comarco cellular test equipment.** Comarco, Inc. (a U.S. test equipment manufacturer), signed a patent license for the use of ITS' MNB speech quality estimation algorithm. Comarco based its Q-MOS algorithm on the ITS MNB algorithm and offered it for sale as an available software tool in several of the Comarco cellular test equipment product lines. This test equipment is used by major cell phone service providers to test, diagnose, and maintain their cellular radio systems.

- **Personal communication services** (PCS). Much of ITS' work in PCS, over several years, has been accomplished through CRADAs with partners such as U.S. West, Bell South, Telesis Technology Laboratory, and Motorola. Collaboration between ITS and Motorola was instrumental in Motorola receiving a license (valued at $100,000,000) to provide PCS in Hong Kong. PCS has now been commercialized worldwide, and new developments continue as PCS is extended to third generation PCS and beyond. ITS continues this work in FY 2003 through a CRADA with Lucent Technologies' Bell Laboratories to investigate smart antenna performance, a technology that is targeted to dramatically increase the capacity of wireless systems and, therefore, reduce the problem of spectrum crowding. This technology is 2 to 4 years from commercial application.

- **Local multipoint distribution services** (LMDS). ITS has been a premier laboratory in millimeter wave research for two decades. CRADAs with private industry have enabled ITS to apply this unique expertise to radio propagation for LMDS. LMDS provides broadband wireless communications for business and residential applications. Systems have been deployed in the U.S. and a number of U.S. companies are exporting systems and services. Research into LMDS was conducted with Hewlett Packard, U.S. West, and Lucent Technologies.

3.3 Department of Defense

This section summarizes the statistics and other data provided by the department in its annual reports on the technology transfer activities and outcomes of its federal laboratories. Currently, these reports provide data through FY 2003. This information covers the activities of the department's following services and agencies: Air Force, Army, Navy, Uniformed Services University of the Health Sciences, and several other defense agencies (unless otherwise noted in the tables below). For additional details, readers should consult the department's full report.[27]

■ Collaborative Relationships for Research and Development

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **CRADAs**, total active in the FY[(1)]			--	--	1,965	1,913	2,134
- New, executed in the FY			--	--	459	449	630
▪ Traditional CRADAs,[(2)] total active in the FY	113	845	1,350	1,364	1,418	1,376	1,523
- New, executed in the FY			449	425	296	347	523
▪ Non-traditional CRADAs,[(3)] total active in FY			--	--	547	537	611
- New, executed in the FY			--	--	163	102	107
● **Other collaborative R&D relationships**							
			--	--	0	0	0

Figures prior to FY 2001 include the activities of only the Air Force, Army, and Navy.
CRADA = Cooperative Research and Development Agreement
-- = Data not requested from agency in reports of earlier years.

(1) "Active" = legally in force at any time during the FY. "Total active" includes all agreements executed under CRADA authority (15 USC 3710a).
(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.
(3) CRADAs used for special purposes -- such as material transfer or technical assistance that may result in protected information.

■ Invention Disclosure and Patenting

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● New inventions disclosed in the FY[(1)]	1,383	1,168	1,060	991	1,005	1,122	1,332
● Patent applications filed in the FY[(2)]	807	759	703	774	809	829	810
● Patents issued in the FY			547	553	619	617	619

Figures prior to FY 2001 include the activities of only the Air Force, Army, and Navy.

(1) Inventions arising at the federal lab.
(2) Tally includes: U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes: provisional, continuation, duplicate foreign, and PCT applications.

[27] This section draws on text and statistics in DOD's "Report to Congress on the activities of the DoD Office of Technology Transition," March 2004 (prepared in response to 10 USC 2515). (Report available on the Internet at http://www.dtic.mil/techtransit)

■ Licensing

Profile of Active Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All licenses**, number total active in the FY[1]			--	--	288	471	364
▫ New, executed in the FY			--	--	--	n/a	n/a
▪ **Invention licenses**, total active in the FY			177	189	283	350	361
▫ New, executed in the FY	15	34	61	67	49	39	49
- Patent licenses,[2] total active in FY			177	189	283	350	361
▫ New, executed in the FY			61	67	49	39	49
- Material transfer (inventions), tot active in FY					--	0	0
▫ New, executed in the FY					--	0	0
- Other invention licenses,[3] total active in FY					--	0	0
▫ New, executed in the FY					--	0	0
▪ **Other IP licenses**, total active in the FY			--	--	5	121	3
▫ New, executed in the FY			--	--	--	n/a	n/a
- Copyright licenses (fee bearing)					--	n/a	n/a
▫ New, executed in the FY					--	n/a	n/a
- Material transfer (non-inv.), total active in FY					--	n/a	n/a
▫ New, executed in the FY					--	n/a	n/a
- Other [4]					--	n/a	n/a
▫ New, executed in the FY					--	n/a	n/a

Figures prior to FY 2001 include the activities of only the Air Force, Army, and Navy.

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (i.e., hybrid licenses) are reported as patent licenses -- and not included in the count of copyright licenses.

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years

(1) "Active" = legally in force at any time during the FY.
(2) Patent license tally includes patent applications that are licensed.
(3) No licenses of this type indicated as active.
(4) No licenses of this type indicated as active.

Licensing Management

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Elapsed execution time,[1] licenses granted in FY**							
▪ **Invention licenses**							
▫ average months			--	--	n/a	7.6	5.4
▫ minimum			--	--	n/a	2.0	1.1
▫ maximum			--	--	n/a	36.0	21.9
- Patent licenses[2]							
▫ average months			--	--	--	7.6	5.4
▫ minimum			--	--	--	2.0	1.1
▫ maximum			--	--	--	36.0	21.9
● **Number of licenses terminated for cause in FY**							
▪ **Invention licenses**			--	--	2	6	21
- Patent licenses[2]			--	--	--	6	21

Data included in this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a subclass.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)
(2) Patent license tally includes patent applications which are licensed.

Characteristics of Licenses Bearing Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All income bearing licenses**, number			--	--	--	n/a	n/a
▫ Exclusive			--	--	--	n/a	n/a
▫ Partially exclusive			--	--	--	n/a	n/a
▫ Non-exclusive			--	--	--	n/a	n/a
▪ **Invention licenses**, income bearing			--	--	--	99	135
▫ Exclusive			--	--	--	59	55
▫ Partially exclusive			--	--	--	17	23
▫ Non-exclusive			--	--	--	48	65
- Patent licenses,(1) income bearing			--	--	--	99	135
▫ Exclusive			--	--	--	59	55
▫ Partially exclusive			--	--	--	17	23
▫ Non-exclusive			--	--	--	48	65
▪ **Other IP licenses**, income bearing			--	--	--	n/a	n/a
▫ Exclusive			--	--	--		
▫ Partially exclusive			--	--	--		
▫ Non-exclusive			--	--	--		
- Copyright licenses (fee bearing)			--	--	--		
▫ Exclusive			--	--	--		
▫ Partially exclusive			--	--	--		
▫ Non-exclusive			--	--	--		
● **All royalty bearing licenses**,(2) number			--	--	n/a	n/a	n/a
▪ **Invention licenses**, royalty bearing, number			--	--	n/a	96	124
- Patent licenses,(1) royalty bearing			--	--	--	96	124
▪ **Other IP licenses**, royalty bearing			--	--	--	n/a	n/a
- Copyright licenses (fee bearing)			--	--	--		

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalites, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of past years.

(1) Patent license tally includes patent applications that are licensed.
(2) Note that royalties are one component of total license income.

Income (annual) from Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Total income**, all licenses active in FY [1]			$2,005,000	$2,213,000	$6,465,468	$6,715,597	$9,965,586
▪ **Invention licenses**			$2,005,000	$2,213,000	$6,383,468	$6,713,679	$9,965,586
- Patent licenses [2]			$2,005,000	$2,213,000	$6,383,468	$6,713,679	$9,965,586
▪ **Other IP licenses**, total active in the FY			$0	$0	$82,000	$1,918	$0
- Copyright licenses			--	--	--	n/a	n/a
● **Total Earned Royalty Income** (ERI) [3]			--	--	n/a	n/a	n/a
▫ Median ERI			--	--	n/a	n/a	n/a
▫ Minimum ERI			--	--	$75	$22	$200
▫ Maximum ERI			--	--	$3,912,000	$4,358,315	$1,500,000
▫ ERI from top 1% of licenses			--	--	n/a	n/a	n/a
▫ ERI from top 5% of licenses			--	--	n/a	n/a	n/a
▫ ERI from top 20% of licenses			--	--	n/a	n/a	n/a
▪ **Invention licenses**			--	--	--	n/a	n/a
▫ Median ERI			--	--	--		
▫ Minimum ERI			--	--	--		
▫ Maximum ERI			--	--	--		
▫ ERI from top 1% of licenses			--	--	--		
▫ ERI from top 5% of licenses			--	--	--		
▫ ERI from top 20% of licenses			--	--	--		
- Patent licenses [2]			--	--	--	n/a	n/a
▫ Median ERI			--	--	--		
▫ Minimum ERI			--	--	--		
▫ Maximum ERI			--	--	--		
▫ ERI from top 1% of licenses			--	--	--		
▫ ERI from top 5% of licenses			--	--	--		
▫ ERI from top 20% of licenses			--	--	--		
▪ **Other IP licenses**			--	--	--	n/a	n/a
▫ Median ERI			--	--	--		
▫ Minimum ERI			--	--	--		
▫ Maximum ERI			--	--	--		
▫ ERI from top 1% of licenses			--	--	--		
▫ ERI from top 5% of licenses			--	--	--		
▫ ERI from top 20% of licenses			--	--	--		
- Copyright licenses			--	--	--	n/a	n/a
▫ Median ERI			--	--	--		
▫ Minimum ERI			--	--	--		
▫ Maximum ERI			--	--	--		
▫ ERI from top 1% of licenses			--	--	--		
▫ ERI from top 5% of licenses			--	--	--		
▫ ERI from top 20% of licenses			--	--	--		

Figures prior to FY 2001 include the activities of only the Air Force, Army, and Navy.

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

(2) Patent license tally includes patent applications that are licensed.

(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or units sold). Not a license fee or minimum royalty.

Disposition of License Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Income distributed** (1)							
▪ **Invention licenses**, total distributed			--	--	n/a	$2,041,787	$3,127,386
- To inventors			--	--	n/a	$761,136	$1,828,904
					20%	37%	58%
-To other(2)			--	--	n/a	$1,280,651	$1,298,482
					80%	63%	42%
- Patent licenses,(3) total distributed			--	--	--	n/a	n/a
- To inventors			--	--	--	n/a	n/a
-To other(2)			--	--	--	n/a	n/a

Invention licenses are the chief policy interest regarding distribution of income; content of this table reflects this focus.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Income includes royalties and other payments received during the FY.
(2) Further details not provided by the agency.
(3) Patent license tally includes patent applications that are licensed.

■ Other Performance Measures

None cited.

■ Downstream Outcomes

DOD's report for FY 2002 included the following selected examples of downstream outcomes from the department's technology transfer activities:

Army

- **Chemical Biological Explosives Containment System/Workshelter**. The primary system, Chemical Biological Explosives Containment System (CBECS) is a pneumatic structure supporting a Kevlar tent with a filling sock for aqueous foam. It is approximately 7 feet in diameter at the base and tapers to about 4 feet in diameter at the top. Once inflated, the unit is designed to be placed over the device/munition and filled with blast suppressive foam. The secondary containment shelter (workshelter) is also an airframe, which is easily inflated and placed over the primary containment system (CBECS). The workshelter is designed to contain/mitigate the residual effects (primarily, escaping fragments and vapors/aerosols from the primary containment system) associated with the detonation of the device/munition. The Army's Edgewood Chemical Biological Center entered into a patent license agreement with ZUMRO Inc. (Willow Grove, Pennsylvania), a leader in the life safety industry, to market CBECS to commercial customers. Both the primary and secondary containment systems were jointly designed by the Army's Chemical/Biological Counterterrorism Team and ZUMRO and then fabricated by ZUMRO.

• **Topical skin-protectant cream for civilian applications**. The Army's Medical Research Material Command has signed a patent license agreement to allow commercial development by a medium-sized U.S. pharmaceutical firm of a topical skin-protectant cream for nursing home and hospital prescription use. The cream was developed initially by Army Medical Research ICD for protection against chemical weapons exposure. It is expected to have widespread non-military uses, including skin protection against harsh chemicals in the home or industrial settings and for protection against irritants such as poison ivy.

• **Biological detection kit**. Development and technology transfer activities by the Army's Edgewood Chemical Biological Center have yielded a commercially available biological detection kit (BDK), BioHaz™, which provides users with capability to sample and detect biological materials in suspect samples. Increased potential for the use of biological agents as weapons of terror and mass destruction underscores the importance of finding means to sample and detect such agents in a rapid and effective manner. The BDK developed by the Army team consists of sampling and detection equipment for biological agents over large area surfaces and in liquid, air, and small solid samples. The kit is a single, integrated package that can analyze samples for the presence of DNA, protein, and bacteria. The BDK uses existing techniques from food safety, personal air monitoring, and analysis venues and integrates them with new approaches to create a technology that can very easily be used in the field. Several CRADAs were involved in developing the BDK: with New Horizons Diagnostics Inc., to package the kit, and with the EAI Corporation, to further refine and market the kit. An Information Exchange Agreement was established with the Military Institute of Hygience and Epidemiology in Poland to enable joint development of the spore luminescence protocol for the kit. The BioHaz™ is currently being marketed by the Response Equipment Corporation (subsidiary of EAI Corp.). The kit is also being marketed by New Horizons Diagnosics, Inc., as SWIPE™. The technology is currently being used by Hazardous Materials teams in several U.S. cities.

• **Integrated Virus Detection System**. An Army scientist at the Edgewood Chemical Biological Center has developed a fundamentally new method for detecting and identifying viruses and nanoparticles. The Integrated Virus Detection System (IVDS) is a patented approach that relies on the properties of size and density to identify and count viruses and other extremely small particles without the use of biochemical reactions. The IVDS technology has been transferred to the commercial sector, through an exclusive license to the Virus Detection Company. Several industries are expected to benefit from this new technology: bioprocessing (to develop new products, including vaccines), materials (refine nanoparticle based creations), computers (computing devices with improved nanometer-sized separations and tolerances). In addition, the IVDS has provided a new standard of measurement on the nanometer scale that relies on instruments such as electronmicrography and light scattering.

Navy

• **Techniques to diagnose or monitor sleep breathing disorders**. The Navy's Naval Underwater Weapons Center has signed two patent license agreements (in FY 2001) with Predictive Technology, Inc., a small company (in Massachusetts) formed to commercialize the use of non-linear signal processing techniques to diagnose or monitor sleep breathing disorders. The patented invention makes it possible to reduce medical and insurance costs by allowing a patient to be diagnosed for sleep apnea in a doctor's office while awake in a 20-30 minute test, rather than needing to undergo an all-night stay at a sleep clinic.

- **Plasma arc waste destruction system**. Over the last decade, researchers at the Carderock Division of the Naval Surface Warfare Center have been investigating plasma arc technology as means to destroy shipboard combustible solid waste. (The technology utilizes an electric arc in a gas to produce a plasma that is hotter than the surface of the sun.) From this work, an NSWC scientific team has recently developed the Plasma Arc Waste Destruction System (PAWDS), which offers a small size, rapid, and efficient operation and the ability to incinerate a wide variety of garbage. The NSWC team moved this patented technology forward through both a CRADA and licensing agreement with PyroGenesis Inc., a private firm that develops and commercializes customized thermal plasma technologies. PyroGenesis plans to manufacture and install PAWDS on commercial cruiseliners.

- **Advanced nontoxic fouling release coating**. A Naval Research Laboratory scientist has worked to develop and commercialize an environmentally safe coating system for ship hulls and pipeline applications (e.g., power plant water intakes). This patented coating system reduces the problem of biofouling (the undesired growth of barnacles, mussels, algae, etc.) with the use of toxic metals and biocides. The coating provides instead a surface to which organisms find it difficult to adhere. This new technology responds to a pressing need for an environmentally safe method for controlling biofouling that can replace the current methods that use metals and other chemicals that are potentially harmful to aquatic life and workers. To move the technology to the marketplace, NRL has licensed the coating system to a private company, Smart Surfaces LLC (Annapolis, Maryland), which plans to promote its use on commercial, private, and government ships, and as well in power plant water intake systems.

- **High speed, ultrastable, fiber optic communications laser**. A team at the Naval Research Laboratory has developed an advanced fiber optic laser that is capable of generating ultrashort pulses of light. Because pulsed laser light is used to carry digital information, NRL's ultrastable and ultrafast laser technology enables development of next generation communications systems. In addition, the patented technology can be used for radar systems and for other applications such as navigation and surveillance. The laser is being transferred by NRL for commercial development through licensing partnerships with two companies: PriTel, Inc., and Calmar Optcom. Presently, a number of products manufactured and marketed under these licensing agreements: four models of optical clocks, three optical transmitters, and two high power polarization maintaining fiber amplifiers.

- **Digital image enhancement**. A team at the Naval Undersea Warfare Center is working to apply digital image enhancement -- technology developed initially for underwater mine hunting sonar -- to the medical community to help in detecting small lesions in mammograms. Several CRADAs and a licensing agreement have been established to aid in the development and transfer of the technology: to Advanced Image Enhancement, Inc., and to the Slater Center for Interactive Technologies. It is expected that digital image enhancement will enable doctors to have greater success in detecting early stage breast cancer.

Air Force

- **Vein Viewer -- a system and method for enhanced visualization of subcutaneous structures**. Scientists at the Air Force Research Laboratory's Materials and Manufacturing Directorate developed this breakthrough medical technology for locating veins and arteries in wounded soldiers on the battlefield. The Vein Viewer is a system and method for enhancing visualization of veins, arteries, or other subcutaneous natural or foreign structures of the body and for facilitating intravenous insertion or extraction of fluids, medication, or the like. The Viewer is comprised of a light source for illuminating or trans-illuminating a portion of the body with light of selected wavelengths, a low-level light detector (such as an image intensifier tube, including night vision goggles; a photomultiplier tube, photodiode, or charge coupled device) for generating an image of the illuminated body portion, and optical filter(s) of selected spectral transmittance (located at the light source, detector, or both). The primary medical application for this new technology is in locating veins and arteries. The capability will also help doctors locate foreign objects such as bullets or shrapnel under the skin. Infrared Imaging Systems (IRIS) is a start-up company (Columbus, Ohio) specifically founded to exploit this technology. The Air Force currently has an exclusive license with IRIS on the original patent and also a follow-on CRADA for further development of the technology.

- **Pinpoint WeatherNet Project**. The Pinpoint WeatherNet Project (PWP) is a CRADA between the Office of Technology Transfer for Education (OTTE) at the Air Force Research Laboratory's Directed Energy and and Space Vehicles Directorates and KOB-TV in New Mexico. PWN provides high quality weather stations for New Mexico middle schools. In FY 2002, 48 schools participated. Also in FY 2002, PWN became part of the Homeland Security WeatherNet Network, a partnership between the National Weather Service and Automated Weather Source.

- **Lightweight, carbon composite cages for low heat generation bearings**. A team at the Air Force Research Laboratory's Propulsion Directorate has developed a composite cage for rolling element bearings. The lightweight, carbon-carbon and carbon-phenolic composite cages enable rolling element bearings to operate at a higher speed with signficiantly less frictional heat generation than bearings fitted with traditional steel and cotton-based phenolic cages. The technology was developed in cooperation with a CRADA partner, Allcomp Inc., which has also received an exclusive license to the patent. Potential beneficiaries of this new technology include domestic bearing manufacturers and users of rotating equipment and turbomachinery.

National Security Agency

- **SilentRunner® for continuous monitoring and analysis of network activity and security performance**. NSA has licensed the SilentRunner® product and technology to the Raytheon Company. SilentRunner® passively gathers data about a network, its structure, its traffice, and its users through analysis of raw network packets. The raw packets are assembled and organized into a knowledge base that provides a detailed activity display of the network. The level of analysis enables assessment of real time data related to security risks and network vulnerabilities.

3.4 Department of Energy

This section summarizes the statistics and other data provided by the department in its annual reports on the technology transfer activities and outcomes of its federal laboratories. Currently, these reports provide data through FY 2003. This information covers the activities of all the department's government owned/government operated (GOGO) and government owned/contractor operated (GOCO) laboratories. For additional details, readers should consult the department's full report.[28]

■ Collaborative Relationships for Research and Development

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **CRADAs**, total active in the FY[(1)]			715	687	558	680	661
- New, executed in the FY			240	151	204	192	140
▪ Traditional CRADAs,[(2)] total active in the FY	1	1,392	715	687	558	680	661
- New, executed in the FY			240	151	204	192	140
▪ Non-traditional CRADAs,[(3)] total active in FY			0	0	0	0	0
- New, executed in the FY			0	0	0	0	0
● **Other collaborative R&D relationships**							
			--	--	0	0	0

CRADA = Cooperative Research and Development Agreement

-- = Data not requested from agency in reports of earlier years. Figures are CRADAs "active during the FY" for FY 2002; "active at the end of the FY" for earlier years.

(1) "Active" = legally in force at any time during the FY. "Total active" includes all agreements executed under CRADA authority (15 USC 3710a).

(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.

(3) CRADAs used for special purposes -- such as material transfer or technical assistance that may result in protected information.

■ Invention Disclosure and Patenting

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● New inventions disclosed in the FY[(1)]	1,335	1,758	1,474	1,371	1,527	1,498	1,469
● Patent applications filed in the FY[(2)]	366	571	850	788	792	711	866
● Patents issued in the FY			525	515	605	551	627

(1) Inventions arising at the federal lab.

(2) Tally includes: U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes: provisional, continuation, duplicate foreign, and PCT applications.

[28] U.S. Dept. of Energy, Office of Policy and International Affairs, *Annual Report on Technology Transfer and Related Technology Partnering Activities at the National Laboratories and Other Facilities, Fiscal Year 2003*, February 2004. Report prepared in response to 15 USC Sec. 3710(f) (requiring an annual "agency report on utilization" for agencies with federal laboratories) and submitted to OMB (consistent with Circular A-11 guidelines). (Report available on the Internet at http://techtransfer.energy.gov/reports.html)

■ Licensing

Profile of Active Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All licenses**, number total active in the FY[1]			1,922	2,070	2,005	3,459	3,687
▫ New, executed in the FY			202	169	226	694	711
▪ **Invention licenses**, total active in the FY			981	1,094	1,162	1,327	1,223
▫ New, executed in the FY	62	140	202	169	226	206	172
- Patent licenses,[2] total active in FY			--	--	1,162	1,327	1,223
▫ New, executed in the FY			--	--	226	206	172
- Material transfer (inventions), tot active in FY			--	--	0	0	0
▫ New, executed in the FY			--	--	0	0	0
- Other invention licenses,[3] total active in FY			--	--	0	0	0
▫ New, executed in the FY			--	--	0	0	0
▪ **Other IP licenses**, total active in the FY			941	976	843	2,132	2,464
▫ New, executed in the FY			--	--	--	488	539
- Copyright licenses (fee bearing)			--	--	--	1,525	1,823
▫ New, executed in the FY			--	--	--	332	348
- Material transfer (non-inv.), total active in FY			--	--	--	581	604
▫ New, executed in the FY			--	--	--	153	180
- Other [4]			--	--	--	26	37
▫ New, executed in the FY			--	--	--	3	11

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (i.e., hybrid licenses) are reported as patent licenses -- and not included in the count of copyright licenses.

-- = Data not requested from agency in reports of earlier years.

(1) "Active" = legally in force at any time during the FY.
(2) Patent license tally includes patent applications that are licensed.
(3) No licenses of this type indicated as active.
(4) Bailment agreements, trademarks, etc.

Licensing Management

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Elapsed execution time,[1] licenses granted in FY**							
▪ **Invention licenses**							
▫ average months			--	--	n/a	4.2	4.4
▫ minimum			--	--	n/a	0.3	0.3
▫ maximum			--	--	n/a	15.5	24.5
- Patent licenses[2]							
▫ average months			--	--	n/a	4.2	4.4
▫ minimum			--	--	n/a	0.3	0.3
▫ maximum			--	--	n/a	15.5	24.5
● **Number of licenses terminated for cause in FY**							
▪ **Invention licenses**			--	--	60	77	35
- Patent licenses[2]			--	--	60	77	35

Data included in this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a subclass.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)
(2) Patent license tally includes patent applications which are licensed.

Characteristics of Licenses Bearing Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All income bearing licenses**, number			--	--	1,012	2,523	2,523
▫ Exclusive			--	--	174	301	246
▫ Partially exclusive			--	--	112	136	235
▫ Non-exclusive			--	--	726	2,086	2,042
▪ **Invention licenses**, income bearing			--	--	--	1,123	1,056
▫ Exclusive			--	--	--	263	215
▫ Partially exclusive			--	--	--	123	196
▫ Non-exclusive			--	--	--	737	645
- Patent licenses,(1) income bearing			--	--	--	1,123	1,056
▫ Exclusive			--	--	--	263	215
▫ Partially exclusive			--	--	--	123	196
▫ Non-exclusive			--	--	--	737	645
▪ **Other IP licenses**, income bearing			--	--	--	1,400	1,467
▫ Exclusive			--	--	--	38	31
▫ Partially exclusive			--	--	--	13	39
▫ Non-exclusive			--	--	--	1,349	1,397
- Copyright licenses (fee bearing)			--	--	--	1,173	1,352
▫ Exclusive			--	--	--	29	25
▫ Partially exclusive			--	--	--	7	35
▫ Non-exclusive			--	--	--	1,137	1,292
● **All royalty bearing licenses**,(2) number			193	220	1,012	2,523	2,523
▪ **Invention licenses**, royalty bearing, number			--	--	--	1,123	1,056
- Patent licenses,(1) royalty bearing			--	--	--	1,123	1,056
▪ **Other IP licenses**, royalty bearing			--	--	--	1,400	1,467
- Copyright licenses (fee bearing)			--	--	--	1,173	1,352

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalites, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of past years.

(1) Patent license tally includes patent applications that are licensed.
(2) Note that royalties are one component of total license income.

Income (annual) from Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Total income**, all licenses active in FY (1)			$11,764,000	$15,840,000	$21,403,362	$23,476,716	$25,805,498
▪ **Invention licenses**	$2,560,000	$3,455,000	$10,199,000	$12,710,000	$18,921,843	$21,253,279	$23,669,908
- Patent licenses (2)			--	--	--	$21,253,279	$23,669,908
▪ **Other IP licenses**, total active in the FY			$1,545,000	$2,836,000	$1,870,071	$2,223,437	$2,135,590
- Copyright licenses			--	--	--	$1,869,644	$2,100,886
● **Total Earned Royalty Income** (ERI) (3)			$1,975,000	$2,228,000	$7,832,481	$5,604,774	$6,611,568
▫ Median ERI			--	--	n/a	$4,000	$3,000
▫ Minimum ERI			--	--	$2	$23	$3
▫ Maximum ERI			--	--	$1,584,922	$793,802	$913,000
▫ ERI from top 1% of licenses			--	--	$2,699,134	$1,550,000	$1,478,000
▫ ERI from top 5% of licenses			--	--	$5,271,631	$3,696,000	$3,789,000
▫ ERI from top 20% of licenses			--	--	$7,162,951	$4,571,000	$5,962,000
▪ **Invention licenses**			--	--	--	$5,310,178	$6,063,693
▫ Median ERI			--	--	--	$6,000	$5,000
▫ Minimum ERI			--	--	--	$25	$3
▫ Maximum ERI			--	--	--	$793,802	$913,000
▫ ERI from top 1% of licenses			--	--	--	$793,802	$1,478,000
▫ ERI from top 5% of licenses			--	--	--	$3,418,529	$3,197,000
▫ ERI from top 20% of licenses			--	--	--	$5,067,977	$5,363,000
- Patent licenses (2)			--	--	--	$5,310,178	$6,063,693
▫ Median ERI			--	--	--	$6,000	$5,000
▫ Minimum ERI			--	--	--	$25	$3
▫ Maximum ERI			--	--	--	$793,802	$913,000
▫ ERI from top 1% of licenses			--	--	--	$793,802	$1,478,000
▫ ERI from top 5% of licenses			--	--	--	$3,418,529	$3,197,000
▫ ERI from top 20% of licenses			--	--	--	$5,067,977	$5,363,000
▪ **Other IP licenses**			--	--	--	$294,597	$547,875
▫ Median ERI			--	--	--	$1,000	$1,000
▫ Minimum ERI			--	--	--	$23	$10
▫ Maximum ERI			--	--	--	$68,802	$168,000
▫ ERI from top 1% of licenses			--	--	--	$69,000	$168,000
▫ ERI from top 5% of licenses			--	--	--	$114,591	$316,000
▫ ERI from top 20% of licenses			--	--	--	$196,945	$480,000
- Copyright licenses			--	--	--	$293,297	$546,182
▫ Median ERI			--	--	--	$2,000	$1,000
▫ Minimum ERI			--	--	--	$23	$10
▫ Maximum ERI			--	--	--	$68,802	$168,000
▫ ERI from top 1% of licenses			--	--	--	$68,802	$168,000
▫ ERI from top 5% of licenses			--	--	--	$100,052	$272,000
▫ ERI from top 20% of licenses			--	--	--	$187,169	$480,000

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

(2) Patent license tally includes patent applications that are licensed.

(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or units sold). Not a license fee or minimum royalty.

Disposition of License Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Income distributed** (1)							
▪ **Invention licenses**, total distributed			--	--	$16,356,052	$16,422,696	$19,540,000
- To inventors			--	--	$5,942,497	$6,386,213	$5,624,000
					36%	39%	29%
-To other(2)			--	--	$10,413,555	$10,036,483	$13,916,000
					64%	61%	71%
- Patent licenses,(3) total distributed			--	--	$16,356,052	$16,422,696	$19,540,000
- To inventors			--	--	$5,942,497	$6,386,213	$5,624,000
					36%	39%	29%
-To other(2)			--	--	$10,413,555	$10,036,483	$13,916,000
					64%	61%	71%

Invention licenses are the chief policy interest regarding distribution of income; content of this table reflects this focus.

-- = Data not requested from agency in reports of earlier years.

(1) Income includes royalties and other payments received during the FY.

(2) To DoE laboratories' management and operating contractor for research, development, technology transfer, training, education and other activities consistent with laboratory mission and objectives.

(3) Patent license tally includes patent applications that are licensed.

■ Other Performance Measures

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
Work-for-Others agreements -- new, executed in FY			--	--	--	1,934	1,952
User Facility							
-- Agreements, total active in FY			--	--	--	--	3,688
-- Projects, total active in FY			--	--	--	--	5,333

■ Downstream Outcomes

DOE’s FY 2003 report provided the following selected examples of downstream outcomes arising from the technology partnering/transfer activities of the department’s federal laboratories:

● **ADVISOR™ improves automotive design productivity**. ADVISOR™ (ADvanced Vehicle SimulatOR) software provides a specialized tool for the automotive engineering community to quickly simulate the performance of a large number of vehicle design options, therefore reducing the time and expense involved in building and testing prototypes. ADVISOR™ software can simulate and analyze light and heavy vehicles—including hybrid electric and fuel cell vehicles. It tests the effect of changes in vehicle components (such as motors, batteries, catalytic converters, climate control systems, and alternative fuels) and other modifications that might affect fuel economy, performance, or emissions. Using ADVISOR™ software, companies can: (1) reduce testing time to evaluate various vehicle powertrain alternatives, (2) assist in developing fuel-efficient vehicles and components, and (3) provide a shared simulation tool for government, universities, and industry.

The Vehicle Systems Analysis Team at the National Renewable Energy Laboratory (NREL) developed the first version of ADVISOR™ in 1994 with the help of industry partners to simulate and analyze various performance aspects of conventional and advanced vehicles. ADVISOR 2003™ was also licensed to AVL Powertrain Engineering Inc. (AVL). The license agreement for the ADVISOR software and a related CRADA facilitates the transfer of the ADVISOR software from NREL to AVL and ultimately to wide application in the transportation sector. AVL will in turn provide a highly visible commercial outlet for NREL's advanced vehicle simulator research, leading to more significant uses of the ADVISOR™ software by automakers and ultimately the development of more efficient advanced vehicles worldwide. The associated three-year CRADA will also enhance the transfer of the ADVISOR™ software to market and will help position AVL to provide comprehensive services and solutions to its clients. By facilitating the design of more efficient vehicles, ADVISOR™ will directly contribute to the reduction of petroleum use and oil imports in the U.S. economy.

● **Alpha particle immunotherapy for treating leukemia and solid tumor metastases**. One promising new cancer treatment is alpha particle immunotherapy (APIT), a technology that makes it possible to treat patients with malignancies of the hematopoietic system, such as leukemia, as well as metastasis from many solid tumors effectively and with fewer side effects than other treatments. This technology combines the power of alpha particle-emitting radioactive isotopes (actinium-225 or bismuth-213) with monoclonal antibodies that bind to and destroy specific cancer cells, but not the nearby healthy tissue. Early trials at major research centers yielded encouraging results.

The primary supplier of APIT is MedActinium, a small radiopharmaceutical firm in Oak Ridge, Tennessee. MedActinium turned to researchers at Pacific Northwest National Laboratory (PNNL) to help solve two obstacles to commercial use of APIT: purifying the isotope and binding it to the antibody to create a stable product. This resulted in new separations chemistry for generating bismuth-213 and a key enabling technology for putting actinium-225 on monoclonal antibodies. The result is that these powerful new radioisotopes are now available to treat patients with leukemia or fast-spreading solid-tumor cancers.

This technology partnership involved collaborative efforts among private industry, academic research institutions, and U.S.Government agencies. PNNL built on relationships with the pharmaceutical industry dating from 1986. PNNL research in APIT-enabling technologies was part of a larger effort to develop beneficial uses for radioactive materials remaining from weapons production during the Cold War. The technology partnering arrangements were fast-tracked during the planning for initial clinical trials. The effort included exclusive license agreements for five immunology patents, negotiation and conclusion of a separate Technology Management Agreement with an earlier research partner, and establishment of a Cooperative Research and Development Agreement (CRADA) for further research. The transfer was completed in January 2003.

The transfer of technologies from PNNL to MedActinium is a contributing factor in the ability of the Memorial Sloan-Kettering Cancer Center and other research medical centers to continue the quest for effective cancer treatments. A second round of clinical trials is scheduled to begin the fall of 2004 at Sloan-Kettering.

● **Battery chemistry is the key to tiny rechargeable battery for microstimulator**. Battery chemistry developed by Argonne National Laboratory (ANL) and its research partners enabled the development of a microbattery to power an implantable bion® microstimulator that could help restore nerve and muscle function in patients suffering from a variety of medical conditions, including stroke, Parkinson's disease, and urinary urge incontinence. In feasibility trials, a prototype bion was implanted in patients to treat urinary urge incontinence, with promising results. The battery chemistry will provide calendar life significantly greater than that of commercially available lithium-ion batteries.

The bion® currently in feasibility trials comprises three integrated parts: the battery, which operates at normal body temperature, developed by Quallion LLC and ANL; an advanced microstimulator, developed by Advanced Bionics Corporation; and a control system, developed by Advanced Bionics Corp., to manage remote reprogramming and battery recharging.

ANL is working with the University of Wisconsin and Quallion, LLC, to develop a next-generation cell chemistry that could give even longer life. Development of the bion microstimulator was funded by a grant to Quallion under the National Institute of Standards and Technology's Advanced Technology Program. The foundation for ANL's research was provided by battery development for hybrid electric vehicles, funded by the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, FreedomCAR and Vehicle Technologies program.

● **Cancer treatment using brachytherapy**. Oak Ridge National Laboratory (ORNL) and an industry partner, Isotron, are collaborating through a CRADA to boost the treatment possibilities for brain tumors and other types of cancer resistant to conventional techniques with X-rays or gamma radiation. The objective is to miniaturize the radioactive sources and enhance a cancer treatment known as neutron brachytherapy. The treatment could enable physicians to deliver a powerful dose of cell-killing neutrons directly to a tumor, using a catheter to funnel the radioactive wire to the site. These research scientists have reduced the diameter of the californium source by more than half, and the neutron emitter can now be applied to organs previously inaccessible. By concentrating the radioactivity, the treatment time can also be shortened – thus limiting the exposure to medical staff. ORNL produces californium-252 in its High Flux Isotope Reactor; nuclear researchers fabricate the wire-like sources in shielded “hot cells” near the reactor.

● **Cold ion deposition technology**. Researchers at the Princeton Plasma Physics Laboratory (PPPL) have developed a unique and proprietary method of rapidly killing bacterial spores. The technology uses the positive ions from a light atom and accelerates them through a high energy potential. The ions are driven toward a surface on which the bacterial spores are located with energy sufficient to damage the spores and render them no longer viable.

The commercial application of this technology is the cleaning and sanitizing of plastics used in food and beverage packaging and has been called the cold ion deposition technology (CID) by the company seeking to commercialize the process. Rather than using heat, water, or chemicals to kill germs, the system uses non-thermal plasma. CID technology uses the ions generated from the plasma to destroy any microbial spores on the inner surface of the container. This is a safe, efficient, inexpensive mechanism for cleaning and sanitizing plastics, and will not alter the taste of the beverage. PlaZtec, LLC was formed to commercialize technologies that are beneficial to the environment and global societies as a whole. Cold ion deposition (CID) is the first technology that PlaZtec is focusing on, with an initial application being in the non-alcoholic beverage bottling industry.

● **Decontamination solution for chemical and biological warfare agents**. A decontamination formulation originally developed at Sandia National Laboratories (SNL) that renders harmless chemical and biological warfare agents has been selected for use by the U.S. Central Command

(CENTCOM). CENTCOM placed an order with EnviroFoam™ Technologies for several thousand gallons of the company's EasyDECON™ solution. EnviroFoam licensed the formulation for EasyDECON from Sandia in August 2000. The formulation neutralizes both chemical and biological agents and is nontoxic, noncorrosive, and environmentally acceptable. The formulation can be deployed as a foam, mist, fog, spray, or liquid. The Sandia formulation, on which EasyDECON is based, has proven effective against both biological and chemical agents, can be applied with current military hardware, has shown no collateral damage, and creates an effluent capable of being washed down the drain. EnviroFoam was one of two U.S. companies granted nonexclusive licenses to the decontamination formulation, which has been under development at Sandia since 1997.

● **Efficient photovoltaic solar cells becoming widely deployed**. CIGS ($Cu(In,Ga)Se_2$) is a recrystallization method for fabricating thin-films on a substrate for semiconductor device applications, particularly solar cells. Global Solar Energy's (GSE) thin-film technology involves sequentially depositing thin layers of CIGS materials onto stainless steel substrates. The resulting product is lightweight, flexible and free of the fragility of crystalline silicon PV technologies. CIGS cells have reached efficiencies of more than 19 percent, higher than other thin-film PV cells, such as amorphous silicon.

The National Renewable Energy Laboratory (NREL) has entered into a licensing agreement with Global Solar Energy. The CIGS technology will provide Global Solar Energy a highly effective way to manufacture and sell thin-film PV solar cells, introducing "the world's lightest, most flexible solar panel." The solar cells come in 5, 10 or 20-watt sizes and can be used as a battery charger as well as direct power source for portable electronics such as GPS, cell phones, and laptop computers. These applications have a wide range of civilian and military uses for field applications, such as heaters for personal warmth and survival, as well as powering equipment. The technology may ultimately find uses in micro-grid and village power stations, telecommunications, and stand-alone and remote power systems.

Upon securing the CIGS patent license, GSE signed an exclusive agreement with CIP Global Technologies of Montreal, the world's largest manufacturer of consumer solar products, to commercialize the CIGS thin film products. It is anticipated that the thin film products will be sold at stores like Radio Shack, Wal-Mart, and Costco. GSE also signed an agreement with SunWize, a photovoltaics company in New York, who will be sole distributor of the CIGS thin film products to a worldwide client base.

● **Electrodynamic ion funnel**. Mass spectrometry is a widely used tool in environmental, biotechnology, clinical, and drug testing applications, as well as in medical, biological, and other broad areas of scientific research. The use of mass spectrometry is strongly affected by the sensitivity of the measurement that can be made. Pacific Northwest National Laboratory's (PNNL) Electrodynamic Ion Funnel can be used to increase sensitivity for many forms of mass spectrometry.

The Electrodynamic Ion Funnel is a revolutionary development that focuses ions in gases, greatly improving the sensitivity of analytical devices such as mass spectrometers that depend on ion formation and transfer in the presence of gases. An additional benefit of the ion funnel can be a significant reduction in the cost of mass spectrometers as a result of its use.

Through a non-exclusive licensing mechanism, PNNL successfully transferred the ion funnel technology to three leading manufacturers of mass spectrometers: Micromass in 2001, Biospect, Inc.

in 2002, and Bruker Daltonics, Inc. in 2003, all major manufacturers of mass spectrometers. Micromass' applications focus on the biotechnology, pharmaceutical, clinical, analytical, environmental and geologic sciences. Bruker Daltonics, Inc. is a leading manufacturer of mass spectrometry instruments and accessories for pharmaceutical, biochemical, and chemical research. Biospect, Inc., wants to use mass spectrometry to analyze human bodily fluids as a way to predict for diseases. The ability to define and monitor biological states through analysis of bodily fluids could lead to a revolution in medicine and biomedical research. Through their connections, these two companies will enable broader use of mass spectrometers using the ion funnel.

● **Field-ready DNA testing systems**. Cepheid – a California start-up company that executed its license with Lawrence Livermore National Laboratory (LLNL) in 1996 -- has recently received much attention for its field-ready DNA testing systems for rapid detection of deadly biothreat agents such as anthrax. Cepheid is developing fully integrated portable instruments and laboratory systems that can be used for rapid detection of infectious disease agents, human genes, and industrial and environmental contaminants quickly and accurately. These products will enhance U.S. biodectector capabilities, which limit current ability to protect against biological terrorism, thereby supporting DOE's mission in responding to weapons of mass destruction and to counter terrorism. The adaptation of LLNL technology, which is the basis of the Smart Cycler®, a portable unit that allows customers to obtain bio-analytical results when and where they are needed.

In May 2003, Cepheid announced that the United States Postal Service (USPS) awarded Northrop Grumman Corporation's Security Systems LLC unit a contract to manufacture and integrate Biohazard Detection Systems (BDS) nationwide. Northrop Grumman is the prime contractor and systems integrator of the BDS, which uses polymerase chain reaction (PCR) technology, developed by Cepheid, to rapidly analyze air samples taken from the mail sorting systems and detect trace levels of DNA from anthrax spores and other biological agents as it moves through the mail processing equipment. The BDS incorporates Cepheid's GeneXpert® modules as its detection and identification system. Cepheid's GeneXpert® fully automated gene analysis system also won an R&D 100 Award in 2002. Technology licensed from LLNL is at the heart of this instrument as well. In a September 2003 Global Security Newswire article, a USPS representative indicated that a 15-city test of the BDS was completed last month, and a USPS spokesman was quoted as describing the test as a "resounding success."

● **Globus alliance leaders win FLC award**. The Federal Laboratory Consortium (FLC) gave a 2003 Award for Excellence in Technology Transfer to Argonne National Laboratory's scientists in recognition of their leadership in Grid computing on behalf of the Globus Alliance. The FLC awards annually recognize federal laboratory employees who have taken technology from the laboratory and applying it in the outside world.

Since 1996, the Globus Alliance has developed open-source Globus Toolkit software that is central to virtually every major deployment of the Grid, an interconnected computing environment that is transforming the nature of science and engineering research. The technology lets users share computing power, databases, and other tools securely online across corporate, institutional, and geographic boundaries without sacrificing local autonomy. In addition to its broad adoption for research, the Globus Toolkit is a de facto standard adopted by major information technology companies.

First funded by the Department of Energy as fundamental research and development, the Globus

Alliance has been embraced by companies like IBM, Oracle, Platform, Entropia, Compaq, Cray, SGI, Sun, Veridian, Fujitsu, Hitachi, and NEC. Each uses the Globus Toolkit as the basis for significant commercial products and services. The project's federally sponsored mission continues while scientists are working with public- and private-sector partners to define new standards called the Open Grid Services Architecture, which promises increases in the availability of Grid applications.

● **GREET model now includes additional hydrogen fuel pathways and fuel cell vehicle options**. When advanced vehicle technologies and new transportation fuels are being introduced, they first must be examined on a full fuel-cycle basis, including energy feedstock production, fuel production, and vehicle operations. To assist in this evaluation, Argonne National Laboratory (ANL) scientists developed a model called GREET (Greenhouse-gases, Regulated Emissions, and Energy use in Transportation) to conduct full fuel-cycle analyses. The computer tool evaluates more than 35 fuel production pathways and more than 50 vehicle technologies/fuel systems on a consistent, systematic basis. Since the first version was released in 1996, the model has been updated in response to changing users' needs and industry trends. There are now 1,100 registered GREET users in both the public and private sectors throughout North America, Europe, and Asia. The model provides information for a variety of industry, government, and academic organizations and institutions.

In one instance, GREET was used to analyze advanced vehicles and new fuels in a major well-to-wheels study conducted for General Motors Corporation (GM). GM, ANL scientists, British Petroleum, ExxonMobil, and Shell participated in the study. When Phase 1 of the study was completed, GM noted, "The results of the work will continue to influence the automotive and energy industries and government policymakers as we progress toward the introduction of advanced fuels and powertrains." Phase 2 of the study, with a focus on criteria pollutant emissions, will be completed by GM, ChevronTexaco, and Shell.

GREET was also used for a milestone government study on ethanol. GREET's analysis of ethanol's greenhouse gas emissions (GHG) emissions may have influenced the public debate on ethanol's energy and GHG emission benefits. In a cover letter for the study, Jim Edgar, then Governor of the State of Illinois, said, "Illinois is very pleased to have sponsored and published the results of this research study. The results clearly identify that ethanol outperformed conventional and reformulated gasoline with respect to energy use and reducing greenhouse gas emissions. The institution responsible for this study, Argonne National Laboratory, is the recognized leader in modeling fuel cycle fossil energy use and greenhouse gas emissions related to the transportation sector. . . .What this means for the agriculture community, ethanol producers, environmentalists, and policymakers is that ethanol fuel deserves a major role in any global climate change strategy to reduce greenhouse gas emissions in the transportation sector."

● **Grid technology is successfully integrated with inSORS software**. The Access Grid Toolkit 2.0 and the inSORS software IG2.0 are now interoperable, thanks to collaboration between Argonne National Laboratory (ANL) and inSORS Integrated Communications, Inc. This technical milestone is critical in meeting the increasing demand for group-to-group collaboration across the computing environment, using multimedia large-format displays for distributed workshops, lectures, and training. The integration of the two technologies combines the benefits of the ANL-developed Access Grid, including open source software, with the specialized applications features provided by the inSORS software, such as record and playback capabilities and remote control for cameras.

● **Guest room occupancy sensor/LED nightlight**. As part of a small CRADA partnership with The Wattstopper, Inc. and in collaboration with the Sacramento Municipal Utility District (SMUD), Lawrence Berkeley National Laboratory (LBNL) developed an integrated occupancy sensor/nighlight providing significant energy and cost savings. LBNL research showed that hotel bathroom lights are repeatedly left on when rooms are vacated or used as nightlights during slumber. According to the research, bathroom lights remained on anywhere from four to eight hours. To address the problem, LBNL and Wattstopper developed an occupancy sensor with a built-in nightlight. When the main bathroom lights are shut off (also timer controlled), a pair of super bright LED's built into the switch turn on automatically – providing an effective very low energy nightlight.

In cooperation with the partnership, the Double Tree Hotel in Sacramento recently installed the combination occupancy sensor/LED nightlights in 400 guestrooms. The new integrated occupancy sensor/nightlights resulted in a 50 percent reduction in guest room light usage with cost savings exceeding $8,000 per year. Guests of one hotel commented on improved comfort and safety, because the LED lights provide enough light to safely navigate a room without the blinding glare from turning on the lights in a dark room. While occupancy sensors and nightlights have been around for years, this partnership-developed occupancy sensor is the first to have a built-in high-efficiency nightlight.

Steps are under way to implement the energy saving device in Hawaii where there are many hotels and electricity costs are among the highest in the Nation. The program is targeted at 50,000 units with a projected energy savings of $8,000,000 over ten years. In addition to hotels, the device is suitable for residential construction, military housing, senior housing, and convalescent homes. Implementing the technology is simple and inexpensive; without risk, it improves safety and results in a significant energy savings.

● **Handheld advanced nucleic acid analyzer** (HANAA). In January 2003, Lawrence Livermore National Laboratory (LLNL) signed a non-exclusive license for the Handheld Advanced Nucleic Acid Analyzer (HANAA) technology, expected to be useful for chemical and biological detection, with Smiths Detection – Edgewood, Inc. (formerly Environmental Technologies Group, Inc. and now a subsidiary of Smiths Aerospace). The HANAA technology is at the heart of Smiths Detection Bio-SeeqTM product, currently being marketed as the first portable, hand-held thermocycler capable of detecting both bacterial and viral pathogens. Smiths Detection's objective is to provide the Department of Defense and the intelligence agencies with highly portable, advanced, bio-detection instruments and to further the DOE objective of putting advanced instrumentation for the detection of biological terrorist agents into the hands of first responders. The HANAA analyzes biological samples for the presence of specific DNA sequences that serve as the fingerprints of specific pathogens. It can simultaneously test four samples, each for two different DNA sequences, and have the results in about 20 minutes. The HANAA provides the first truly man-portable, handheld, field-worthy, real-time PCR bio-detection instrument. It is ideally suited for emergency response where biological pathogens are suspected, and for field monitoring where portability and fast answers are critical (e.g., monitoring water or food supplies for biological contamination in real time). It can also be used in intelligence, combat, or reconnaissance missions.

● **Implantable drug delivery devices**. Advanced Neuromodulation Systems, Inc. (ANS) and Sandia National Laboratories (SNL) recently executed a Work-for-Others agreement and related intellectual property agreements to explore the possibility of using a microelectromechanical system based microvalve in implantable drug delivery devices. ANS designs, develops, manufactures, and markets advanced implantable neuromodulation devices that deliver electrical current or drugs directly to targeted areas of the body to manage chronic pain. Commercialization of the microvalve technology in a medical application could lead to other applications that directly support SNL's national security mission.

● **Inductively coupled plasma/mass spectrometry collision cell technology**. The Inductively Coupled Plasma/Mass Spectrometry (ICP/MS) Collision/Reaction Cell (CRC) Technology developed at Pacific Northwest National Laboratory (PNNL) has advanced the analysis capabilities of mass spectrometer instruments worldwide. ICP/MS can now detect and measure many important elements that are not detectable with conventional mass spectrometry. This technology has had a significant and widespread impact in the analytical chemistry world because of its broad applications in environmental monitoring and testing, biotechnology, semiconductor manufacturing, and homeland security. Battelle, operating contractor for PNNL, has successfully licensed this technology to manufacturers in several countries. Currently, more than 60 percent of the mass spectrometers sold worldwide incorporate the CRC technology developed at PNNL.

● **Inductrack technology**. In July 2003, General Atomics signed a license with Lawrence Livermore National Laboratory (LLNL) for the Inductrack technology, a magnetic levitation system using new configurations of high-field permanent magnets to create its own levitating fields for urban and high-speed maglev train systems. The features of this unique technology include passive levitation leading to fail-safe behavior upon power loss, lower cost, and maintenance requirements compared to those of existing maglev systems, tight turn radius, steep hill-climbing capability, low noise, and low environmental impact. General Atomics is the prime contractor for the General Atomics Low Speed Maglev Technology Development Project, one of the projects funded by the Federal Transit Administration (FTA) as part of their Urban Maglev Program. The overall objective of this FTA program is to develop magnetic levitation technology as a cost effective, reliable, and environmentally sound transit option for urban mass transportation in the United States. The Inductrack system represents an enabling technology for urban maglev transportation that General Atomics hopes to apply to cities throughout the nation.

● **Magnetic-microsphere-based technology for molecular separation and detection**. Biophoretix, an Albuquerque-based biotechnology startup company, entered into an exclusive license agreement with Los Alamos National Laboratory (LANL) to commercialize a magnetic-microsphere-based technology for molecular separation and detection. The technology’s potential ranges from ensuring the safety of the world’s food, water, and air supplies to monitoring the efficacy of medical treatments. Biophoretix develops, manufactures, and markets diagnostic and discovery systems based on its multiplexed separation technology, which integrates easily with existing bioassay and detection systems. The Biophoretix platform can make current tests more sensitive, cheaper, and faster, while enabling many tests that are currently not possible.

Initial applications of the technology include accurate CD4/CD8 lymphocyte counts, necessary for monitoring drug therapies for AIDS, at a cost and speed that make access to monitoring attainable in the developing world. Monitoring in the United States and other developed nations is slow, expensive, and reliant on central clinical laboratories. This technology offers promise of closing that gap with its rugged, inexpensive, and portable platform. Other applications include a hepatitis panel, complete blood counts, and any testing that requires the sorting of cells or other biological material. Target markets for separating biological materials include: clinical diagnostics, drug discovery, environmental monitoring, and for use in bioterrorism detection.

● **Micro high-G acceleration devices in collaborative development**. Recently, Sandia National Laboratories (SNL) and the ENDEVCO Corporation, a leading supplier of dynamic instrumentation for vibration, shock, inertial motion, and dynamic pressure measurements, signed a CRADA to develop a high-G robust (60,000 g's) low-volume, low-power, accelerometer and acceleration recording device. The CRADA will help SNL design and develop smaller, lower power, acceleration recording devices in support of its Defense Program and Emerging Threats missions. ENDEVCO will be better able to meet its needs as a supplier to both the defense industry and DOE/DP by increasing capabilities for future weapon systems.

● **Millimeter wave holographic screening device**. During research originally intended for the Federal Aviation Administration to augment current airport security systems, a breakthrough technology was developed. This technology, with applications spanning entertainment, health, apparel, and security arenas, has significant benefits to each industry and their consumers. The millimeter-wave holographic screening device, developed by researchers at the Pacific Northwest National Laboratory (PNNL) will be used by two different companies in two very different industries: security and apparel.

The screening device uses non-harmful, ultra high-frequency radio waves to penetrate clothing, enabling security personnel to detect both metallic and nonmetallic concealed objects. This technology can also be used to obtain accurate volumetric body measurements for improved apparel fitting. The high-speed, full-body measurements capability offers significant advantages over systems currently in the marketplace.

This innovative technology uses radar cylindrical holographic techniques invented at PNNL and a new combined imaging algorithm to obtain complete body measurements while the individual remains fully clothed in normal attire. The system rapidly scans objects and sends reflected signals into a high-speed image processing computer and then produces a high-resolution 3-D image from the data.

PNNL has successfully licensed this technology to a company formed to offer it to the security market and is under option to a second company whose vision is to transform the way clothing is marketed and produced.

● **Miniature integrated nuclear detection system with improved detection capability**. The Miniature Integrated Nuclear Detection System (MINDS) is a type of radiation detector. The MINDS system acts as a warning system to detect radiation from gamma and/or neutron emitters, contained in objects, containers, or vehicles, or carried by a pedestrian, and differentiate between sources of radiation from threatening radio nuclides. If the source of radiation is from a threatening radionuclide, the MINDS activates an alarm when the signal from the detection system exceeds a threshold. The system is very small and can be manufactured for a very modest cost. A field prototype has been developed. The combination of low cost, modest size and ease of manufacturability makes the MINDS a potential system that can be deployed fairly soon and perhaps provide the detection and monitoring capability needed to prevent another terrorist attack.

The development of the MINDS technology is a joint effort between the U.S. Department of Energy's Princeton Plasma Physics Laboratory and the Rutgers University Center for Advanced Information Processing (CAIP). The effort was also supported by funding from the U.S. Army at

Picatinny Arsenal. The Princeton University Office of Research and Project Administration is in discussions with potential licensees for the technology.

● **Monitor for air particulates**. Los Alamos National Laboratory (LANL) has licensed an environmental monitoring tool to Advanced Realtime Technologies (ART), LLC, to develop a commercial version of a cost-effective, real-time, continuous, field-portable, air-particulate monitor. The core technology for ART was developed at LANL to compliment the Department of Energy's Chronic Beryllium Disease Prevention Program. The Laboratory's Industrial Business Development (IBD) Division is assisting Advanced Realtime Technologies with business development. The technology will have broad applications in environmental monitoring, occupational safety inspection, mining processes, and the aerospace, semiconductor, and petrochemical industries.

The instrument will combine the advantages of a highly sensitive laboratory technique with the portability and ease-of-use of an in-the-field instrument. It can be used for on-site environmental pollution monitoring, real-time occupational safety inspection, and industrial process control. Through real-time, highly sensitive detection in the field, the instrument can provide instant feedback to site-workers, allowing them to take prompt action to avoid overexposure to harmful chemicals or environmental hazards.

● **Novel chemical sensing technologies for safety**. Development of chemical sensing technologies, and especially sorbents for surface acoustic array (SAW) sensors, is a long-standing aim of researchers at Pacific Northwest National Laboratory (PNNL). Arising out of this work is a patented hydrogen bonding polymer sorbent directed towards the detection of nerve agents, which was recently licensed by Battelle, operator of PNNL, to BAE Systems Integrated Defense Solutions. This hydrogen bonding hybrid organic/inorganic polymer was designed to be selective for nerve agents, and displays four times greater sensitivity to nerve agents than any other known polymer used in SAW devices. BAE Systems uses this polymer in the "JCAD Chem SentryTM" (Joint Chemical Agent Detector) currently being delivered to the armed services. This is a small, hand-held device that offers state-of-the-art chemical warfare detection capabilities. BAE's system using PNNL developed technology will soon to be available in a version for sale to civilian markets.

● **Opening new markets for agricultural by-products**. Each year, the U.S. corn milling industry generates almost 14 billion pounds of fiber (as hulls) during the processing of corn kernels to obtain starch, protein, and vegetable oils. Cattle feed is the primary use for this fiber byproduct and is typically the lowest value product of corn milling. But processes developed through a Cooperative Research and Development Agreement (CRADA) between Pacific Northwest National Laboratory (PNNL) and the National Corn Growers Association (NCGA) show promise for changing the way corn kernels are processed.

Researchers at PNNL have developed processes that will reclaim greater value from this resource by separating the corn fiber into its basic components: lipids, carbohydrates, proteins. These products will then be used to produce fuel ethanol and the building blocks for industrial chemicals, as well as higher value food, feed, and consumer products. The group is taking a low-market value byproduct and opening up new markets, while also creating new supplies for existing, higher-margin markets.

Initiated in 2001, the CRADA extends previous work, which resulted in technology for converting of five-carbon and six-carbon sugars derived from corn fiber to ethylene glycol or propylene glycol. In order to commercialize the technology, Battelle and NCGA have entered into license and income sharing agreements. Battelle, as operator of PNNL, serves as the commercialization agent for laboratory-derived technologies.

Depending upon how the conversion process is conducted, one may obtain either mixed or pure streams of the glycol products. The mixed products production process was licensed to NCGA for use as coalescing solvents, paraffin substitutes, and industrial emulsifiers; with Battelle retaining responsibility for licensing the pure products production process, and then sharing that licensing income with NCGA. Researchers from Michigan State University also contributed to the work developing the six-carbon conversion process, and the license and income sharing agreements between Battelle and NCGA were specifically crafted to reflect their contribution and to return licensing income to Michigan State.

● **Oak Ridge National Laboratory wins four *R&D 100* awards**. In FY 2003, researchers at the Department of Energy's Oak Ridge National Laboratory (ORNL) won four research and development awards from *R&D Magazine* (which since 1963 has given the awards for the 100 most significant innovations of the year). ORNL's total of 116 awards is second only to General Electric. The following inventions received honors:

RAMiTS, Raman Integrated Tunable Sensor, is a compact, "point-and-shoot," fully integrated, battery-operated Raman monitor and is based on solid-state acousto-optic tunable filter technology. Outside the laboratory, this device can perform qualitative analysis of chemical and biological samples in seconds. RAMiTS can identify hundreds of substances, including toxic chemicals, by-products from explosives, biomedical markers, pharmaceuticals, and illicit drugs. RAMiTS also could help revolutionize sensing applications such as environmental monitoring, medical diagnostics, and homeland security, researchers said.

MicroTrapMS is a highly miniaturized ion trap mass spectrometer that is based on ORNL patented technology. The product can be used for applications from on-line screening for toxins in municipal watersheds to detecting hazardous substances at airport checkpoints. MicroTrapMS will enhance real-time capabilities of field engineers to sweep many local areas for pesticides, drugs, explosives, and more. MicroTrapMS has the power of a conventional mass spectrometer at a lower cost.

CF8C-Plus is designed to drastically improve high-temperature durability, performance, and reliability based on ORNL's unique engineered microstructure alloy development methodology. The engineered microstructure method dramatically changes CF8C-Plus from steel that cannot be used above 600-650 degrees Celsius to steel that can be used up to 850 degrees Celsius and resists failure during creep, mechanical fatigue and thermal fatigue. Developers said that end users like Caterpillar or commercial foundries like MetalTek will benefit from CF8C-Plus because it is a cost-effective product with higher performance and immense reliability.

The Uncooled Micromechanical Infrared Camera (UMIR-Cam) is a sensitive, miniature imaging, and infrared photo-detection device. It runs at room temperature and can be used in a number of endeavors, including night vision, industrial process monitoring, and medical imaging. It also can help firefighters see through smoke and has particularly important uses in the commercial and military sectors, because infrared radiation is the second-most intense source of radiation in our environment.

● **Processing technology for cleaning, decontaminating, and etching surfaces**. APJeT, a startup company that holds an exclusive license for materials processing technology developed at Los Alamos National Laboratory (LANL), recently announced $3 million in funding by two strategic investors. APJeT's technology was invented at Los Alamos National Laboratory by, a LANL physicist who is now APJeT's president and CEO. The technology produces a gas stream of reactive chemicals that can clean, decontaminate, etch, or coat surfaces at atmospheric pressure and low temperatures. Heretofore, such plasma treatments could take place only in a vacuum, a process that is considerably slower and more costly than the APJeT solution.

The new technology aids in treating synthetic fibers to make them absorb or repel water, removing photo-sensitive material from silicon wafers, depositing thin films, and decontaminating surfaces exposed to chemical and biological warfare agents, such as anthrax spores. It could also be used in sterilizing medical products for the health care industry. Other investors in the company include Air Products & Chemicals of Allentown, Pennsylvania, a market leader in industrial gas and chemical processing, and Advanced Energy Industries of Fort Collins, Colorado, a global leader in plasma source and power supply systems used in the manufacture of semiconductors, data storage products, and flat panel displays.

● **PVScan and Reflectometer**. PVScan is a high-speed optical scanner designed for characterizing photovoltaic (PV) materials and devices. It is used to analyze defects in semiconductor material and identify problems in the fabrication of electro-optical devices such as PV cells. The system is capable of measuring defect densities, grain-boundary distributions, reflectance, and light-beam-induced current (LBIC) on devices up to 20 cm x 20 cm and at rates up to 10 cm per second. The system, recognized by an *R&D 100* award as one of the best technologies of the year in 1993, provides valuable information for both crystal growers and process engineers, who require quick feedback on process changes. It has worldwide economic development applications for the semiconductor and PV markets by being able to quickly test for and identify defects in the wafers so that the manufacturing processes may be changed and quality may be improved, thus improving the efficiency and cost-effectiveness of the product.

The Reflectometer is a patented optical system for determining physical characteristics of a solar cell. It is used to help PV manufacturers and research and development laboratories produce high yields of high-quality cells to make high-quality PV modules. Using reflectance spectroscopy, the Reflectometer can measure physical parameters of wafers, wafer surfaces, and other materials deposited during solar cell fabrication. The market strength for the Reflectometer is through its unique design approach to production monitoring systems that is capable of very high throughput with accuracy and sensitivity.

The National Renewable Energy Laboratory (NREL) entered into licensing agreements with GTi Equipment Technologies, Inc. (GTi) to further develop and commercialize the PVScan and Reflectometer technologies. GTi is a small but profitable business specializing in the design and production of semi-custom and specialty equipment for materials processing industries, serving niche markets for semiconductor and photovoltaic applications. GTi's solar division provides equipment, support, and training for turnkey solar panel manufacturing projects worldwide. GTi has already begun selling new products that integrate these technologies.

● **RadScout radiation detector and analyzer**. The ORTEC Products business unit of AMETEK signed a non-exclusive license agreement with Lawrence Livermore National Laboratory (LLNL) in

April 2003 to commercialize the Lab's RadScout radiation detector and analyzer. The technology is a premier example of Homeland Security applications moving to the market place. ORTEC, based in Oak Ridge, Tennessee, will incorporate the RadScout technology into its next generation of advanced portable nuclear detection systems. The detector features a miniaturized refrigeration system that eliminates the need to carry liquid nitrogen to cool the device's high-purity germanium crystals. Those crystals are used to detect minute amounts of neutrons and gamma rays emitted by radioactive materials. First responders can use these high-performance, high-resolution portable systems at border crossings, cargo ship docks, transportation terminals, post offices, etc., to quickly differentiate between potentially dangerous radioactive materials and harmless radiation sources, and to determine whether or not they pose a threat. ORTEC plans to market the detector within a year as the Detective and Detective-EX. The detectors are part of a suite of technologies either offered or under development by ORTEC for Homeland Security.

● **R&D awards for Sandia National Laboratories' technologies**. Developed under a Shared Vision program, the SnifferStar™ mounts on a drone aircraft for remote surveillance of battlefield situations where suspect plumes or clouds are present. The detector's primary purpose is to save lives by warning soldiers that chemical weapons are present on a battlefield. The entire module weighs less than a golf ball, operates on 0.5 watts, and uses the wind generated by the motion of the craft to collect samples for analysis. SnifferStar technology isolates compounds of concern from common interferents and is capable of analyzing chemical blister and nerve agents in 20 seconds. The device also has potential for use in public buildings and military bases.

Acoustic telemetry technology, developed at SNL in cooperation with Extreme Engineering Ltd. of Calgary, Alberta, and with support from DOE, represents the fulfillment of an oil-industry quest that goes back to the 1940s. As more accessible reserves have been depleted, deeper and more complex extraction techniques have become necessary, making better communication between the driller and the drill bit more critical. Existing communication methods, based on mud-pulse techniques, were revolutionary when introduced in the early 1980s. But mud-pulse is slow—much, much slower than even first-generation telephone modems. Acoustic telemetry technology uses the well-drilling tubing as the data transmission medium and sound waves as the data carrier, creating a 10-fold improvement in data rates and thereby improving drilling control and accuracy.

A large group of collaborators from SNL, Lawrence Livermore National Laboratory, and Lawrence Berkeley National Laboratory were honored for developing the Extreme Ultraviolet Lithography (EUVL) Full-Field Step-Scan System, a technological advance that will lead to dramatic improvements in the speed and memory of computer systems. (See also previous section). Researchers created the only system that can pattern full chip-size areas on silicon wafers with features as small as 50 nanometers. It is the embodiment of a set of groundbreaking technologies that were considered by many to be impossible as recently as a few years ago. In addition to the national laboratory team, the award is being given jointly to Northrop Grumman Space Technology/Cutting Edge Optronics. The work was done in partnership with an industrial consortium comprising Intel, Motorola, AMD, Infineon, IBM, and Micron. Intel ordered the first production-level instrument based on this technology last year.

The Low Emissions Atmospheric Metering Separator (LEAMS) is a family of atmospheric geothermal separators used in developing geothermal power. LEAMS safely contains and cleans the steam vented into the atmosphere of polluting solids, liquids, and noxious gasses. LEAMS can be used in drilling, well testing, and geothermal power plant start-up. In partnership with Sandia, LEAMS technology was developed by Two-Phase Engineering and Research, Inc., Santa Rosa, California, and fabricated by Drill Cool Systems, Inc., Bakersfield, California.

The Adaptive Optics Phoropter system uses a micro-electro-mechanical (MEMS) based deformable mirror technology in a compact, transportable system that expands upon traditional devices used for optometry. In addition to determining corrections needed for near-sightedness, far-sightedness and astigmatism, it also determines correction needed for high-order aberrations that can interfere with night vision and can provide a preview of correction to a patient. Technologies from astronomy and micromachining are combined to advance the study and treatment of retinal diseases. Applications for the tool include generation of improved prescriptions for custom contact lenses or laser eye surgery, as well as high-resolution retinal imaging. The partnership, led by Lawrence Livermore National Laboratory, includes Sandia, the University of Rochester, Wavefront Sciences, Boston Micromachines Corp., and Bausch & Lomb.

Lightning strikes, equipment failures, or other anomalies in electric powered transmission systems can cause brown-outs or even network failures. But a fast-response semiconductor device developed under Sandia's direction allows a utility to rapidly convert energy stored in a DC device into AC power and minimize the effects of interruptions on electrical devices. Under the auspices of the DOE Energy Storage Systems Program, Sandia-led researchers at Virginia Tech in developing the advanced semiconductor unit, called an ETO (emitter turn-off thyristor). The ETO is rated at 4,000A and 4,500V and can switch power at 1-3 kHz—far exceeding other devices. The component could become a critical part of inverters, motor controllers, and many other power electronics systems that require medium voltage and high-current switches. In addition to inventors at Virginia Tech, the ETO was developed with Solitronics (a Blacksburg, Virginia, small business) marketing the ETO and the American Competitiveness Institute in Philadelphia.

● **RAM^{SM}/VAM^{SM} technology aids in assessing vulnerabilities to the Nation's infrastructure and facilities**. In response to an increased need for assessing the vulnerabilities of dams, transmission lines, water utilities, communities, and chemical facilities, Sandia National Laboratories (SNL) has developed a variety of risk assessment methodologies (RAMs^{SM}) and vulnerability assessment methodologies (VAMs^{SM}) and licensed these technologies to the private and public sector. These commercial licenses are offered with very reasonable financial terms in an effort to encourage the participation of many small business entities. The licenses allow non-SNL personnel to train third parties in the use of some of the methodologies (i.e. RAM-W^{SM} and CVAM^{SM}) and standard licenses that allow access some of the methodologies quickly (i.e. RAM-D^{SM} and RAM-T^{SM}). Beyond simply developing the licensing mechanisms, techniques have been developed to ensure that export control requirements are met while still providing exceptional turn-around when licensing requests are made, with licenses being placed within 24 hours of the initial contact in time-critical situations. In all, more than 200 licenses have been put in place for the various RAMs^{SM} and VAMs^{SM} technologies.

● **Safer stun grenades protect hostages, can be reused for training**. Diversionary devices – also called stun grenades or flash-bangs – are used when law enforcers need to temporarily disable the occupants of a room, for example, in hostage situations. To use a stun grenade, the officers break down a door or smash a window of the room containing the hostages and captors, then lob in the explosive device. The nonlethal device – about the size of a soda can – creates a blinding, deafening, but not deadly explosion. Most devices currently in use contain a metal powder that violently combines with an oxidizer. When this mixture is ignited by a grenade-style fuse, an explosion takes place within the body of the device, creating a zone of extreme pressure that may be dangerous if the device lands too near a person. The explosion also destroys the shell of the device, making the current flash-bangs expensive to use as training tools.

Prison officials require a grenade that, if remaining whole after use, is too soft and flexible to be used as a weapon by rioting convicts. Soldiers need a lightweight canister that can be carried over long distances. Police do not want the canister to contain any explosive material that could be turned into a bomb.

SNL's new configuration satisfies a variety of law enforcement needs. The explosive source in Sandia National Laboratories' (SNL) stun grenade fans out as an airborne powder before it ignites, making it less dangerous. This new device is made of plastic and contains metal powder but no oxidizer. Instead of ignition within the device, the particles are forced out like a burst of talcum powder through holes in the bottom of the canister. The particles form a sheet of metal dust about five feet in diameter before igniting by combining with oxygen present in the atmosphere. The distributed powder lowers the pressure in the immediate vicinity of the exploded device to a safer level. This design leaves the canister undamaged, making it more economical to use as a training device.

● **Simulation of comet impact**. Sandia National Laboratories (SNL) has been asked by the Denver Museum of Nature and Science to develop a realistic computational simulation of a comet impact on Jupiter's moon Europa. This work builds on SNL's past analysis of the Shoemaker-Levy (SL9) impact on Jupiter itself. The SL9 work won several international awards and is generally regarded as the most predictive of analyses completed before the impact. SNL will use the shock physics code CTH to model the first few minutes of the hypothetical impact event. SNL is the developer of the CTH code, which is widely used in the DOE and DoD weapons laboratories. CTH was developed with DOE funds for Defense Program needs and is currently receiving support and development funds from the DoD/DOE Memorandum of Understanding for conventional munitions.

● **Solar water heating technology transferred**. The Salt River Project (SRP) Agricultural Improvement and Power District (in Arizona) has signed a CRADA and a Work-for-Others agreement with Sandia National Laboratories (SNL) and a manufacturing license agreement with Energy Laboratories, Inc. to develop an innovative all-stainless-steel solar domestic water heater. SNL developed and patented a laser welding process used in assembling the solar array. The laser welder and associated equipment will be loaned to SRP for the duration of the agreements and used at the Energy Labs' manufacturing facility in Jacksonville, Florida, to prove this technique in a manufacturing environment. SNL also has the expertise and data on stainless steel to achieve certification from the Solar Rating and Certification Corporation. Two other SNL patents (pending) are used for the solar selective black coating that is applied to the copper fins used in the solar panels.

● **Tank retrieval processes**. Sandia National Laboratories (SNL) has recently completed a USIC/IPP-funded CRADA with Mississippi State University's Diagnosis and Instrumentation Analysis Laboratory (MSU/DIAL) for developing technologies to retrieve liquid and solid radioactive wastes from tanks used during cold-war weapons production. The partners, including participants from the Newly Independent States of the Former Soviet Union, successfully demonstrated three technologies: chemical softening of hard sludges, bulk retrieval of liquid and solid sludges, and separation of radioactive components in aqueous solutions. One emerging technology, the pulsating mixing pump, has been demonstrated to Hanford and Savannah River Site personnel. The pump has no replaceable parts inside the tank, is easily mounted on the tank top, and recirculates the water or other liquid being used to mobilize the tank wastes. The Russian-developed pulsating mixing pump offers a cost-effective and operationally efficient way to support DOE's commitment to resolve tank waste problems at contaminated sites. The technology is now being commercialized through the creation of a company (employing the Russian personnel and management) that will offer tank retrieval and decontamination services worldwide. This second-phase activity is conducted under the Nuclear Cities Initiative Program of DOE-NNSA Russian Transitions Initiative Office.

● **U.S. military using gun-shot residue kit in Iraq**. On August 5, 2003, MSNBC News reported that U.S. military forces in Iraq are using a Sandia National Laboratories' developed gun powder residue kit to identify whether a suspected shooter has fired a weapon in the previous 24-48 hours. The field test kits, known to the military as RIFFs, are produced by Law Enforcement Technologies, Inc., of Colorado Springs, Colorado. MSNBC quotes retired Army special operations forces leader Colonel Andy Gembara, now a board member of Law Enforcement Technologies, "The Army wanted something small. It is meant to be provided to patrols and to MPs (military police) so they can help sort out the good guys from the bad guys." Gembara says the Army and Marine Corps have purchased thousands of cases of the kits in the past few months.

● **VISTA, an intuitive Web-based software for visualizing genome comparisons**. Now that the Human Genome Project is nearly complete, one of the most promising new paths to gaining useful knowledge from the human DNA sequence is the growing field of comparative genomics. By comparing the human genome with the genomes of various other organisms, scientists can identify common regions of DNA, gain insights into how genes are switched on and off, and further their understanding of the human genome's evolution, structure and function.

Lawrence Berkeley National Laboratory (LBNL) has developed a user-friendly computer program, VISTA, which enables researchers to quickly compare the genomes of various organisms. VISTA (Visualization Tool for Alignments) software depicts long sequence alignments of DNA from two or more species in an easy-to-read graphical format that clearly illustrates the extent to which the sequences are similar or different. VISTA also functions to match common regions of DNA from two different organisms, at lengths of DNA ranging from less than a single gene to whole genomes.

LBNL has also implemented a multi-pronged approach to ensure the software's broad dissemination. The lab developed a Web site and Web interface so that the programs could be used over the Web or downloaded to the user's computer. VISTA has become one of the most popular and widely praised comparative genomics tools available to biologists, geneticists, and biomedical researchers. In FY 2003, researchers from 41 countries used the system, submitting nearly 22,000 DNA sequences to the VISTA Web site for analysis. LBNL also granted close to 1,000 academic research licenses in FY 2003 and sold its eighth commercial license. LBNL continues to make the program available over the Web free of charge.

3.5 Environmental Protection Agency

This section summarizes the statistics and other data provided by the department in its annual reports on the technology transfer activities and outcomes of its federal laboratories. Currently, these reports provide data through FY 2003. This information covers the activities of the agency's Office of Research and Development (ORD) and other divisions with federal lab technology transfer. For additional details, readers should consult the department's full report.[29]

■ Collaborative Relationships for Research and Development

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **CRADAs**, total active in the FY(1)			--	--	48	59	91
- New, executed in the FY			--	--	19	21	39
▪ Traditional CRADAs,(2) total active in the FY	11	30	38	44	45	55	77
- New, executed in the FY			13	40	18	18	27
▪ Non-traditional CRADAs,(3) total active in FY			--	--	3	4	14
- New, executed in the FY			--	--	1	3	12
● **Other collaborative R&D relationships**							
			--	--	0	0	0

CRADA = Cooperative Research and Development Agreement
-- = Data not requested from agency in reports of earlier years.

(1) "Active" = legally in force at any time during the FY. "Total active" includes all agreements executed under CRADA authority (15 USC 3710a).
(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.
(3) CRADAs used for special purposes -- such as material transfer or technical assistance that may result in protected information.

■ Invention Disclosure and Patenting

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● New inventions disclosed in the FY(1)	12	15	5	11	17	16	14
● Patent applications filed in the FY(2)	6	24	15	10	14	14	23
● Patents issued in the FY			8	6	12	9	8

-- = Data not requested from agency in reports of earlier years.

(1) Inventions arising at the federal lab.
(2) Tally includes: U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes: provisional, continuation, duplicate foreign, and PCT applications.

[29] Environmental Protection Agency, "Annual Report on Federal Lab Technology Transfer in FY 2003," March 2004. Report prepared in response to 15 USC Sec. 3710(f) (requiring an annual "agency report on utilization" for agencies with federal laboratories) and submitted to OMB (consistent with Circular A-11 guidelines).

■ Licensing

Profile of Active Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002
● **All licenses**, number total active in the FY(1)			17	18	16	23
▫ New, executed in the FY			2	3	4	9
▪ **Invention licenses**, total active in the FY			17	18	16	23
▫ New, executed in the FY	1	1	2	3	4	9
- Patent licenses,(2) total active in FY			--	--	16	23
▫ New, executed in the FY			--	--	4	9
- Material transfer (inventions), tot active in FY			--	--	0	0
▫ New, executed in the FY			--	--	0	0
- Other invention licenses,(3) total active in FY			--	--	0	0
▫ New, executed in the FY			--	--	0	0
▪ **Other IP licenses**, total active in the FY			0	0	0	0
▫ New, executed in the FY			0	0	0	0
- Copyright licenses (fee bearing)						
▫ New, executed in the FY						
- Material transfer (non-inv.), total active in FY						
▫ New, executed in the FY						
- Other (4)						
▫ New, executed in the FY						

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (i.e., hybrid licenses) are reported as patent licenses -- and not included in the count of copyright licenses.

-- = Data not requested from agency in reports of earlier years.

(1) "Active" = legally in force at any time during the FY.
(2) Patent license tally includes patent applications that are licensed.
(3) No licenses of this type indicated as active.
(4) No licenses of this type indicated as active.

Licensing Management

		FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Elapsed execution time,**(1) licenses granted in FY								
▪ **Invention licenses**								
▫ average	months			--	--	n/a	n/a	n/a
▫ minimum				--	--	3.0	3.0	3.0
▫ maximum				--	--	12.0	12.0	12.0
- Patent licenses(2)								
▫ average	months			--	--	n/a	n/a	n/a
▫ minimum				--	--	3.0	3.0	3.0
▫ maximum				--	--	12.0	12.0	12.0
● **Licenses terminated for cause,** in the FY								
▪ **Invention licenses**				--	--	0	0	0
- Patent licenses(2)						0	0	0

Data included in this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a subclass.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)
(2) Patent license tally includes patent applications which are licensed.

Characteristics of Licenses Bearing Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All income bearing licenses**, number			--	--	16	23	32
▫ Exclusive					6	7	7
▫ Partially exclusive					2	2	2
▫ Non-exclusive					8	14	23
▪ **Invention licenses**, income bearing			--	--	16	23	32
▫ Exclusive					6	7	7
▫ Partially exclusive					2	2	2
▫ Non-exclusive					8	14	23
- Patent licenses,(1) income bearing					16	23	32
▫ Exclusive					6	7	7
▫ Partially exclusive					2	2	2
▫ Non-exclusive					8	14	23
▪ **Other IP licenses**, income bearing			--	--	0	0	0
▫ Exclusive							
▫ Partially exclusive							
▫ Non-exclusive							
- Copyright licenses (fee bearing)							
▫ Exclusive							
▫ Partially exclusive							
▫ Non-exclusive							
● **All royalty bearing licenses**,(2) number			--	--	16	23	32
▪ **Invention licenses**, royalty bearing, number			--	--	16	23	32
- Patent licenses,(1) royalty bearing					16	23	32
▪ **Other IP licenses**, royalty bearing			--	--	0	0	0
- Copyright licenses (fee bearing)							

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalites, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of past years.

(1) Patent license tally includes patent applications that are licensed.

(2) Note that royalties are one component of total license income.

Income (annual) from Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Total income**, all licenses active in FY (1)			--	--	$544,431	$400,437	$907,604
▪ **Invention licenses**			--	--	$544,431	$400,437	$907,604
- Patent licenses (2)					$544,431	$400,437	$907,604
▪ **Other IP licenses**, total active in the FY			--	--	$0	$0	$0
- Copyright licenses							
● **Total Earned Royalty Income** (ERI) (3)			--	--	$533,906	$315,000	$677,354
▫ Median ERI					n/a	n/a	n/a
▫ Minimum ERI					n/a	n/a	n/a
▫ Maximum ERI					n/a	n/a	n/a
▫ ERI from top 1% of licenses					n/a	n/a	$500,000
▫ ERI from top 5% of licenses					n/a	n/a	$500,000
▫ ERI from top 20% of licenses					n/a	n/a	$500,000
▪ **Invention licenses**					$533,906	$315,000	$677,354
▫ Median ERI					n/a	n/a	n/a
▫ Minimum ERI					n/a	n/a	n/a
▫ Maximum ERI					n/a	n/a	n/a
▫ ERI from top 1% of licenses					n/a	n/a	$500,000
▫ ERI from top 5% of licenses					n/a	n/a	$500,000
▫ ERI from top 20% of licenses					n/a	n/a	$500,000
- Patent licenses (2)					$533,906	$315,000	$677,354
▫ Median ERI					n/a	n/a	n/a
▫ Minimum ERI					n/a	n/a	n/a
▫ Maximum ERI					n/a	n/a	n/a
▫ ERI from top 1% of licenses					n/a	n/a	$500,000
▫ ERI from top 5% of licenses					n/a	n/a	$500,000
▫ ERI from top 20% of licenses					n/a	n/a	$500,000
▪ **Other IP licenses**					$0	$0	$0
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							
- Copyright licenses							
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

(2) Patent license tally includes patent applications that are licensed.

(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or units sold). Not a license fee or minimum royalty.

Disposition of License Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Income distributed** (1)							
▪ **Invention licenses**, total distributed			--	--	$533,906	$315,000	$677,354
- To inventors			--	--	$186,867	$110,250	$178,971
					35%	35%	26%
-To other(2)			--	--	$347,039	$204,750	$498,383
					65%	65%	74%
- Patent licenses,(3) total distributed			--	--	$533,906	$315,000	$677,354
- To inventors			--	--	$186,867	$110,250	$178,971
					35%	35%	26%
-To other(2)			--	--	$347,039	$204,750	$498,383
					65%	65%	74%

Invention licenses are the chief policy interest regarding distribution of income; content of this table reflects this focus.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Income includes royalties and other payments received during the FY.
(2) To the agency's laboratories.
(3) Patent license tally includes patent applications that are licensed.

■ Other Performance Measures

None cited.

■ Downstream Outcomes

EPA's FY 2003 report included the following selected examples of downstream outcomes from the technology transfer activities of its federal labs.

● **Technology for the Identification and Quantification of Molds Using Quantitative Polymerase Chain Reaction** (QPCR). This technology was developed by EPA without a CRADA. However, since the technology was patented, EPA has entered into approximately 15 CRADAs (with more on the way) with companies in the United States and the European Union. Through these CRADAs, EPA scientists have been training company staffs in the protocols and application of the technology. The CRADAs have also given EPA access to collaborations with scientists around the world. These collaborations are bringing samples and data into the laboratory that would not have been available to the EPA. EPA is now respected for its leadership on this issue. EPA scientists are now invited to provide lectures, presentations and training to other government agencies, civic, academic, medical, construction and legal groups. The EPA is now a major player in the world in improving our understanding of building ecology, where humans spend 90 percent of their time.

The technology is now commercially available in the United States and the European Union. Information on the technology and a list of the companies that have licensed the technology can be found at http://www.epa.gov/nerlcwww/moldtech.htm. Additionally, companies in Canada, Japan, and Australia are in various stages of licensing the technology. Although the technology was only patented in 2002, at last reporting well over $1 million in business had already been done. This technology has created jobs for American people and income for U.S. companies.

As a spin-off of this technology, applications in other fields are being identified. For example, one of the licensed companies is going to be using this technology to monitor mold contamination in food, feed and pharmaceuticals. Molds, and the toxins they produce, are major issues in agriculture and the food and drug industry. Use of this technology should help prevent these kinds of contamination or, at least, identify when they have occurred before they become a part of the final product.

In medicine, hospitals have a major problem with nosocomial mold infections in their patients. These types of infections frequently (60-90 percent) result in the death of the patient. Use of this technology in the health care arena is already happening. Although not directly EPA's "business," this application will likely prevent deaths in hospitals.

As a result of license fees and royalties, the laboratory has been able to invest in new developments that are furthering its leadership role in building ecology and health studies. For example, a patent was recently filed on a new technology for measuring "human exposure to molds." This will form the basis for new technology, which is in the process of being commercialized. Our strong position in the field, as a result of the previous licensing, will allow EPA to help our clients – the American people – by providing the technology for addressing human exposures. We are transferring this new technology to CDC-NIOSH, so that it can better investigate workplace problems.

● **Hydraulic Hybrid Motor Vehicles.** The EPA, through its National Vehicle and Fuel Emissions Laboratory in Ann Arbor, Michigan, owns several patents for inventions related to fuel efficient hybrid motor vehicles, particularly highly efficient hydraulic hybrid vehicles. The EPA's hydraulic hybrid vehicles have shown the potential for significantly greater fuel mileage (and reduced cost), even compared to new, state-of-the-art gas-electric hybrid vehicles that are currently gaining acclaim among the environmental community. Currently, first generation demonstration vehicles for the EPA's hydraulic hybrid technology have been completed and tested with great success. As a recent example, in November 2003, a demonstration EPA hydraulic hybrid urban delivery vehicle (using a 2003 Ford F550 chassis) competed in the heavy duty portion of the international Michelin Challenge Bibendum, and received attention for achieving a top award ("A") in energy efficiency at the competition. Because of the technology's promise for the future, multiple industry partners continue to be actively engaged in working with the EPA to further develop this hydraulic hybrid technology for commercial production.

3.6 Department of Health and Human Services

This section summarizes the statistics and other data provided by the department in its annual reports on the technology transfer activities and outcomes of its federal laboratories. Currently, these reports provide data through FY 2003. This information covers the activities of the department's following divisions: National Institutes of Health (NIH), Food and Drug Administration (FDA), and Centers for Disease Control (CDC). For additional details, readers should consult the department's full report.[30]

■ Collaborative Relationships for Research and Development

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **CRADAs**, total active in the FY[(1)]			468	438	498	470	427
- New, executed in the FY			136	125	137	126	102
▪ Traditional CRADAs,[(2)] total active in the FY	110	152	237	244	289	261	254
- New, executed in the FY			58	50	61	52	54
▪ Non-traditional CRADAs,[(3)] total active in FY			231	194	209	209	173
- New, executed in the FY			78	75	76	74	48
● **Other collaborative R&D relationships**							
			--	--	0	0	0

CRADA = Cooperative Research and Development Agreement

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) "Active" = legally in force at any time during the FY. "Total active" includes all agreements executed under CRADA authority (15 USC 3710a).

(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.

(3) CRADAs used for special purposes -- such as material transfer or technical assistance that may result in protected information.

■ Invention Disclosure and Patenting

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● New inventions disclosed in the FY[(1)]	215	307	328	375	434	431	472
● Patent applications filed in the FY[(2)]	239	166	241	263	255	262	279
● Patents issued in the FY			180	132	119	116	136

(1) Inventions arising at the federal lab.

(2) Tally includes: U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes: provisional, continuation, duplicate foreign, and PCT applications.

[30] National Institutes of Health, Office of Technology Transfer, *Agency Annual Report on Federal Laboratory Technology Transfer: Fiscal Year 2003 Activities, NIH, CDC, and FDA*, January 2004. Report prepared in response to 15 USC Sec. 3710(f) (requiring an annual "agency report on utilization" for agencies with federal laboratories) and submitted to OMB (consistent with Circular A-11 guidelines).

■ Licensing

Profile of Active Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All licenses**, number total active in the FY[1]			1,364	1,608	1,367	1,357	1,380
▫ New, executed in the FY			--	--	--	220	211
▪ **Invention licenses**, total active in the FY			1,041	1,222	1,007	1,213	1,298
▫ New, executed in the FY			208	192	212	198	199
- Patent licenses,[2] total active in FY			--	--	--	736	765
▫ New, executed in the FY						115	119
- Material transfer (inventions), tot active in FY			--	--	--	n/a	n/a
▫ New, executed in the FY						n/a	n/a
- Other invention licenses,[3] total active in FY			--	--	--	n/a	n/a
▫ New, executed in the FY						n/a	n/a
▪ **Other IP licenses**, total active in the FY			323	386	360	144	82
▫ New, executed in the FY			--	--	--	22	12
- Copyright licenses (fee bearing)			--	--	--	n/a	n/a
▫ New, executed in the FY						n/a	n/a
- Material transfer (non-inv.), total active in FY			--	--	--	n/a	n/a
▫ New, executed in the FY						n/a	n/a
- Other[4]			--	--	--	144	82
▫ New, executed in the FY						22	12

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (i.e., hybrid licenses) are reported as patent licenses -- and not included in the count of copyright licenses.

-- = Data not requested from agency in reports of earlier years.

(1) "Active" = legally in force at any time during the FY.
(2) Patent license tally includes patent applications that are licensed.
(3) No licenses of this type indicated as active.

Licensing Management

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Elapsed execution time,[1] licenses granted in FY**							
▪ **Invention licenses**							
▫ average — months			--	--	n/a	6.3	5.6
▫ minimum			--	--	n/a	0.03	0.03
▫ maximum			--	--	n/a	61.0	51.5
- Patent licenses[2]							
▫ average — months			--	--	n/a	9.1	8.4
▫ minimum			--	--	n/a	0.03	4.0
▫ maximum			--	--	n/a	61.0	51.5
● **Number of licenses terminated for cause in FY**							
▪ **Invention licenses**			--	--	n/a	12	6
- Patent licenses[2]			--	--	n/a	10	6

Data included in this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a subclass.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)
(2) Patent license tally includes patent applications which are licensed.

Characteristics of Licenses Bearing Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All income bearing licenses**, number			--	--	--	751	821
▫ Exclusive						115	121
▫ Partially exclusive						11	9
▫ Non-exclusive						625	691
▪ **Invention licenses**, income bearing			--	--	--	723	761
▫ Exclusive						106	116
▫ Partially exclusive						11	9
▫ Non-exclusive						606	636
- Patent licenses,[1] income bearing						494	520
▫ Exclusive						113	111
▫ Partially exclusive						11	9
▫ Non-exclusive						370	400
▪ **Other IP licenses**, income bearing			--	--	--	14	7
▫ Exclusive						9	4
▫ Partially exclusive						0	0
▫ Non-exclusive						5	3
- Copyright licenses (fee bearing)						0	0
▫ Exclusive							
▫ Partially exclusive							
▫ Non-exclusive							
● **All royalty bearing licenses**,[2] number			223	230	727	383	478
▪ **Invention licenses**, royalty bearing, number			--	--	--	369	425
- Patent licenses,[1] royalty bearing						206	236
▪ **Other IP licenses**, royalty bearing			--	--	--	14	53
- Copyright licenses (fee bearing)						0	0

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalites, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of past years.

(1) Patent license tally includes patent applications that are licensed.
(2) Note that royalties are one component of total license income.

Income (annual) from Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Total income**, all licenses active in FY (1)			$44,821,000	$52,547,000	$46,722,000	$52,882,331	$55,198,722
▪ **Invention licenses**	$5,839,000	$19,727,000	$42,599,000	$48,592,000	$41,322,000	$51,868,102	$54,570,939
- Patent licenses (2)			--	--	--	$35,503,320	$35,695,820
▪ **Other IP licenses**, total active in the FY			$2,222,000	$3,955,000	$5,400,000	$1,014,229	$627,783
- Copyright licenses			--	--	--	0	0
● **Total Earned Royalty Income** (ERI) (3)			$34,599,000	$43,892,000	$36,612,000	$36,012,005	$38,338,328
▫ Median ERI			--	--	n/a	n/a	n/a
▫ Minimum ERI			--	--	n/a	n/a	n/a
▫ Maximum ERI			--	--	n/a	n/a	n/a
▫ ERI from top 1% of licenses			--	--	n/a	n/a	n/a
▫ ERI from top 5% of licenses			--	--	n/a	n/a	n/a
▫ ERI from top 20% of licenses			--	--	n/a	n/a	n/a
▪ **Invention licenses**			--	--	--	$35,616,859	$37,923,105
▫ Median ERI						n/a	n/a
▫ Minimum ERI						n/a	n/a
▫ Maximum ERI						n/a	n/a
▫ ERI from top 1% of licenses						n/a	n/a
▫ ERI from top 5% of licenses						n/a	n/a
▫ ERI from top 20% of licenses						n/a	n/a
- Patent licenses (2)						$21,595,052	$20,858,675
▫ Median ERI						n/a	n/a
▫ Minimum ERI						n/a	n/a
▫ Maximum ERI						n/a	n/a
▫ ERI from top 1% of licenses						n/a	n/a
▫ ERI from top 5% of licenses						n/a	n/a
▫ ERI from top 20% of licenses						n/a	n/a
▪ **Other IP licenses**			--	--	--	$395,146	$415,223
▫ Median ERI						n/a	n/a
▫ Minimum ERI						n/a	n/a
▫ Maximum ERI						n/a	n/a
▫ ERI from top 1% of licenses						n/a	n/a
▫ ERI from top 5% of licenses						n/a	n/a
▫ ERI from top 20% of licenses						n/a	n/a
- Copyright licenses						0	0
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years. dw = data withheld by agency to protect proprietary information.

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).
(2) Patent license tally includes patent applications that are licensed.
(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or units sold). Not a license fee or minimum royalty.

Disposition of License Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Income distributed** (1)							
▪ **Invention licenses**, total distributed			--	--	n/a	n/a	$54,474,175
- To inventors			--	--	n/a	n/a	$7,391,171
							14%
-To other (2)			--	--	n/a	n/a	$47,083,004
							86%
- Patent licenses, (3) total distributed			--	--	--	n/a	n/a
- To inventors			--	--	--	n/a	n/a
-To other (2)			--	--	--	n/a	n/a

Invention licenses are the chief policy interest regarding distribution of income; content of this table reflects this focus.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.
Difference between "total income" (previous table) and "income distributed" is due to holdovers.

(1) Income includes royalties and other payments received during the FY.
(2) Income distributed to NIH Institutes and Centers, FDA, and partners of Interinstitutional Agreements.
(3) Patent license tally includes patent applications that are licensed.

■ Other Performance Measures

None cited.

■ Downstream Outcomes

HHS' FY 2003 report provides the following selected examples of downstream outcome arising from the technology transfer activities of the department's federal labs:

National Institutes of Health

● **Formulation technology in the cancer drug Velcade®**. Velcade® is the first therapy for multiple myeloma approved by the FDA in more than 10 years. A license to Millennium Pharmaceuticals (L-271-2001/0) concerned the formulation technology for this cancer drug. With the incidence of multiple myeloma expected to reach 15,000 new cases annually, the development of this product dramatically supports the public health mission of the NIH.

● **Software for data management**. A license to Agilent Technologies (9L-073-2002/0) has resulted in development of a scientific software platform for data management. This platform will allow basic researchers to more easily distribute and share their research findings.

● **New molecular diagnostic for adverse effect predispositions to 5-fluorouracil chemotherapy**. A license to IMPATH (L-310-2002/0) has addressed development of a new molecular diagnostic used for the identification of pre-dispositions to adverse effects following treatment with the common chemotherapy 5-fluorouracil (5-FU). Approximately 1 percent of the general population carries this mutation, which results in severe toxicity and oftentimes death, following 5-FU treatment. Early diagnosis will aid in determining which patients should not undergo 5-FU treatment and should prevent these premature deaths.

● **Tissue microarray products**. A license to Chemicon International (L-179-2002/0) concerns development of tissue microarray products. Tissue microarray technology is expected to expedite drug discovery. This means that news drugs can be developed more expeditiously than in the past, which should also positively affect the public health mission of the NIH.

● **DNA-based vaccine therapeutic for treating a variety of solid and hematological cancers**. Currently available cancer therapeutics have a variety of mild-to-severe side effects. Although, cancer vaccines, which have recently been successful in several clinical trials, offer the promise of a therapeutic with few-to-none side effects. A license to Cell Genesys (L-078-2003) is for a cancer vaccine, which will be based on a National Cancer Institute technology, mesothelin (which is expressed in a number of different cancers but not in normal tissue). Cell Genesys plans to pursue pancreatic cancer as a first target, which is a disease for which there are few effective treatment options.

● **Cell line that expresses hyper-glycosylated human chorionic gonadotropin**. A license to Nichols Institute Diagnostics (L-015-2003) is for a cell line that expresses hyper-glycosylated human chorionic gonadotropin (HCG). HCG is expressed most highly during pregnancy, and is used as a marker to detect Downs Syndrome in-utero. Current assays for Downs Syndrome are problematic for two reasons. First, because the detection rate is relatively low: the currently available test only detects Downs approximately 50-85 percent of the time, depending on exactly which tests are performed. Second, there is also a high rate of false positives: the vast majority of women who receive a positive result will, in fact, have normal babies. This causes much unneeded stress on families and medical professionals. It is anticipated that this cell line, when integrated into a new test kit for Downs Syndrome, will greatly increase detection rates, and decrease false positive readings for tests performed as part of an amniocentesis.

Centers for Disease Control and Prevention

● **Recombinant DNA antigen for West Nile Virus**. In 1999, New York City and surrounding areas experienced an outbreak of viral encephalitis that caused seven deaths with 62 confirmed cases. Concurrent with this outbreak, local health officials observed increased mortalities among birds (especially crows) and horses. The outbreak was subsequently shown to be caused by West Nile Virus (WNV), a mosquito borne flavivirus that is transmitted by various species of mosquitoes. The most serious manifestation of WNV infection is fatal encephalitis (inflammation of the brain) in humans and horses, as well as mortality in certain domestic and wild birds. In 2002, there were 4,156 and 14,571 reported cases of WNV human and equine infection, respectively, with the virus reaching 44 states. Faced with the rapid spread of WNV, CDC worked quickly with national and state authorities to develop a comprehensive national response plan.

Accurate WNV diagnostic tests and preventatives are essential tools for the development of effective surveillance, prevention, and control of WNV. In response to this crisis, CDC developed a recombinant plasmid expressing a critical WNV antigen that provided the necessary specificity for diagnostic purposes and proved highly effective as a vaccine. CDC has patent applications pending on both the early flavivirus constructs and the WNV specific construct. This antigen was incorporated into a diagnostic test for WNV IgM and IgG antibodies in humans and animals. The tests were immediately distributed to national and state public health labs in order to facilitate the formation of a national surveillance program. The value of this antigen over then available antigens for diagnostic testing was quickly recognized by the private sector and the antigen has now been licensed to 10 companies for use in WNV diagnostics worldwide. Within two months of the first commercial license, the WNV recombinant antigen was available as a commercial product and, within one year, a diagnostic test kit incorporating the antigen received FDA approval.

In direct collaboration with the academic community and the private sector, CDC facilitated the use of the WNV recombinant DNA as a vaccine in horses and birds. Currently working its way through USDA approval, the horse vaccine will be the first recombinant DNA vaccine approved for use anywhere in the world. As a second-generation horse vaccine, the CDC WNV recombinant DNA will provide greater vaccine efficacy and allow for improved surveillance by providing researchers with the ability to distinguish between natural infection and vaccine-induced immunity. In 2002, an emergency effort was initiated to evaluate the DNA vaccine for protection of birds on the endangered species list and resulted in the vaccination of more than 220 condors in the California condor recovery program.

● **Improved detection technology for occupational and general public exposures to lead**. Lead poisoning is a global problem having significant public health and occupational health consequences. Worldwide, 240 million people are estimated to have health risks from lead poisoning. There is no level of lead in blood that is considered normal or safe. Lead is the number one environmental health hazard to children. From a U.S. public health perspective, about 900,000 children ages 1 to 5 have a blood lead level of concern. Occupational exposure to lead is one of the most common over exposures found in U.S. industry, and a leading cause of workplace illness. The U.S. Occupational Safety and Health Administration (OSHA) has deemed the reduction of occupational lead exposure a priority.

In response, scientists at CDC’s National Institute for Occupational Safety and Health (NIOSH) developed a new handwipe technology for lead, as a cost effective way to significantly reduce lead exposures in workers as well as the general public through risk awareness. The technology is novel, sensitive, and specific. The results of a test are immediate: a color change from yellow to red indicates the presence of lead (the red color is intended to suggest to the user: "Stop! If it's red, there's lead!"). The method will identify lead in the tens of millionths of a gram! The technology was awarded a U.S. patent and is licensed to SKC, Inc., a U.S. company that is a global leader in sampling technologies. The company has created a web site for this technology (http://www.skcinc.com/prod/550 001.asp), and it is selling well. Through this successful technology transfer to SKC, this invention is now available to help industries to meet OSHA's goal of reducing occupational lead exposure and help the U.S. Public Health Service meet its Healthy People 2010 goal to reduce the number of persons with elevated blood lead levels to zero by the year 2010.

● **Pneumococcal vaccine**. CDC’s pneumococcal vaccine candidate, patented and licensed to Aventis Pasteur, is nearing the successful completion and phase 1 clinical trials and is scheduled to begin phase 2 trials later this year. This vaccine recognizes all 90 serotypes of streptococcal pneumonia. Currently available vaccines recognize only 16 of the serotypes. Diseases caused by this infectious agent include pneumonia in children and adults, and otitis media in children, the dreaded ear infection that so plagues our children in their infant and toddler years. We anticipate that in just a few more years, both of these diseases will be completely preventable through early vaccination.

● **Automatic warning system for mine worker exposures to nearby vehicles and machinery**. In response to a fatal mining accident, CDC's National Institute for Occupational Safety and Health (NIOSH) invented a new technology that will save the lives of mothers and fathers who toil in our Nation's mines. The installation of our Perimeter Warning System in large mining vehicles and machinery automatically alerts the operator to the presence of workers near enough to the equipment to be in danger of being struck by the vehicle or machinery, allowing the shutdown of the equipment in time to avoid a potentially fatal accident.

● **Human Microvascular Endothelial Cell Line**. CDC continues to distribute widely the Human Microvascular Endothelial Cell Line, HMEC-1 that was developed by CDC scientists several years ago. Endothelial cells are crucial components of basic physiological processes such as tumor growth, wound healing, graft rejection, inflammation, circulation, and immune function. Most of these processes occur at the blood vessel level. The very qualities of endothelial cells present a problem for researchers because they are difficult to isolate and have a limited life span. As a result, scientists have had to use highly variable human tissue or live animals to conduct experiments. When faced with this problem, two scientists at CDC's National Center for Infectious Disease used human cells provided by Emory University to create HMEC-1, the first immortalized human microvascular endothelial cell line that retains the morphological, phenotypical, and functional characteristics of normal cells.

Other scientists and physicians throughout the United States and in 25 other countries on six continents have distributed this cell line for use. The HMEC-1 cell line is now used as an alternative to animal testing in the cosmetic and pharmaceutical industries to screen new compounds and drugs for toxicity to skin. Its impact includes a significant reduction in the use of animals in laboratory experiments and testing, and its widespread use as an essential tool for many scientists for research in the fields of drug screening, viral infectivity, immune function, wound healing, toxicity testing, and carcinogenicity testing. The cells are also used to produce and harvest cellular products used in cancer screening protocols. In addition, HMEC-1 is used to coat vascular prostheses, such as stints, to reduce rejection.

Food and Drug Administration

● **Dimethyl penclodedine, a possible cancer therapeutic**. Xanthus Life Sciences recently licensed (L-105-2002) a patent from the FDA, which claims demethyl penclomedine. This compound is the active metabolite of penclomedine. Penclomedine has been shown in several clinical trials to be potentially useful as a cancer therapeutic for a wide variety of solid tumors. Unfortunately, penclomedine has an unacceptable level of toxicity at therapeutic dosages. The active metabolite, demethyl penclomedine, appears to have little to no toxicity at therapeutic dosages, and should be useful in treating solid tumors. This compound might also be useful in treating tumors that have not responded to other treatment regimens. Xanthus has identified this compound as a lead compound, and plans to begin clinical trials within three years.

3.7 Department of the Interior

This section summarizes the statistics and other data provided by the department in its annual reports on the technology transfer activities and outcomes of its federal laboratories. Currently, these reports provide data only through FY 2001. This information covers the activities of the department's following bureaus: U.S. Geological Survey (USGS), Bureau of Reclamation (unless otherwise noted in the tables below). For additional details, readers should consult the department's full report.[31]

■ Collaborative Relationships for Research and Development

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **CRADAs**, total active in the FY(1)			--	--	50	n/a	n/a
- New, executed in the FY			--	--	21	n/a	n/a
▪ Traditional CRADAs,(2) total active in the FY	12	15	30	40	41	n/a	n/a
- New, executed in the FY			10	8	14	n/a	n/a
▪ Non-traditional CRADAs,(3) total active in FY			--	--	9	n/a	n/a
- New, executed in the FY			--	--	7	n/a	n/a
● **Other collaborative R&D relationships**							
			--	--	0	n/a	n/a

Figures for FY 2001 include activities of the USGS and the Bureau of Reclamation. Figures for prior years include only the USGS.

CRADA = Cooperative Research and Development Agreement
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) "Active" = legally in force at any time during the FY. "Total active" includes all agreements executed under CRADA authority (15 USC 3710a).
(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.
(3) CRADAs used for special purposes -- such as material transfer or technical assistance that may result in protected information.

■ Invention Disclosure and Patenting

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● New inventions disclosed in the FY(1)	26	2	8	16	6	n/a	n/a
● Patent applications filed in the FY(2)	15	2	3	5	22	n/a	n/a
● Patents issued in the FY			1	4	2	n/a	n/a

Figures for FY 2001 include activities of the USGS and the Bureau of Reclamation. Figures for prior years include only the USGS.
n/a = Data not available from agency at time of this report.

(1) Inventions arising at the federal lab.
(2) Tally includes: U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes: provisional, continuation, duplicate foreign, and PCT applications.

[31] U.S. Department of the Interior, *Annual Report on Technology Transfer: Programs, Plans, FY 2001 Activities and Achievements, September 2002*. DOI has not yet provided similar reports for FY 2002 and 2003.

■ Licensing

Profile of Active Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All licenses**, number total active in the FY[1]			12	6	8	n/a	n/a
▫ New, executed in the FY			0	2	2	n/a	n/a
▪ **Invention licenses**, total active in the FY			12	6	8	n/a	n/a
▫ New, executed in the FY			0	2	2	n/a	n/a
- Patent licenses [2] total active in FY			--	--	--	n/a	n/a
▫ New, executed in the FY			--	--	--	n/a	n/a
- Material transfer (inventions), tot active in FY			--	--	--	n/a	n/a
▫ New, executed in the FY			--	--	--	n/a	n/a
- Other invention licenses,[3] total active in FY			--	--	--	n/a	n/a
▫ New, executed in the FY			--	--	--	n/a	n/a
▪ **Other IP licenses**, total active in the FY			0	0	0	n/a	n/a
▫ New, executed in the FY			0	0	0	n/a	n/a
- Copyright licenses (fee bearing)						n/a	n/a
▫ New, executed in the FY						n/a	n/a
- Material transfer (non-inv.), total active in FY						n/a	n/a
▫ New, executed in the FY						n/a	n/a
- Other [4]						n/a	n/a
▫ New, executed in the FY						n/a	n/a

Figures for FY 2001 include activities of the USGS and the Bureau of Reclamation. Figures for prior years include only the USGS.

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (i.e., hybrid licenses) are reported as patent licenses -- and not included in the count of copyright licenses.

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) "Active" = legally in force at any time during the FY.
(2) Patent license tally includes patent applications that are licensed.
(3) No licenses of this type indicated as active.
(4) No licenses of this type indicated as active.

Licensing Management

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Elapsed execution time,[1] licenses granted in FY**							
▪ **Invention licenses**							
▫ average months			--	--	3.5	n/a	n/a
▫ minimum			--	--	3.0	n/a	n/a
▫ maximum			--	--	4.0	n/a	n/a
- Patent licenses[2]							
▫ average months			--	--	--	n/a	n/a
▫ minimum			--	--	--	n/a	n/a
▫ maximum			--	--	--	n/a	n/a
● **Number of licenses terminated for cause in FY**							
▪ **Invention licenses**			--	--	0	n/a	n/a
- Patent licenses[2]			--	--	--	n/a	n/a

Data included in this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a subclass.

Data lin this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a subclass.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)
(2) Patent license tally includes patent applications which are licensed.

Characteristics of Licenses Bearing Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All income bearing licenses**, number			11	5	6	n/a	n/a
▫ Exclusive			--	--	0	n/a	n/a
▫ Partially exclusive			--	--	0	n/a	n/a
▫ Non-exclusive			--	--	6	n/a	n/a
▪ **Invention licenses**, income bearing			11	5	6	n/a	n/a
▫ Exclusive			--	--	0	n/a	n/a
▫ Partially exclusive			--	--	0	n/a	n/a
▫ Non-exclusive			--	--	6	n/a	n/a
- Patent licenses,(1) income bearing					--	n/a	n/a
▫ Exclusive					--	n/a	n/a
▫ Partially exclusive					--	n/a	n/a
▫ Non-exclusive					--	n/a	n/a
▪ **Other IP licenses**, income bearing			0	0	0	n/a	n/a
▫ Exclusive						n/a	n/a
▫ Partially exclusive						n/a	n/a
▫ Non-exclusive						n/a	n/a
- Copyright licenses (fee bearing)						n/a	n/a
▫ Exclusive						n/a	n/a
▫ Partially exclusive						n/a	n/a
▫ Non-exclusive						n/a	n/a
● **All royalty bearing licenses**,(2) number			11	5	6	n/a	n/a
▪ **Invention licenses**, royalty bearing, number			11	5	6	n/a	n/a
- Patent licenses,(1) royalty bearing			--	--	--	n/a	n/a
▪ **Other IP licenses**, royalty bearing			0	0	0	n/a	n/a
- Copyright licenses (fee bearing)							

Figures for FY 2001 include activities of the USGS and the Bureau of Reclamation. Figures for prior years include only the USGS.

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalites, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of past years.

(1) Patent license tally includes patent applications that are licensed.
(2) Note that royalties are one component of total license income.

Income (annual) from Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Total income**, all licenses active in FY [1]			$1,640,000	$850,000	$235,000	n/a	n/a
▪ **Invention licenses**			$1,640,000	$850,000	$235,000	n/a	n/a
- Patent licenses [2]			--	--	--	n/a	n/a
▪ **Other IP licenses**, total active in the FY			$0	$0	$0	n/a	n/a
- Copyright licenses							
● **Total Earned Royalty Income** (ERI) [3]			$1,640,000	$850,000	$220,000	n/a	n/a
▫ Median ERI			--	--	n/a	n/a	n/a
▫ Minimum ERI			--	--	$2,000	n/a	n/a
▫ Maximum ERI			--	--	$20,000	n/a	n/a
▫ ERI from top 1% of licenses			--	--	n/a	n/a	n/a
▫ ERI from top 5% of licenses			--	--	n/a	n/a	n/a
▫ ERI from top 20% of licenses			--	--	n/a	n/a	n/a
▪ **Invention licenses**			--	--	--	n/a	n/a
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							
- Patent licenses [2]						n/a	n/a
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							
▪ **Other IP licenses**			$0	$0	$0	n/a	n/a
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							
- Copyright licenses						n/a	n/a
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							

Figures for FY 2001 include activities of the USGS and the Bureau of Reclamation. Figures for prior years include only the USGS.

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of previous years.

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).
(2) Patent license tally includes patent applications that are licensed.
(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or units sold). Not a license fee or minimum royalty.

Disposition of License Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Income distributed** (1)							
▪ **Invention licenses**, total distributed			--	--	$235,250	n/a	n/a
- To inventors			--	--	$16,375	n/a	n/a
					7%		
-To other(2)			--	--	$218,875	n/a	n/a
					93%		
- Patent licenses,(3) total distributed			--	--	--	n/a	n/a
- To inventors			--	--	--	n/a	n/a
-To other(2)			--	--	--	n/a	n/a

Invention licenses are the chief policy interest regarding distribution of income; content of this table reflects this focus.

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in previous

(1) Income includes royalties and other payments received during the FY.

(2) To agency (internal): salaries of some tech transfer staff, patent filing preparation fees, patent annuity payments, fees to agency labs.

Note on FY 2001 figures: Most of the reported income stems from the royalty stream created by a patent infringement judgment won by the department. Because of the particulars of the case, no significant portion of these royalties is payable to the individual investors.

As a general policy, USGS's royalty sharing percentage is 33%; the Bureau of Reclamation's is 30%.

(3) Patent license tally includes patent applications that are licensed.

■ Other Performance Measures

None cited.

■ Downstream Outcomes

No outcome examples to cite. Information on DOI technology transfer activities in FY 2002 or 2003 are not yet available from the department for this report.

3.8 National Aeronautics and Space Administration

This section summarizes the statistics and other data provided by the department in its annual reports on the technology transfer activities and outcomes of its federal laboratories. Currently, these reports provide data through FY 2003. This information covers the activities of all of NASA's federal labs and research centers, including the Jet Propulsion Lab run by the California Institute of Technology (unless otherwise noted in the tables below). For additional details, readers should consult the department's full report.[32]

■ Collaborative Relationships for Research and Development

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **CRADAs**, total active in the FY[(1)]	0	0	1	1	1	1	0
- New, executed in the FY			1	0	0	0	0
▪ Traditional CRADAs,[(2)] total active in the FY	0	0	1	1	1	1	0
- New, executed in the FY			1	0	0	0	0
▪ Non-traditional CRADAs,[(3)] total active in FY			0	0	0	0	0
- New, executed in the FY			0	0	0	0	0
● **Other collaborative R&D relationships**							
▪ Space Act Agreements[(4)], JPL Tasks[(5)], Software Useage Agreements[(6)]: total active in the FY			81	104	1,053	1,104	1,056
- New, executed in the FY			n/a	30	496	537	385

CRADA = Cooperative Research and Development Agreement
n/a = Data not available from agency at time of this report.

(1) "Active" = legally in force at any time during the FY. "Total active" includes all agreements executed under CRADA authority (15 USC 3710a).
(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.
(3) CRADAs used for special purposes -- such as material transfer or technical assistance that may result in protected information.
(4) NASA does not often employ CRADA authority to enter into collaborative R&D; it instead uses its broad authority under the National Aeronautics and Space Act of 1958 to enter into Space Act Agreements. NASA has not in the past tracked the number of Space Act agreements, but it plans to do so in the future
(5) R&D tasks reported by the Jet Propulsion Laboratory (JPL), as part of NASA's overall R&D effort.
(6) Agreements executed with industry.

■ Invention Disclosure and Patenting

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● New inventions disclosed in the FY[(1)]	538	517	525	574	696	775	736
● Patent applications filed in the FY[(2)]	181	164	129	158	152	166	163
● Patents issued in the FY			87	148	159	128	136

(1) Inventions arising at the federal lab.
(2) Tally includes: U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes: provisional, continuation, duplicate foreign, and PCT applications.

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[32] National Aeronautics and Space Administration, *Annual Report on Technology Transfer: Programs, Plans, FY 2003 Activities and Achievements*, July 2004. Report prepared in response to 15 USC Sec. 3710(f) (requiring an annual "agency report on utilization" for agencies with federal laboratories) and submitted to OMB (consistent with Circular A-11 guidelines).

■ Licensing

Profile of Active Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002
● **All licenses**, number total active in the FY[1]			288	305	328	357
▫ New, executed in the FY			58	67	65	62
▪ **Invention licenses**, total active in the FY			230	238	292	290
▫ New, executed in the FY			46	46	42	52
- Patent licenses,[2] total active in FY			230	238	292	290
▫ New, executed in the FY			46	46	42	52
- Material transfer (inventions), tot active in FY			0	0	0	0
▫ New, executed in the FY			0	0	0	0
- Other invention licenses,[3] total active in FY			0	0	0	0
▫ New, executed in the FY			0	0	0	0
▪ **Other IP licenses**, total active in the FY			58	67	36	67
▫ New, executed in the FY			12	21	23	10
- Copyright licenses (fee bearing)			52	60	36	67
▫ New, executed in the FY			10	20	23	10
- Material transfer (non-inv.), total active in FY			0	0	0	0
▫ New, executed in the FY			0	0	0	0
- Other [4]			6	7	0	0
▫ New, executed in the FY			2	1	0	0

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (i.e., hybrid licenses) are reported as patent licenses -- and not included in the count of copyright licenses.

-- = Data not requested from agency in reports of earlier years.

(1) "Active" = legally in force at any time during the FY.
(2) Patent license tally includes patent applications that are licensed.
(3) No licenses of this type indicated as active.
(4) Releases for Open Channel Web licenses.

Licensing Management

		FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Elapsed execution time,[1] licenses granted in FY**								
▪ **Invention licenses**								
▫ median	months			2.0	2.0	14.4	5.3	10.1
▫ minimum				0.1	0.1	4.0	0.7	2.0
▫ maximum				24.0	24.0	49.9	35.9	39.3
- Patent licenses[2]								
▫ median	months			2.0	2.0	14.4	5.3	10.1
▫ minimum				0.1	0.1	4.0	0.7	2.0
▫ maximum				24.0	24.0	49.9	35.9	39.3
● **Number of licenses terminated for cause in FY**								
▪ **Invention licenses**				0	0	21	32	20
- Patent licenses[2]				0	0	21	30	19

Data included in this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a subclass.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)
(2) Patent license tally includes patent applications which are licensed.

Characteristics of Licenses Bearing Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All income bearing licenses**, number			163	171	105	131	247
▫ Exclusive			87	99	53	64	139
▫ Partially exclusive			14	13	13	17	19
▫ Non-exclusive			62	59	39	50	89
▪ **Invention licenses**, income bearing			131	133	98	119	206
▫ Exclusive			81	90	48	59	105
▫ Partially exclusive			13	13	13	17	19
▫ Non-exclusive			37	30	37	43	82
- Patent licenses,(1) income bearing			131	133	98	119	206
▫ Exclusive			81	90	48	59	105
▫ Partially exclusive			13	13	13	17	19
▫ Non-exclusive			37	30	37	43	82
▪ **Other IP licenses**, income bearing			32	38	7	12	41
▫ Exclusive			6	9	5	5	34
▫ Partially exclusive			1	n/a	0	0	0
▫ Non-exclusive			25	29	2	7	7
- Copyright licenses (fee bearing)			10	16	7	12	41
▫ Exclusive			2	5	5	5	34
▫ Partially exclusive			1	n/a	0	0	0
▫ Non-exclusive			7	11	2	7	7
● **All royalty bearing licenses**,(2) number			130	109	76	96	160
▪ **Invention licenses**, royalty bearing, number			113	84	72	86	128
- Patent licenses,(1) royalty bearing			96	84	72	86	128
▪ **Other IP licenses**, royalty bearing			17	25	4	10	32
- Copyright licenses (fee bearing)			17	25	4	10	32

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalites, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of past years.

(1) Patent license tally includes patent applications that are licensed.
(2) Note that royalties are one component of total license income.

Income (annual) from Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Total income**, all licenses active in FY [1]			$1,360,061	$1,756,796	$1,970,739	$2,498,167	$2,852,985
▪ **Invention licenses**			$1,128,458	$1,087,003	$1,318,884	$2,075,038	$2,411,886
- Patent licenses [2]			$1,128,458	$1,087,003	$1,318,884	$2,075,038	$2,411,886
▪ **Other IP licenses**, total active in the FY			$231,603	$669,793	$651,855	$423,129	$441,099
- Copyright licenses			$231,603	$669,793	$651,855	$423,129	$441,099
● **Total Earned Royalty Income** (ERI) [3]			$183,294	$116,490	$521,164	$554,769	$814,624
▫ Median ERI			$22,615	$15,446	$21,735	n/a	$9,522
▫ Minimum ERI			$18	$270	$71	$20	$65
▫ Maximum ERI			$61,724	$72,888	$232,159	$90,000	$152,000
▫ ERI from top 1% of licenses			$61,724	$72,888	n/a	n/a	n/a
▫ ERI from top 5% of licenses			$61,724	$72,888	n/a	n/a	n/a
▫ ERI from top 20% of licenses			$100,820	$72,888	$419,867	n/a	n/a
▪ **Invention licenses**			$149,595	$90,001	n/a	$311,987	$808,766
▫ Median ERI			$16,477	$15,446		n/a	$9,624
▫ Minimum ERI			$18	$1,667		$20	$65
▫ Maximum ERI			$61,724	$72,888		$90,000	$152,000
▫ ERI from top 1% of licenses			$61,724	$72,888		n/a	n/a
▫ ERI from top 5% of licenses			$61,724	$72,888		n/a	n/a
▫ ERI from top 20% of licenses			$100,820	$72,888		n/a	n/a
- Patent licenses [2]			$149,595	$90,001	n/a	$311,987	$808,766
▫ Median ERI			$16,477	$15,446		n/a	$9,624
▫ Minimum ERI			$18	$1,667		$20	$65
▫ Maximum ERI			$61,724	$72,888		$90,000	$152,000
▫ ERI from top 1% of licenses			$61,724	$72,888		n/a	n/a
▫ ERI from top 5% of licenses			$61,724	$72,888		n/a	n/a
▫ ERI from top 20% of licenses			$100,820	$72,888		n/a	n/a
▪ **Other IP licenses**			$33,700	$26,488	n/a	$242,692	$5,858
▫ Median ERI			$33,700	$13,379		n/a	$5,858
▫ Minimum ERI			$33,700	$270		$675	$5,858
▫ Maximum ERI			$33,700	$26,218		$90,000	$5,858
▫ ERI from top 1% of licenses			$33,700	$26,218		n/a	n/a
▫ ERI from top 5% of licenses			$33,700	$26,218		n/a	n/a
▫ ERI from top 20% of licenses			$33,700	$26,218		n/a	n/a
- Copyright licenses			$33,700	$26,488	n/a	$242,692	$5,858
▫ Median ERI			$33,700	$13,379		n/a	$5,858
▫ Minimum ERI			$33,700	$270		$675	$5,858
▫ Maximum ERI			$33,700	$26,218		$90,000	$5,858
▫ ERI from top 1% of licenses			$33,700	$26,218		n/a	n/a
▫ ERI from top 5% of licenses			$33,700	$26,218		n/a	n/a
▫ ERI from top 20% of licenses			$33,700	$26,218		n/a	n/a

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

(2) Patent license tally includes patent applications that are licensed.

(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or units sold). Not a license fee or minimum royalty.

Disposition of License Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Income distributed** (1)							
▪ **Invention licenses**, total distributed			$1,076,932	$1,044,003	$1,450,989	$1,220,890	$1,324,848
- To inventors			$828,930	$608,910	$615,558	$699,854	$905,477
			77%	58%	42%	57%	68%
-To other(2)			$248,002	$435,093	$835,431	$521,036	$419,371
			23%	42%	58%	43%	32%
- Patent licenses,(3) total distributed			$1,076,932	$1,044,003	$1,450,989	$1,220,890	$1,324,848
- To inventors			$828,930	$608,910	$615,558	$699,854	$905,477
			77%	58%	42%	57%	68%
-To other(2)			$248,002	$435,093	$835,431	$521,036	$419,371
			23%	42%	58%	43%	32%

Invention licenses are the chief policy interest regarding distribution of income; content of this table reflects this focus.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Income includes royalties and other payments received during the FY.
(2) Returned to U.S. Treasury or to the originating laboratory, as provided by law.
(3) Patent license tally includes patent applications that are licensed.

■ Other Performance Measures

None cited.

■ Downstream Outcomes

NASA's FY 2003 report indicated that diverse downstream benefits had arisen from the agency's technology transfer activities: a) technology arising under a collaborative research, development, and demonstration relationship had become commercially available; b) technology arising under a collaborative research, development, and demonstration relationship had worked to strengthen NASA's capabilities; c) technology licensed by the agency had become commercially available; also d) products or processes developed by agency licensees had strengthened NASA's capabilities.

NASA collects "success stories," following a standardized format, in order to maintain awareness of successful transfer and application of technology by industry and the public. While these success stories are anecdotal in nature, they are a useful indicator of the application of NASA technology. During the past fiscal year, a total of 183 such stories were documented. The following is a sampling of these cases:

● **Tool for real-time emergency action coordination** (Stennis Space Center). The Real-Time Emergency Action Coordination Tool (REACT) is a decision support system developed to support various real-time models. Initially developed and deployed to support the St. Tammany Parish (Louisiana) EMOC flood mitigation efforts, REACT is extendable to support numerous types of geographic impact models. The main benefit REACT provides is integration of disparate information to enable more efficient decision-making by emergency management personnel.

The system was developed to support a variety of impact models such as fires, hazardous material spills, airborne biochemical agents, and many others of crucial importance to first responders. This development provided NASA's Earth Science Directorate with practical application as well as verification and validation regarding ongoing technological developments.

REACT was the result of a Dual-Use contract and is an excellent example of how NASA and industry can partner to further develop a NASA technology while at the same time help fulfill a commercial need.

● **VolumeViewer - a high-resolution volumetric 3D display system** (Stennis Space Center). VolumeViewer is a patented volumetric 3D display system that is fundamentally different from conventional 3D visualization technologies. It enables group viewing of a 360-degree, 3D volume display without wearing any special viewing aids or goggles. This provides both physiological and psychological depth cues to human viewers to truthfully perceive 3D objects. The system generates "fish-tank like" volumetric 3D images within a display media that has a physical 3D volume.

The technological breakthroughs in the development of VolumeViewer have resulted in the release of a line of patented 3D cameras (under the name Rainbow 3D®, 3D digitizer systems (3D EI Digitizer™, 3D Dental Digitizer™), and 3D visualization and application software (3D Surgeon™, 3D Mosaic™, 3D FaceMap™, 3D Enroll™ and 3D Face ID™). Genex has also improved a related 360-degree imaging technology (OmniEye®) using cameras pointed into a mirror to provide a panoramic view. Within the last 12 months sales of the 3D line of cameras have been approximately $350,000. Omni-Eye is presently being field tested by security dealers, and sales have been modest (about $50,000) over the past 12 months. Additionally, Genex has cross-licensing agreements with Align Technologies valued at $1,500,000.

● **The heart of the matter** (Johnson Space Center). The same technology that pumps hundreds of thousands of gallons of fuel through the Space Shuttle's engines is helping those who need heart transplants survive the wait for a donor organ with tiny heart-assist implants. The ingenuity lies within the inner workings of the tiny, titanium pump, which houses the only moving part—an impeller—among the pump's three main components that minimize blood-flow turbulence, guide direction and drive constant outflow. The single-rotating impeller, co-designed by a team of NASA engineers experienced on working with Shuttle fuel and oxidizer pumps, propels blood in a one-way, continuous flow. The heart pump weighs only 4 ounces, is silent in operation and measures only 1"X3", about the size of a "C" cell battery.

This effort began in 1996 when NASA granted exclusive rights, under its patents for the mechanical left-ventricular assist device (LVAD), to MicroMed, which manufactures the heart assist pump, now called the MicroMed-DeBakey VAD®. The pump's scalable design makes it possible to implant a smaller version in children. The heart assist pump has been implanted in about 240 adult patients, 176 during European trials that began in 1998. U.S. trials began in 2000 and are still underway to reach a planned total of 180 implants. The heart pump has recently earned Food and Drug Administration approval for use in children between the ages of five and 16.

● **Rotating bioreactor** (Johnson Space Center). A rotating bioreactor, invented at Johnson Space Center, has been licensed for development of medical products and for research in various biological areas. This license is provided under a Cooperative Research and Development Agreement. The results of use of the bioreactor have increased understanding of the human liver in space; further use is expected to provide new treatments of liver and kidney disorders. Key areas explored include: a liver assist device; liver cell and kidney cell production; and in-vitro studies of efficacy, toxicity, and metabolism.

● **Damage tolerant material development** (Glenn Research Center). NASA Glenn Research Center's (GRC's) ballistic impact testing facility has been used to test how materials respond to high speed impacts. The 40 ft. gas gun can shoot a gas turbine blade at 2,000 ft./sec. The Center was approached by a small company with an innovative composite material in order to conduct a needed impact testing of its Tycor material. A partnership to conduct ballistic impact testing of Tycor was formed, which introduced NASA Glenn researchers to Webcore's material. Tycor's successful performance led to a partnership including GRC, Webcore, the Air Force, and GE Aircraft Engines, to develop a damage tolerant fan case using Tycor material.

● **Lithium battery development** (Glenn Research Center). Researchers at Glenn developed an innovative rod-coil polymer electrolyte for lithium batteries, and have been designing and testing new lithium battery concepts incorporating this new electrolyte material. Energizer signed an agreement to access NASA's electrolyte technology and battery development results. Energizer expects this partnership to lead to better performing, lower cost lithium batteries. A space act agreement was negotiated. This partnership gives NASA access to Energizer's considerable battery design and manufacturing experience. Energizer is able to prototype new battery designs, more quickly than NASA, which will accelerate NASA's development of a new lithium battery for aerospace applications.

● **Hydrogen fuel reformer** (Glenn Research Center). In the course of developing fuel cell technologies, a partnership with Catacel led to improved design and performance of fuel reformers and heat exchangers. The partnership has led to reduced development costs and the development of a new product that is estimated to reduce fuel savings on a commercial aircraft flight of up to 20 percent for auxiliary power generation. The new product is estimated to eventually create 50 new jobs for the firm.

3.9 Department of Transportation

This section summarizes the statistics and other data provided by the department in its annual reports on the technology transfer activities and outcomes of its federal laboratories. Currently, these reports provide data through FY 2002. This information covers the activities of the department's following agencies: Federal Aviation Administration (FAA), Federal Highway Administration (FHWA), and Research and Special Programs Administration (RSPA) (unless otherwise noted in the tables below). For additional details, readers should consult the department's full report.[33]

■ Collaborative Relationships for Research and Development

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **CRADAs**, total active in the FY(1)			--	--	82	92	96
- New, executed in the FY			--	--	11	14	7
▪ Traditional CRADAs,(2) total active in the FY	1	37	51	79	78	80	96
- New, executed in the FY			5	38	11	9	7
▪ Non-traditional CRADAs,(3) total active in FY			0	0	4	12	0
- New, executed in the FY			0	0	0	5	0
● **Other collaborative R&D relationships**							
			--	--	0	0	0

CRADA = Cooperative Research and Development Agreement
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) "Active" = legally in force at any time during the FY. "Total active" includes all agreements executed under CRADA authority (15 USC 3710a).
(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.
(3) CRADAs used for special purposes -- such as material transfer or technical assistance that may result in protected information.

■ Invention Disclosure and Patenting

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● New inventions disclosed in the FY(1)	1	0	1	0	2	0	0
● Patent applications filed in the FY(2)	1	2	0	1	3	0	0
● Patents issued in the FY			0	3	0	0	0

(1) Inventions arising at the federal lab.
(2) Tally includes: U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes: provisional, continuation, duplicate foreign, and PCT applications.

[33] U.S. Department of Transportation, *FY 2003 Annual Report on Technology Transfer*, October 2003. Report prepared in response to 15 USC Sec. 3710(f) (requiring an annual "agency report on utilization" for agencies with federal laboratories).

■ Licensing

Profile of Active Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All licenses**, number total active in the FY[(1)]			0	0	1	0	0
▫ New, executed in the FY			0	0	1	0	0
▪ **Invention licenses**, total active in the FY			0	0	1	0	0
▫ New, executed in the FY			0	0	1	0	0
- Patent licenses,[(2)] total active in FY					1	0	0
▫ New, executed in the FY					1	0	0
- Material transfer (inventions), tot active in FY					0	0	0
▫ New, executed in the FY					0	0	0
- Other invention licenses,[(3)] total active in FY					0	0	0
▫ New, executed in the FY					0	0	0
▪ **Other IP licenses**, total active in the FY			0	0	0	0	0
▫ New, executed in the FY			0	0	0	0	0
- Copyright licenses (fee bearing)							
▫ New, executed in the FY							
- Material transfer (non-inv.), total active in FY							
▫ New, executed in the FY							
- Other [(4)]							
▫ New, executed in the FY							

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (i.e., hybrid licenses) are reported as patent licenses -- and not included in the count of copyright licenses.

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) "Active" = legally in force at any time during the FY.
(2) Patent license tally includes patent applications that are licensed.
(3) No licenses of this type indicated as active.
(4) No licenses of this type indicated as active.

Licensing Management

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Elapsed execution time,[(1)] licenses granted in FY**							
▪ **Invention licenses**							
▫ average months			--	--	n/a	*	*
▫ minimum			--	--	n/a	*	*
▫ maximum			--	--	n/a	*	*
- Patent licenses[(2)]							
▫ average months			--	--	n/a	*	*
▫ minimum			--	--	n/a	*	*
▫ maximum			--	--	n/a	*	*
● **Number of licenses terminated for cause in FY**							
▪ **Invention licenses**			--	--	0	0	0
- Patent licenses[(2)]			--	--	0	0	0

* No new licenses were executed in FY 2002 or 2003

Data included in this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a subclass.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)
(2) Patent license tally includes patent applications which are licensed.

Characteristics of Licenses Bearing Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All income bearing licenses**, number			0	0	1	0	0
▫ Exclusive					0		
▫ Partially exclusive					0		
▫ Non-exclusive					1		
▪ **Invention licenses**, income bearing			0	0	1	0	0
▫ Exclusive					0		
▫ Partially exclusive					0		
▫ Non-exclusive					1		
- Patent licenses,(1) income bearing					1		
▫ Exclusive					0		
▫ Partially exclusive					0		
▫ Non-exclusive					1		
▪ **Other IP licenses**, income bearing			0	0	0	0	0
▫ Exclusive							
▫ Partially exclusive							
▫ Non-exclusive							
- Copyright licenses (fee bearing)							
▫ Exclusive							
▫ Partially exclusive							
▫ Non-exclusive							
● **All royalty bearing licenses**,(2) number			0	0	1	0	0
▪ **Invention licenses**, royalty bearing, number					1	0	0
- Patent licenses,(1) royalty bearing							
▪ **Other IP licenses**, royalty bearing					0	0	0
- Copyright licenses (fee bearing)							

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalites, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of past years.

(1) Patent license tally includes patent applications that are licensed.
(2) Note that royalties are one component of total license income.

Income (annual) from Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Total income**, all licenses active in FY (1)			$0	$0	$5,500	$0	$0
▪ **Invention licenses**			$0	$0	$5,500	$0	$0
- Patent licenses (2)					$5,500		
▪ **Other IP licenses**, total active in the FY			$0	$0	$0	$0	$0
- Copyright licenses							
● **Total Earned Royalty Income** (ERI) (3)			$0	$0	n/a	$0	$0
▫ Median ERI					n/a		
▫ Minimum ERI					n/a		
▫ Maximum ERI					n/a		
▫ ERI from top 1% of licenses					n/a		
▫ ERI from top 5% of licenses					n/a		
▫ ERI from top 20% of licenses					n/a		
▪ **Invention licenses**					n/a		
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							
- Patent licenses (2)							
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							
▪ **Other IP licenses**					n/a		
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							
- Copyright licenses							
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							

n/a = Data not available from agency at time of this report.

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).
(2) Patent license tally includes patent applications that are licensed.
(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or units sold). Not a license fee or minimum royalty.

Disposition of License Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Income distributed** (1)							
▪ **Invention licenses**, total distributed			$0	$0	$3,625	$0	$0
- To inventors			$0	$0	$2,225	$0	$0
					61%		
-To other(2)			$0	$0	$1,400	$0	$0
					39%		
- Patent licenses,(3) total distributed			--	--	$3,625	$0	$0
- To inventors			--	--	$2,225	$0	$0
					61%		
-To other(2)			--	--	$1,400	$0	$0
					39%		

Invention licenses are the chief policy interest regarding distribution of income; content of this table reflects this focus.

-- = Data not requested from agency in reports of earlier years.

(1) Income includes royalties and other payments received during the FY.

(2) To agency: patentability search, provisional patent filing

(3) Patent license tally includes patent applications that are licensed.

■ Other Performance Measures

None cited.

■ Downstream Outcomes

DOT's reports for FY 2002 and 2003 report provided the following selected examples of downstream outcomes arising from the technology transfer activities of the department's federal labs:

Federal Highway Administration

● **Development of software toolbox to aid roadway design**. The Federal Highway Administration's (FHWA) Turner-Fairbank Research Center signed a CRADA in 2003 with CaiCE (now part of Autodesk) to develop a toolbox that would serve as an interface between their products such as CAiCE Visual Transportation 10 and software utilized by Turner-Fairbank for the purposes of evaluation. The development of this toolbox has enabled staff at state departments of transportation to utilize CAiCE software to design the geometry of roadways, and export that data utilizing this CAiCE toolbox. The toolbox enables FHWA to import the data in a format that is accepted by their software. In turn, the designers of the roadway geometry can then utilize FHWA software to evaluate the design.

Federal Aviation Administration

● **Partnership to promote education**. The FAA's William J. Hughes Technical Center entered into a Memorandum of Agreement (MOA) with the Atlantic City Board of Education. The MOA is to provide technical, professional, and engineering employees to serve in various teaching capacities. The MOA is effective through June 30, 2006.

Research and Special Programs Administration

● **Dissemination of technology through multiple CRADAs**. In support of the Federal Transit Administration's Advanced Public Transportation Systems (APTS) program, the Volpe Center developed a Mobile Showcase. The APTS Mobile Showcase is a 48-foot trailer with expandable sides that serves as a research lab, classroom, and briefing facility on wheels that tours the country and demonstrates transit-related Intelligent Transportation Systems initiatives to encourage their adoption at the local level. These technologies range from improving operations, such as automated vehicle location (AVL) system; improving communications, such as mobile data terminals; improving passenger service, such as real-time information kiosks; and improving safety, such as pedestrian detection technologies. The showcase also serves as a mechanism for educating the transit community. Hands-on technical courses taught during Showcase visits to transit agencies give the individuals visiting the opportunity to gain firsthand knowledge about APTS technologies. In 2003, the Mobile Showcase has traveled to numerous transit agencies and to national, state, and regional transit and transportation conferences to provide transportation professionals, legislative and executive branch officials, and the general public with increased exposure to APTS technology. A large number of technology manufacturers, suppliers, vendors, and consultants are participating in this program through Cooperative Research and Development Agreements (CRADAs). Currently, there are 44 active CRADAs supporting this program.

● **FLC education and training**. The Volpe Center's technology transfer representative currently serves as the Chair of the Federal Laboratory Consortium's (FLC) Education and Training Committee. This committee has developed a Technology Transfer Training Resources Data Base that will feature all technology transfer courses currently available through the federal laboratory system and technology transfer associations such as the Association of University Technology Managers and the National Technology Transfer Center. It is also in the process of developing on-line technology transfer training that will be made available through the FLC's Web site (www.federallabs.org) and will further the state of technology transfer education.

3.10 Department of Veterans Affairs

This section summarizes the statistics and other data provided by the department in its annual reports on the technology transfer activities and outcomes of its federal laboratories. Currently, these reports provide data through FY 2003. This information covers the activities of Veterans Affairs (VA) laboratories and VA academic affiliates (university medical schools) with which the VA has an active Cooperative Technology Administration Agreement (CTAA). For additional details, readers should consult the department's full report.[34]

■ Collaborative Relationships for Research and Development

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **CRADAs**, total active in the FY(1)			--	--	2	2	10
- New, executed in the FY			--	--	0	2	8
▪ Traditional CRADAs,(2) total active in the FY			1	2	2	2	10
- New, executed in the FY			1	2	0	2	8
▪ Non-traditional CRADAs,(3) total active in FY			--	--	0	0	0
- New, executed in the FY			--	--	0	0	0
● **Other collaborative R&D relationships**							
			--	--	0	0	0

CRADA = Cooperative Research and Development Agreement

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) "Active" = legally in force at any time during the FY. "Total active" includes all agreements executed under CRADA authority (15 USC 3710a).

(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.

(3) CRADAs used for special purposes -- such as material transfer or technical assistance that may result in protected information.

■ Invention Disclosure and Patenting

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● New inventions disclosed in the FY(1)			48	85	131	125	183
● Patent applications filed in the FY(2)			37	35	38	34	36
● Patents issued in the FY			0	1	4	4	8

Reported figures for FY 2001 and 2002 are incomplete: data from many of the VA's academic affiliates was not available at the time of this report, since they were not yet due according to the CTAA reporting schedule.

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Inventions arising at the federal lab.

(2) Tally includes: U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes: provisional, continuation, duplicate foreign, and PCT applications.

[34] Department of Veterans Affairs, Office of Research and Development, Technology Transfer Program, *Annual Reporting on Agency Technology Transfer, FY 2005 Budget Submission*, March 2004. Report prepared in response to 15 USC Sec. 3710(f) (requiring an annual "agency report on utilization" for agencies with federal laboratories) and submitted to OMB (consistent with Circular A-11 guidelines).

■ Licensing

Profile of Active Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All licenses**, number total active in the FY[(1)]			--	--	86	81	88
▫ New, executed in the FY			--	--	--	5	7
▪ **Invention licenses**, total active in the FY			--	--	76	69	76
▫ New, executed in the FY			47	3	5	3	7
- Patent licenses,[(2)] total active in FY					--	n/a	n/a
▫ New, executed in the FY					--	n/a	n/a
- Material transfer (inventions), tot active in FY					--	n/a	n/a
▫ New, executed in the FY					--	n/a	n/a
- Other invention licenses,[(3)] total active in FY					--	n/a	n/a
▫ New, executed in the FY					--	n/a	n/a
▪ **Other IP licenses**, total active in the FY			0	0	10	12	12
▫ New, executed in the FY			0	0	--	2	0
- Copyright licenses (fee bearing)					--	n/a	n/a
▫ New, executed in the FY					--	n/a	n/a
- Material transfer (non-inv.), total active in FY					--	n/a	n/a
▫ New, executed in the FY					--	n/a	n/a
- Other [(4)]					--	n/a	n/a
▫ New, executed in the FY					--	n/a	n/a

Reported figures for FY 2001 and 2002 are incomplete: data from many of the VA's academic affiliates was not available at the time of this report, since they were not yet due according to the CTAA reporting schedule.

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (i.e., hybrid licenses) are reported as patent licenses -- and not included in the count of copyright licenses.

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) "Active" = legally in force at any time during the FY.
(2) Patent license tally includes patent applications that are licensed.
(3) No licenses of this type indicated as active.
(4) No licenses of this type indicated as active.

Licensing Management

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Elapsed execution time,[(1)] licenses granted in FY**							
▪ **Invention licenses**							
▫ average months			--	--	n/a	n/a	n/a
▫ minimum			--	--	n/a	n/a	n/a
▫ maximum			--	--	n/a	n/a	n/a
- Patent licenses[(2)]							
▫ average months			--	--	--	n/a	n/a
▫ minimum			--	--	--	n/a	n/a
▫ maximum			--	--	--	n/a	n/a
● **Number of licenses terminated for cause in FY**							
▪ **Invention licenses**			--	--	2	n/a	n/a
- Patent licenses[(2)]			--	--	--	n/a	n/a

Data included in this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a subclass.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)
(2) Patent license tally includes patent applications which are licensed.

Characteristics of Licenses Bearing Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **All income bearing licenses**, number			--	--	58	60	67
▫ Exclusive			--	--	3	4	8
▫ Partially exclusive			--	--	2	2	2
▫ Non-exclusive			--	--	53	54	57
▪ **Invention licenses**, income bearing			--	--	--	60	67
▫ Exclusive						4	8
▫ Partially exclusive						2	2
▫ Non-exclusive						54	57
- Patent licenses,(1) income bearing						60	67
▫ Exclusive						4	8
▫ Partially exclusive						2	2
▫ Non-exclusive						54	57
▪ **Other IP licenses**, income bearing			--	--	--	n/a	n/a
▫ Exclusive							
▫ Partially exclusive							
▫ Non-exclusive							
- Copyright licenses (fee bearing)							
▫ Exclusive							
▫ Partially exclusive							
▫ Non-exclusive							
● **All royalty bearing licenses**,(2) number			--	--	58	n/a	n/a
▪ **Invention licenses**, royalty bearing, number			--	--	--	n/a	n/a
- Patent licenses,(1) royalty bearing							
▪ **Other IP licenses**, royalty bearing			--	--	--	n/a	n/a
- Copyright licenses (fee bearing)							

Reported figures for FY 2001 and 2002 are incomplete: data from many of the VA's academic affiliates was not available at the time of this report, since they were not yet due according to the CTAA reporting schedule.

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalites, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of past years.

(1) Patent license tally includes patent applications that are licensed.
(2) Note that royalties are one component of total license income.

Income (annual) from Licenses

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Total income**, all licenses active in FY [1]			--	--	$38,000	$18,000	$153,000
▪ **Invention licenses**			--	--	$23,000	n/a	n/a
- Patent licenses [2]					--	n/a	n/a
▪ **Other IP licenses**, total active in the FY			--	--	$14,000	n/a	n/a
- Copyright licenses					--	n/a	n/a
● **Total Earned Royalty Income** (ERI) [3]			--	--	$17,000	n/a	n/a
▫ Median ERI					$481	n/a	n/a
▫ Minimum ERI					$8	n/a	n/a
▫ Maximum ERI					$6,000	n/a	n/a
▫ ERI from top 1% of licenses					n/a	n/a	n/a
▫ ERI from top 5% of licenses					n/a	n/a	n/a
▫ ERI from top 20% of licenses					n/a	n/a	n/a
▪ **Invention licenses**			--	--	--	n/a	n/a
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							
- Patent licenses [2]			--	--	--	n/a	n/a
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							
▪ **Other IP licenses**			--	--	--	n/a	n/a
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							
- Copyright licenses			--	--	--	n/a	n/a
▫ Median ERI							
▫ Minimum ERI							
▫ Maximum ERI							
▫ ERI from top 1% of licenses							
▫ ERI from top 5% of licenses							
▫ ERI from top 20% of licenses							

Reported figures for FY 2001 and 2002 are incomplete: data from many of the VA's academic affiliates was not available at the time of this report, since they were not yet due according to the CTAA reporting schedule.

n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee (including patent costs).
(2) Patent license tally includes patent applications that are licensed.
(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or units sold). Not a license fee or minimum royalty.

Disposition of License Income

	FY 1990	FY 1995	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
● **Income distributed** (1)							
▪ **Invention licenses**, total distributed			--	--	n/a	$15,000	$129,000
- To inventors			--	--	n/a	$0	$0
						0%	0%
-To other(2)			--	--	n/a	$15,000	$129,000
						100%	100%
- Patent licenses,(3) total distributed			--	--	--	n/a	n/a
- To inventors			--	--	--	n/a	n/a
-To other(2)			--	--	--	n/a	n/a

Invention licenses are the chief policy interest regarding distribution of income; content of this table reflects this focus.
n/a = Data not available from agency at time of this report. -- = Data not requested from agency in reports of earlier years.

(1) Income includes royalties and other payments received during the FY.
(2) VA Medical Center labs
(3) Patent license tally includes patent applications that are licensed.

■ Other Performance Measures

None cited.

■ Downstream Outcomes

The VA's FY 2003 report did not provide information on downstream outcomes from the technology transfer activities of its federal labs.

Appendix

Agency Progress in Strengthening Performance Metrics for Federal Lab Technology Transfer

A portion of the Technology Transfer Commercialization Act (which provides the statutory basis for this annual federal laboratory reporting) tasks this *Summary Report* with providing a regular update on progress made by agencies in improving performance assessment of technology transfer programs by federal agencies.[35]

The commentary below addresses this topic. This provides an update since the last published report (the September 2002 edition of the *Summary Report*). These observations reflect the perspective of the Office of Technology Policy, which for some time has had a leading role in preparing the *Summary Reports* and developing the conceptual framework and process elements for the reporting process.

Noteworthy Achievements

● The Office of Management and Budget's *Circular A-11* (starting with the July 2003 edition) now formally recognizes the annual agency utilization report on federal lab technology transfer[36] as a component of the agency's annual budget proposal documents (see Section 25.5, Table 1, "Has technology transfers"). The *Circular A-11* outlines requested report content (referencing the guidelines developed by the Interagency Working Group on Technology Transfer), as well as clarifies the timing of agency submission of report materials.

● Agency responsiveness to the annual reporting requirement has generally improved since the first cycle of the revised reporting process in FY 2001. Some of this improvement reflects movement along the learning curve gained from the experience of the now several completed reporting cycles. Some reflects the guidance of OMB's revised *Circular A-11*, which attaches the technology transfer reporting more concretely to the agency budget proposal process. In addition, many of the agencies have been working to improve their management information systems to enable more timely and reliable presentation of the data requested by the reporting process. While there remains room for further improvement, there has been significant progress since the first reporting cycle.

● The standardized data framework prepared for the agencies to use in assembling information for their annual reports (guidelines developed through the Interagency Working Group on Technology Transfer) has been reviewed and improved each year since first used in the FY 2001 reporting. Most of these changes have been incremental in nature, reflecting issues raised by the previous year's reporting cycle, and the framework is now approaching a fairly stable form. One significant change, nevertheless, introduced in mid-2002, is an enlarged typology of licenses -- this, to better capture the existing diversity of license type utilization across the agencies and to provide a better basis for

[35] See 15 United States Code Sec. 3710 (g)(2)(B)(iii)

[36] See 15 United States Code Sec. 3710 (f)

tracking what is expected to be a growing mix of license types in the future. The new license schema retains the statutory distinction between "invention" licenses and "other intellectual property (IP)" licenses, but adds several subcategories for each.

● Over the last several years, many of the agencies have sought to sharpen the description of their federal lab technology transfer efforts: broader concepts of the what and how of technology transfer relevant to their technology areas, interest in the use of new kinds of mechanisms, greater clarity in how technology transfer efforts play a role in achieving the agency's overall mission. Accordingly, there is interest in identifying metrics, beyond the usual core measures, that can better reflect this wider group of activities. Thus far, this interest has become palpable in only a few agencies incorporating new measures into their annual reporting: for example, the "other types of collaborative R&D relationships" identified by USDA, DOC, and NASA and the "other activity measures" identified by DOC and DOE (see Chapter 2 for details). These additional measures tend to reflect the specifics of an agency's mission and operating environment. Nonetheless, more agencies may pursue a similar approach in the future, as they become more familiar with the initiatives that the "first mover" agencies are taking.

The Issues Still Outstanding

● Agencies recognize the widespread interest of policymakers and other stakeholders in identifying and counting the benefits that arise from the investment of public resources in R&D. Some agencies have indicated plans to expand their abilities to better track the downstream results of the technology transfer they initiate. Yet, as ever, doing so in a comprehensive way faces both resource and analytical challenges that remain hard to overcome.

The downstream outcomes that most vividly indicate the success of federal lab technology transfer activities (e.g., a commercially successful new product or process) are often several developmental stages and considerable calendar time downstream from the federal lab's technology transfer relationship with an outside party. Also, not all technology transfer relationships yield success that so visible. As a practical reality, most federal lab technology transfer offices do not have the resources to maintain comprehensive databases over a long period of time to track all relevant developments arising from the transfer of federally funded research and development. For better or worse, the case study method, based in large part on anecdotal knowledge of successful downstream outcomes, remains the prime information tool in this realm.

Some efforts are underway to better use patent databases (in the United States and abroad), which are increasingly comprehensive and accessible via Internet channels, to systematically assess benefits resulting from the transfer of federally funded research and development.[37] However, patents cover only part of the full scope of federal lab technology transfer activities.

● What remains (as it has, for some time) the most difficult metrics challenge for the technology transfer community is to identify and put measures in place that can help technology transfer

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[37]For example, the work of the Office of Planning & Analysis in the Department of Energy's Office of Science over the last several years to bring new analytical tools to bear in assessing the performance of research programs (www.science.doe.gov/sc-5)

managers better understand the effectiveness and productivity of the programs they operate. Counts of licenses, CRADAs, royalty income, and other traditional measures are typically not difficult to assemble – although significant time and resources may be needed to establish and maintain appropriate databases, particularly where an agency's technology transfer activities are widely distributed across numerous labs. Such data can be useful in providing a picture of the priorities and depth of an agency's technology transfer activities. But these measures do not directly address questions about program effectiveness or productivity – such as how well collaborative research and development relationships with external partners are working, whether the licensing strategies employed are facilitating new technology commercialization to the maximum extent, and what return on investment is being realized from the eventual downstream outcomes. This finding is far from new, but it identifies a primary area of performance metrics where the community yet needs to make progress.