Annual Report
on
Technology Transfer and Related Technology Partnering Activities
at the
National Laboratories and Other Facilities

Fiscal Year 2004

Prepared by:

Office of Policy and International Affairs
U.S. Department of Energy

In Coordination With:

National Laboratory Technology Partnerships Working Group
Department of Energy Technology Transfer Working Group

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FOREWORD

On behalf of the U.S. Department of Energy (DOE), I am pleased to present this *Annual Report on Technology Transfer and Related Technology Partnering Activities at the National Laboratories and Other Facilities for Fiscal Year (FY) 2004*. The *Report* is prepared in accordance with the requirements of the Technology Transfer and Commercialization Act of 2000 [15USC 3710(f)1].

In FY 2004, DOE and its laboratories and facilities negotiated and executed 10,091 technology transfer-related transactions. These transactions include 610 new or active cooperative research and development agreements (CRADAs); 1,884 work-for-others projects involving non-Federal entities (NFE); 4,345 licenses of intellectual property; and 3,252 user facility agreements. In addition, DOE disclosed 1,617 inventions; filed 661 patent applications; was issued 520 patents; and logged more than 260,000 downloads of its copyrighted open-source software. Associated with these activities, DOE's laboratories and facilities reported $185 million in NFE work-for-others, $30 million of "funds-in" for CRADAs, $27 million in licensing income and nearly $11 million in earned royalties.

These activities evidence a robust technical enterprise, enabled by DOE outreach and technology partnering. While these activities are intended to facilitate research and innovation and encourage the development and transfer of emerging technologies, they also contribute to DOE missions and strengthen the technical competencies of DOE's laboratories and facilities. The extent of this work is a reflection, as well, of the continued confidence in DOE on the part of thousands of private partners who work with DOE in these ways. This *Report* describes these activities and outlines DOE's procedures for ensuring appropriate management and oversight of their conduct, in accord with prevailing policy and authorities.

This year's *Report* presents a special feature on NFE-funded work-for-others, "funds-in" CRADAs and on the disposition of income from licensing and royalties. Appendix B provides 37 examples of recent and successful technology partnerships and their outcomes. These outcomes span a broad range of research areas and DOE missions. Highlights include new technologies for homeland security, improved environmental performance, and energy supply and efficiency.

Finally, I would like to acknowledge the valued role played by the many professional practitioners of technology transfer throughout the DOE complex. I encourage them and their management to continue this excellent work. The resulting contributions add significantly to our Nation's economic competitiveness and to DOE's mission accomplishment.

Karen Harbert
Assistant Secretary
Office of Policy and International Affairs

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CHAPTER 1

OVERVIEW AND HIGHLIGHTS

The transfer of Federally-developed technologies and capabilities to non-Federal technology partners, including private firms, has been an aim of Government policy since the passage by Congress of enabling technology transfer legislation in 1980.[1] In 1989, the National Competitiveness Technology Transfer Act [2] strengthened this aim by establishing technology transfer as a mission of Federal R&D agencies, including the Department of Energy (DOE). DOE has since encouraged its laboratories and production facilities to enter into technology partnering activities with non-Federal entities as appropriate to each entity's mission, using a variety of mechanisms, including cooperative research and development agreements (CRADAs), and to patent and license intellectual property that may arise from DOE research and development (R&D).

Today, technology partnering is an active and significant component of DOE's overall mission, particularly in areas associated with its scientific, engineering and related technical activities. As authorized by DOE through provisions in its management and operating (M&O) contracts, technology transfer is now carried out at all 12 of DOE's national laboratories and at 12 other DOE research and production facilities (for a list, see page 4).

For DOE, technology partnering is important to the vibrancy of DOE's technical competencies at its research laboratories and facilities. To accomplish it mission, DOE cannot afford to home-grow or replicate all the required skills inside its own fences; rather it must have access to the rapidly evolving technical expertise and commercial technology of selected non-Federal entities, in effect "reverse technology transfer", that is, transferring know-how and technology from the private sector to the Federal sector. Also, DOE laboratories and facilities create and the contractor operating the laboratory owns intellectual property, which can only be diffused into society for public benefit if developed further and commercialized. Private companies often have more experience in getting this goal accomplished successfully. For these reasons, it is beneficial, if not essential, for DOE to find efficient and effective ways to partner with such firms.

At the same time, private firms and other non-Federal entities have found that DOE's research laboratories and facilities can provide valuable and often unique problem solving capabilities. The firms are also interested in building long-term relationships that pay dividends over time. Technology partnering can enable and facilitate productive leveraging of different but aligned motivations, benefiting both DOE and its partners, in addition to furthering Federal missions and national priorities.

Technology Partnering Goals

In 2003, DOE reissued its Order 482.1 that governs technology partnering at its laboratories and facilities. In concert with the relevant statutes in this area, DOE Order 482.1 establishes technology transfer as a mission of DOE and its facilities and sets the policy context in which

[1] Bayh-Dole (P.L. 96-517, as amended by P.L. 98-620) and Stevenson-Wydler (P.L. 96-480)
[2] P.L. 99-502

partnering is to take place, requiring of its practitioners, for example, a public purpose (i.e., a DOE mission). It established procedures to ensure fairness of opportunity, protect the national security, promote the economic interests of the United States, prevent inappropriate competition with the private sector, and provide a variety of means to respond to the private sector concerns and interests about technology partnering activities. The DOE Order assigns roles and responsibilities to various DOE organizational elements for the oversight, management and administration of DOE facility technology partnering activities. The DOE Order also sets forth a series of broad purposes for such activities. These are:

- Facilitate the efficient and expeditious development, transfer, and exploitation of Federally owned or originated technology to non-DOE entities for public benefit and to enhance the accomplishment of DOE missions;

- Leverage DOE resources, through its programs and facilities, through partnering; and

- Ensure fairness of opportunity, protect the national security, promote the economic interests of the United States, prevent inappropriate competition with the private sector, and provide a variety of means to respond to private-sector concerns and interests about facility technology partnering activities.

Technology Partnering Activities

Technology partnering can mean many things – technical assistance to solve a specific problem, use of unique facilities, licensing of patents and software, exchange of personnel, and cooperative research agreements. The most appropriate mechanism will depend on the objective of each partner. The most commonly used technology transfer mechanisms are described below:

- *Intellectual Property.* Identifying and protecting intellectual property made, created, or acquired at or by a DOE facility. This includes new invention disclosures, creation and filings of patent applications, issue of patents, copyright assertion, trademark creation, and associated monitoring and reporting. In FY 2004 there were 1,617 invention disclosures, 661 patent applications filed, and 520 patents issued.

- *Cooperative Research and Development Agreements.* Performing work for non-Federal sponsors under DOE Order 483.1. Negotiating all aspects of and entering into Cooperative Research and Development Agreements (CRADAs), performed under the National Competitiveness Technology Transfer Act of 1989. Such agreements focus on mutually beneficial collaborative research. They may involve resource commitments by each partner for its own use, or resource commitments from the non-Federal partner to the Federal partner, but no resource commitments from the Federal partner to the non-Federal partner. In FY 2004 there were 610 active CRADAs.

- *Licensing*. Negotiating and entering into license agreements and bailments that provide rights in intellectual property made, created, or acquired at or by a DOE facility, which is controlled or owned by the contractor for that facility. A license transfers *less* than ownership rights to intellectual property, such as a patent or copyright, to permit its use by the licensee. Licenses may be exclusive, or limited to a specific field of use, or limited to a

specific geographical area. Royalties and income may be associated with the licensing. In FY 2004 there were 4,345 active licenses.

- *Work-for-Others*. Performing work for non-Federal sponsors under DOE Order 481.1. WFO agreements permit reimbursable work, mostly research and development, to be carried out at DOE laboratories or facilities. This work is usually categorized into that for Federal agencies and non-Federal entities (NFE). It is the NFE work that is of interest to technology partnering in this report. For proprietary R&D conducted for NFEs, the Federal laboratory or facility is reimbursed for the full cost of the activity. Intellectual property rights generally belong to the NFE, but may be negotiated. In FY 2004 there were 1,884 Work-for-Others (WFO) agreements with non-Federal organizations.

- *User Facilities.* Making available laboratory or weapon production user facilities. User facility agreements permit non-Federal entities to conduct research and development at a laboratory or use a particular scientific facility or instrument. For proprietary R&D, the laboratory is reimbursed for the full cost of the activity. If the work will be published, cost may be adjusted. Intellectual property rights generally belong to the investigator. In FY 2004 there were 3,252 active user facility agreements.

- *Technical Consulting*. Technical consulting usually takes the form of technical assistance to small businesses, undertaken in response to an inquiry or request for such assistance from an individual or organization seeking knowledge, understanding or solutions to a problem, or means to improve a process or product. The extent of such consulting is often limited to a relatively low level of overall effort.

- *Personnel Exchanges*. These arrangements allow facility staff to work in a partner's technical facilities, or the partner's staff to work in the government laboratory, in order to enhance technical capabilities and/or support research in certain areas. Costs are typically borne by the sponsoring organization. IP arrangements may be negotiated as part of these exchanges.

Laboratories and Facilities Engaged in Technology Partnering

DOE authorizes some of its laboratories and facilities to conduct such technology partnering activities. Most of these laboratories and facilities have established formal technology transfer programs. Many also have staff dedicated to the facilitation of the administrative and negotiating processes involved in entering into agreements with non-Federal partners. This Report presents trends and analyses of the technology transfer activities at the aggregate level for DOE. It does not show individual facility data.[3]

[3] Considerable differences exist among the DOE laboratories and facilities. These differences consist of two main determinants: amount of R&D funding and type of R&D activity. Laboratories and facilities receive R&D funding from DOE's Cognizant Secretarial Offices (CSO). Each CSO exercises primary oversight, management, and administrative responsibility for technology partnering activities at the laboratories and facilities under its respective cognizance.

The laboratories and facilities authorized by DOE to carry out technology transfer activities are listed below. These 24 entities constitute the scope of data included in this Report.

- Albany Research Center
- Ames Laboratory
- Argonne National Laboratory
- Bettis Atomic Power Laboratory
- Brookhaven National Laboratory
- Fermi National Accelerator Laboratory
- Idaho National Laboratory
- Kansas City Plant
- Knolls Atomic Power Laboratory
- Lawrence Berkeley National Laboratory
- Los Alamos National Laboratory
- Lawrence Livermore National Laboratory
- National Energy Technology Laboratory
- National Renewable Energy Laboratory
- Nevada Test Site
- Oak Ridge National Laboratory
- Pacific Northwest National Laboratory
- Pantex Plant
- Princeton Plasma Physics Laboratory
- Sandia National Laboratories
- Savannah River National Laboratory
- Stanford Linear Accelerator Center
- Thomas Jefferson National Accelerator Facility
- Y-12 National Security Complex

Summary of Transactions

In FY 2004, there were 10,091 technology transfer-related transactions negotiated and executed by DOE and its laboratories and facilities. These include 3,252 user facility agreements, 1,884 work-for-others projects involving non-Federal entities, 4,345 licenses of intellectual property, and 610 new or active cooperative research and development agreements (CRADAs). In addition, DOE disclosed 1,617 inventions, filed 661 patent applications, and was issued 520 patents.

As part of these activities, DOE reported $27.3 million in licensing income, of which $10.9 million was earned royalties. A summary of FY 2004 technology partnering activities for the DOE's laboratories and facilities is presented in Table 1. Technology transfer data for the past five years is provided in Appendix A.

Successful Accomplishments

There are numerous examples of technology partnerships that reflect the successful transfer of technologies out of the laboratory and into the marketplace. For FY 2004, 37 representative accomplishments are presented in Appendix B for FY 2004.

Table 1: Summary of FY 2004 Technology Partnering Activities at DOE National Laboratories and Facilities

Technology Transfer Data Element	FY 2004
Transactions and Activities	
CRADAs, total active in the FY	610
New inventions disclosed	1,617
Patents applications filed	661
Patents issued	520
Total Licenses; Active in the FY	4,345
• Invention Licenses	1,362
• Other IP (copyright, material transfer, other) Licenses	2,983
Licenses that are income-bearing	3,236
Work-for-Others Agreements, Non-Federal Entities, Active in FY	1,884
User Facility Agreements, Active in FY	3,252
Reported Income (Thousands of Dollars)	
Total Licensing Income Received	$ 27,252
• Invention (Patent) Licenses	$ 23,321
• Other Licenses	$ 3,931
Total Royalty Income Earned	$ 10,882

Organization, Management and Oversight

DOE exercises oversight, management and administration of its technology partnering activities at its national laboratories and facilities in two ways. First, DOE's secretarial officers and heads of associated field organizations, guided by the applicable statutes and DOE Orders, set policy, establish procedure and provide oversight and accountability for all technology partnering activities at the laboratories and facilities under their cognizance. Second, DOE's "matrixed" organizations, known as working groups, assist in this effort by meeting regularly to coordinate, communicate and integrate these policies and practices into daily activity across all of the DOE sites. These working groups also provide support to, and enable consistency across, all of the DOE mission areas and program offices. These working groups also address, as appropriate, issues or concerns as may arise.

There are two DOE working groups. For DOE Headquarters and its operations and field offices, the Technology Transfer Working Group (TTWG) is composed of Federal employees appointed to represent their respective organizations. For the DOE laboratories and facilities, the Technology Partnerships Working Group (TPWG) is composed of employees from DOE headquarters and operations and field offices and DOE laboratories and facilities.

DOE Technology Transfer Working Group

At DOE Headquarters, the Technology Transfer Working Group (TTWG) is comprised of about 35 Federal employees engaged in the oversight of technology partnering or transfer activities within their R&D programs elements at DOE Headquarters, or the administrative elements at the DOE Operations offices. The TTWG provides an agency wide forum for exchange of information on current activities and a focal point, when needed, for the review, development, and integration of technology transfer policies. The TTWG serves to inform DOE headquarters and its program offices about ongoing activities and emerging issues.

The TTWG meets monthly via a teleconference. Its agenda and meeting exhibits are prepared in advance and transmitted electronically to all TTWG members. The Director of the Office of Science and Technology Policy, in DOE's Office of Policy and International Affairs, chairs the TTWG. The TTWG is co-chaired by the Assistant General Counsel for Technology Transfer and Intellectual Property, in DOE's Office of General Counsel. In addition to the 35 Federal members of the TTWG, a number of leading technology transfer managers and practitioners of the DOE laboratories and facilities, including those elected to the TPWG executive committee, are regularly invited to participate. Through these means, the TTWG builds, maintains and regularly exercises a network of communications among professionals in the Headquarters and the field.

DOE Technology Partnerships Working Group

The field-led DOE Technology Partnerships Working Group (TPWG) is comprised of more than 200 DOE-complex technology partnering practitioners. An executive committee comprised of six annually elected members, three from DOE operations and field offices, and three from DOE laboratories or facilities, lead the TPWG. The executive committee meets periodically to set and revise an annual program of activities believed to be useful to TPWG members. The executive committee also participates in the TTWG teleconferences.

The TPWG serves to address common needs of technology partnering offices and professionals across the DOE complex and facilitates in the sharing of best practices. It also provides services to the TTWG. It identifies field personnel who can contribute to ad hoc groups addressing current issues or planning activities, and ensures completion. The TPWG organizes periodic training and information exchange sessions on technology partnering. It serves as the coordinating body for gathering and compiling data to meet the needs of the DOE Annual Report. With guidance from the TTWG, the TPWG has helped organize the agenda and acquires speakers for the DOE Annual Meeting on Technology Partnering. In May 2004, the TPWG combined their meeting with the Federal Laboratory Consortium on Technology Transfer in San Diego.

Federal Multi-Agency Coordination and Liaison Activities

In addition, DOE is active in a number of interagency and liaison activities. The Director of DOE's Office of Science and Technology Policy, is designated as the DOE representative to the Federal Interagency Working Group on Technology Transfer, led by the Technology Administration, U.S. Department of Commerce. The IWG meets monthly and is attended by agency representatives and patent counsels from 17 Federal agencies. The IWG serves as an

interagency forum for the exchange of information, and means to raise, address, and coordinate issues and concerns across the Federal agencies.

Federal Laboratory Consortium on Technology Transfer

The Federal Laboratory Consortium for Technology Transfer (FLC) is formally chartered by U.S. Congress to facilitate technology transfer in the United States. Its membership draws from more than 225 Federal laboratories, including DOE's 24 technology transfer laboratories and facilities. In DOE, the Director of DOE's Office of Science and Technology Policy, and chair of DOE's TTWG, is the designated "agency representative" to the FLC. As required by statute, in FY 2004, DOE contributed funds (about $356,000), along with funds from other research and development agencies (totaling about $2.2 million), to the operations and management of the FLC. The FLC is supported by a contract between the National Institute of Standards and Technology, U.S. Department of Commerce, and the Universal Technical Resource Services, Inc., of Cherry Hill, New Jersey.

The DOE-designated agency representative of the Office of Policy and International Affairs participated in several FLC Board Meetings and the FLC annual meeting in San Diego, California in May 2004. The representative also coordinated the update and certification of voting membership lists from DOE laboratories (one voting member each).

DOE Technology Transfer Website

In March 2004, DOE completed development of a technology transfer website, as part of the Secretary of Energy's e-government initiative. The website provides the public with information on DOE's technology transfer policies, procedures, and activities. It enables public access to information regarding technologies available for licensing from the DOE Laboratories and Facilities, and serves as a comprehensive reference for technology transfer activities. The website can be found at http://techtransfer.energy.gov/. In FY 2004, there were 1,772 visits (hits) to the website.

Alternative Dispute Resolution

DOE's Office of Dispute Resolution, in DOE's Office of General Counsel, provides assistance to DOE national laboratories and facilities regarding the use of alternative dispute resolution as a means to resolve formal disputes that otherwise would require investigations or litigation. The Office assists by providing measures that range from techniques, such as partnering, processes for acknowledging and addressing differing professional opinions, and ombuds, to mediation of complaints involving intellectual property, contract, environment, grants, or whistleblower issues. Because non-Federal partners are often not familiar with Federal statutes and rules governing technology partnering, there is opportunity for confusion and misplaced expectations. It is important for DOE to communicate clearly and to be sensitive to potential complaints and disputes.

In FY 2004, ombuds at DOE's national laboratories and facilities were involved in nine potential disputes involving CRADAs, patents, licenses, WFO or other issues. One of these issues was

resolved, two were withdrawn and five are still pending. One dispute was not resolved using this process and is being addressed by other avenues.[4]

The overall rate of incidence of disputes is considered low, in light of the total number of partnering arrangements of one kind or another initiated or continued each year between a DOE laboratory or facility and a non-Federal partner. Every such arrangement may be seen as an active engagement with a partner, and an opportunity for a dispute if not handled properly. In FY 2004, there were 10,091 such active arrangements, either new or continuing.

Open Source Software

In this year's report, the number of downloads from open source software is being reported for the first time by some DOE national laboratories. Two DOE laboratories reported over 263,000 downloads of open source software in FY 2004. Of these, 231,000 downloads were reported from Argonne National Laboratory. One of Argonne's special servers, the Network-enabled Optimization Systems (NEOS) server, enables users to solve optimization problems over the Internet with state-of-the-art software and without tedious downloading and linking of code. NEOS provides access to dozens of academic and commercial optimization solvers through an assortment of Internet interfaces. Because of its ease of use, NEOS has gained widespread popularity.

Another ANL open source software is the Globus Toolkit. Globus is a fundamental enabling technology that allows the sharing of computer power, databases, and other tools securely across geographic boundaries. Its application includes resource management, data management communication, and other uses. At DOE, it is used in DOE-funded Particle Physics Data Grid, Earth System Grid, and Fusion Collaboratory. In commercial application, it is the basis for new distributed-computing strategies of computer vendors such as IBM, Sun Microsystems, and HP.

Lawrence Berkeley National Laboratory reported over 30,000 downloads of EnergyPlus, an open source software. EnergyPlus is a building energy simulation program for modeling building heating, cooling, lighting, ventilating, and other energy flows. It builds on the most popular features and capabilities of prior software packages but also includes many innovative simulation capabilities such as time steps of less than an hour, modular systems and plant integrated with heat balance-based zone simulation, multizone air flow, thermal comfort, and photovoltaic systems.

Multi-Year Trends in Key Indicators

In order to understand better the dynamics of technology transfer and technology partnering activities across the DOE complex, it is useful to examine a number of multi-year trends of a few key indicators. The data sources vary, and span various periods, reflecting data availability. Indicators selected for presentation are: (a) CRADAs; (b) invention disclosures, patent applications, and patents issued; (c) active licenses; (d) income from licenses; (e) work-for-others agreements involving only non-Federal entities (WFO from other Federal agencies are excluded); and (f) user facilities agreements.

[4] Data provided by DOE's General Counsel on Technology Transfer, Feb 24, 2005.

Cooperative Research and Development Agreements

Cooperative research and development agreements (CRADAs) are used by DOE authorized laboratories and facilities to partner with industry and other non-Federal entities. Congress authorized the CRADA mechanism in 1986 to encourage the Federal laboratories to participate in R&D partnering.

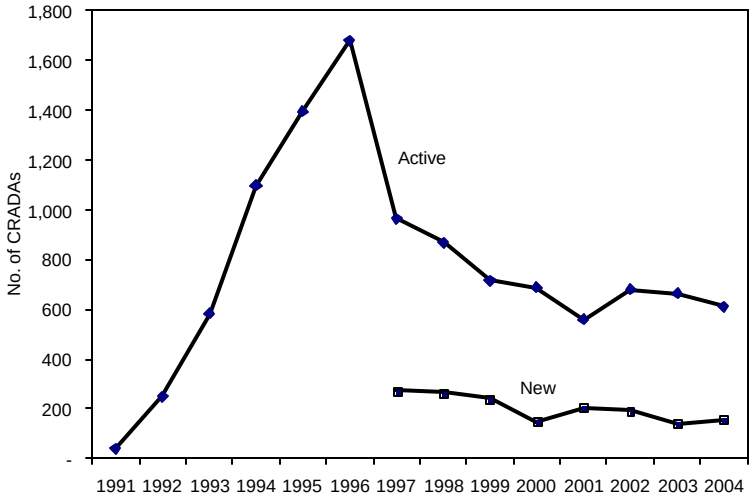

Figure 1: Cooperative Research and Development Agreements (CRADAs)

Figure 1 indicates that the number of active CRADAs peaked to just over 1,600 in FY 1996. After FY 1996, the number of CRADAs decreased by nearly 60 percent, to 558 in FY 2001. In FY 2004, the number of active CRADAs was 610. The number of new CRADAs executed by laboratories and facilities in FY 2004 was 157, and has remained steady over the recent years.

The initial growth and subsequent decline in the use of CRADAs over the entire period, from 1990 to 2004, reflects the availability of resources provided by DOE to support activities on the DOE-side of such partnerships. Early in this history, Congress, through the Technology Partnership Program (TPP) and the Laboratory Technology Research (LTR) Program, provided dedicated funding for CRADAs. The combined TPP and LTR funding peaked at $261 million in FY 1995, and then declined to zero in FY 2004.

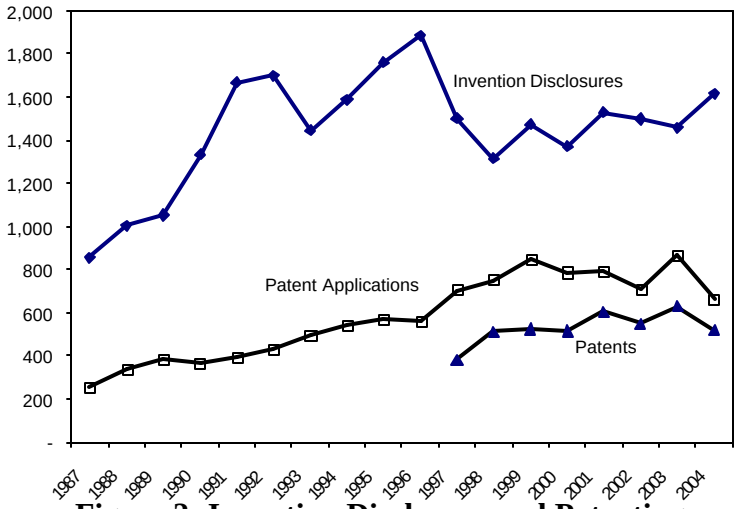

Figure 2: Invention Disclosure and Patenting

Reflecting a prevailing view within DOE that dedicated funding for these activities competed with other and more important priorities for direct mission support, the TPP Program ended in FY 2000, and the LTR program was terminated in FY 2004. Among the leaders of the DOE laboratories and facilities, the issue of resource support for CRADAs remains an issue of

concern.[5] It was addressed by DOE's Laboratory Operations Board of the Secretary of Energy Advisory Board in FY 2003.[6]

Figure 2 shows invention disclosures, patent applications, and patents issued. All three indicators continue to show fluctuation from year-to-year. Invention disclosures increased over the past six years, while patent applications and patents issued declined slightly. It is too soon to tell whether this reflects a general trend or a single occurrence.

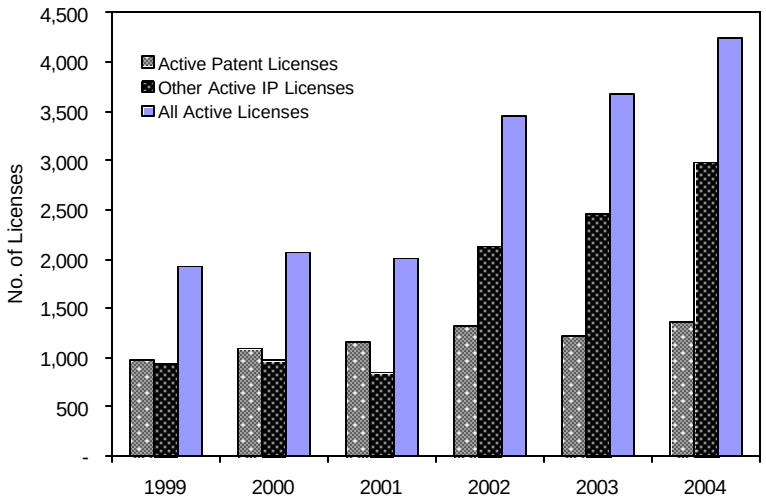

Figure 3: Licenses of Intellectual Property

Intellectual Property Management

Figure 3 presents data from 1999 through 2004 for the total number of active licenses; these are divided into two classes: patent (invention) licenses and other licenses. There were a total of 4,345 licenses for inventions and other intellectual property in FY 2004. Other licenses are attributed to licensing of copyrighted software, biological materials and other forms of intellectual property. The "other IP" licenses are now the largest category of licenses, with 2,136 in FY 2004. Copyright licenses make up the bulk of "other IP" licenses and are continuing to grow, signaling new and growing areas for future licensing activity across the DOE complex. The number of patent (invention) licenses, saw an increase over the previous year, totaling 1,362 in FY 2004.

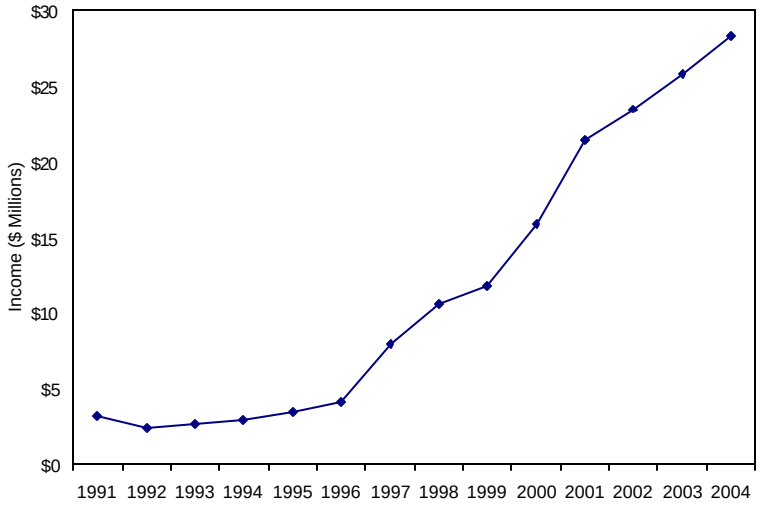

Figure 4: Income from Invention Licenses

Figure 4 shows the continuing upward trend in income from licensing of inventions, which exceeds $28 million in FY 2004. Since FY 1996, this trend has been increasing at an average of $3 million per year. DOE's

[5] U.S. General Accounting Office (2002), *Technology Transfer – Several Factors Have Led to a Decline In Partnerships at DOE's Laboratories*, GAO-02-465.
[6] Secretary of Energy Advisory Board (2002), *Recommendations Regarding Industry Partnering/Technology Transfer Within the Department of Energy*.

policies guide, and the negotiated M&O contracts specify, the uses to which this income may be applied. Section 2 focuses on how this income is used to facilitate the accomplishment of DOE's mission.

Other Technology Partnering Agreements

Figure 5 displays trends in Work-for-Others agreements with non-Federal entities (NFEs). While historical data are not available for all DOE laboratories and facilities, data are available for 12 laboratories from a recent GAO report.[7] As Figure 5 shows, technology partnering at these 12 laboratories and facilities grew rapidly, with an accompanying influx of funds from businesses and other non-Federal entities for this purpose. Work-for-Others agreements with NFEs at these laboratories grew four-fold over ten years, from 1992 through 2001. For the larger set of 24 DOE laboratories and facilities covered in this year's *Report*, including the 12 studied by GAO, the total number of Work-for-Others-NFE agreements numbered 1,884 in FY 2004.

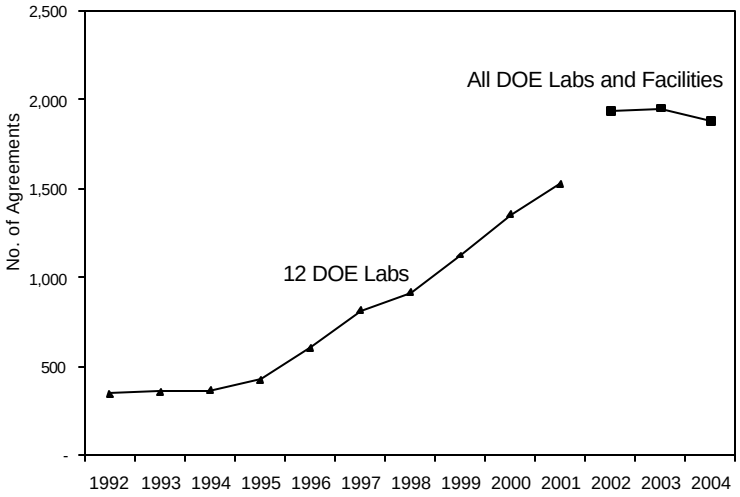

Figure 5: Work-for-Others Agreements, NFE

Figure 6 shows data on the number of partnering or project agreements negotiated at DOE scientific user facilities. These agreements provide access to unique DOE research equipment and facilities, and are regarded as another measure of technology partnering activity. In FY 2004, the second year of collecting data across the entire DOE complex, there were 3,252 active user facility agreements, down somewhat from the previous year.

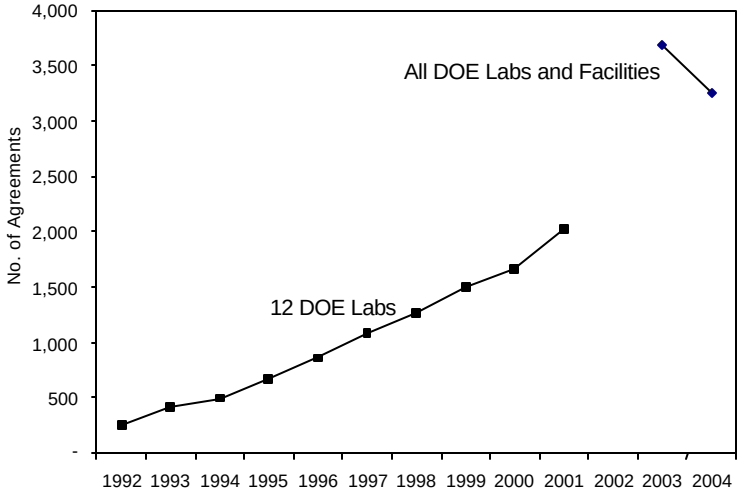

Figure 6: User Facility Agreements

[7] U.S. General Accounting Office (2002), *Technology Transfer – Several Factors Have Led to a Decline In Partnerships at DOE's Laboratories*, GAO-02-465.

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CHAPTER 2

TECHNOLOGY PARTNERSHIPS CONTRIBUTING TO DOE'S MISSION

Technology partnering, broadly defined, has emerged as a significant mechanism for the DOE laboratories and facilities to engage non-federal entities in partnering arrangements in order to advance the process of technology development and commercialization. Motivated by mutual self-interest, and notably without the transfer of Federal funds to the non-Federal partner, these arrangements provide means for collaboration and cooperation between DOE and the private sector that leverage resources and serve as useful alternatives to traditional forms of Federal interaction, such as contracting, grants and other forms of financial assistance.

Today, technology partnering is a robust and growing technical enterprise. In FY 2004, DOE laboratories and facilities, collectively, reported $185 million in funded work from non-Federal partners under Work-for-Others (WFO) agreements; $30 million in funds-in for Cooperative Research and Development Agreements (CRADAs); $27 million in licensing income; and nearly $11 million in royalty income. The application and disposition of these funds are governed by the provisions of the Management and Operation (M&O) contracts, which themselves are governed by provisions in law and by DOE policy, as promulgated by various DOE directives.

Across the Federal government, the Department of Energy ranks first in the number of licenses, second to the Department of Defense in the number of CRADAs, and second to the Department of Health and Human Services in licensing income.[8] Over the past 3 years, the Department has annually averaged more than 600 active CRADAs and about 1,900 WFO agreements with non-Federal partners. Over this same period, DOE laboratories and facilities negotiated an average of nearly 4,000 technology licenses annually with industry partners. The extent of interest on the part of business and industry is a strong indication of the excellence and engineering capabilities that serve as the primary basis for partnerships with industry.

The primary *modus operandi* of the DOE laboratories and facilities is to carry out DOE missions and programs as directed by DOE. These activities, of course, engage many external partners via contracts, subcontracts and other collaborative work arrangements. The technology partnering addressed here also further DOE missions and programs, but also benefit the non-Federal partner and the mutually beneficial arrangements themselves are typically initiated, not by DOE, but by the laboratory or non-Federal partner.

This section of the Annual Report addresses how CRADAs, WFO agreements with NFE, the associated funds-in from such CRADAs and WFOs, and income from licenses of M&O contractor-owned intellectual property and royalties income are used to benefit DOE missions and strengthen the capacities of the DOE complex. They also enable the building of partnerships and long-term relationships with NFE that promote technology development and transfer and provide DOE access to unique private sector competencies.

[8] U.S. Department of Commerce, *Summary Report on Federal Laboratory Technology Transfer*, September 2002.

Relevance to DOE Mission

DOE's mission is to "advance the national, economic and energy security of the United States; to promote scientific and technological innovation in support of that mission; and to ensure the environmental cleanup of the national nuclear weapons complex."[9] Towards achieving this mission, four strategic goals have been established:

- **Defense Strategic Goal:** To protect our national security by applying advanced science and nuclear technology to the Nation's defense;
- **Energy Strategic Goal:** To protect our national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy;
- **Science Strategic Goal:** To protect our national and economic security by providing world-class scientific research capacity and advancing scientific knowledge; and
- **Environment Strategic Goal:** To protect the environment by providing a responsible resolution to the environmental legacy of the Cold War and by providing for the permanent disposal of the Nation's high-level radioactive waste.

In addition to these mission and strategies goals, the National Competitiveness Technology Transfer Act[10] established technology transfer as a mission of all Federal laboratories. DOE has since issued directives and modified M&O contract provisions to ensure that technology transfer is an integrated component to carry out the DOE specific missions.

As a result, the DOE laboratories and other facilities with research activities now include statements on the importance of technology transfer and industry partnering in their mission statements and strategic plans. For illustration, Lawrence Berkeley National Laboratory's (LBNL) mission statement included, as one of its goals:

> "transfer knowledge and technological innovations and to foster productive relationships among Berkeley Lab's research programs, universities, and industry in order to promote national economic competitiveness."

Such goals and those more generally across the DOE-complex, emphasize the importance of technology partnerships and transfer as an integrated component of the DOE mission and larger national interests. One means of accomplishing these goals is through the embodiment of science and technology originating in the National Laboratories into new products, services, and scientific advancement, all of which are in the domain of technology transfer.

Work-for-Others with Non-Federal Entities

In FY 2004, there were 1,884 Work-for-Others agreements with non-Federal entities, totaling over $185 million of private sector funds that were received by the DOE laboratories and facilities. Using Work-for-Others (WFO) agreements, DOE can make the highly specialized or unique expertise and capabilities residing within its national laboratories and facilities available to non-Federal customers on a fully reimbursable basis. Work performed by a DOE laboratory

[9] U.S. Department of Energy, *The Department of Energy Strategic Plan*, DOE/ME-0030, September 30, 2003.
[10] P.L. 99-502

or facility under a WFO agreement is not funded by DOE, but rather paid entirely by the non-Federal entity. The objectives of a WFO agreement for non-Federal entities (NFE) are to:

- Provide assistance to NFEs in accomplishing goals that may be otherwise unattainable and to avoid duplication of effort at Federal facilities;
- Provide access to highly specialized or unique facilities, services, or technical expertise when private sector facilities are not adequate;
- Increase research and development interaction between DOE laboratories and industry to transfer technology originating out of the laboratories to industry for further development and commercialization; and
- Maintain core competencies and enhance the science and technology base at the DOE laboratories and facilities.[11]

Meeting these objectives thus provides benefits to the NFE by providing access to some of the country's most talented scientists and engineers, as well as world-class research facilities. At this same time WFO agreements facilitate DOE in meeting its strategic goals by providing a means for technology to be put into commercial use and thereby contributing to national security, energy security, and environmental improvement. Work-for-Others agreements also contribute to enhancing science and technology capabilities of the DOE laboratories. To illustrate how WFO agreements make these contributions, a few examples are provided below:

- *Consortium for Electric Reliability Technology Solutions.* Lawrence Berkeley National Laboratory (LBNL) uses Work-for-Others (WFO) agreements as a partnership tool to support DOE's goal of "energy security" with many sponsors. The California Energy Commission (CEC), for example, funds numerous projects in the areas of energy efficiency and energy reliability. A major project is the LBNL-led Consortium for Electric Reliability Technology Solutions (CERTS), which develops and disseminates new methods, tools, and technologies to protect and enhance the reliability of the U.S. electric power system and functioning of a competitive electricity market. One specific approach to this problem is the development of effective control systems for "microgrids" which consist of: (1) end-use equipment (including electricity- and heat-using devices); (2) distributed power systems (e.g., fuel cells, micro turbines, co-generators, photo voltaic arrays); (3) electricity storage devices (e.g., batteries, flywheels, capacitors); and (4) a hierarchy and variety of information, communication, power electronics, and control systems. The result of the assessment will be the identification of technological needs to make the microgrid a widespread commercially viable enterprise.
- *Macromolecular Crystallography Facility.* LBNL has succeeded in supporting the DOE's "science strategic" goal by bringing private sector WFO partners into the Berkeley Center for Structural Biology. Companies have contributed to the capital construction and operating costs of beamlines in the Macromolecular Crystallography Facility at the Advanced Light Source. The diffraction patterns collected at the beamlines allow solutions of structures of proteins and other molecules that were heretofore unknown.

[11] U.S. Department of Energy, *Work For Others (Non-Department of Energy Funded Work)*, DOE Order 0 481.1C.

- *Synthetic Aperture Radar*. Unlike more conventional electro-optical radar systems, Synthetic Aperture Radar (SAR) provides a day/night, all-weather imaging capability. Sandia National Laboratories (SNL) supports DOE's "national security" goals by performing research and development activities on SARs since the early 1980s. This activity grew from roots in nuclear weapon radar fuzing and has continued under the sponsorship of DOE; a number of Department of Defense agencies, including the U.S. Navy and the Defense Threat Reduction Agency; and DOE's Laboratory Directed Research and Development Program (LDRD) throughout the past two decades. In the mid-1980s, private industry began providing additional support for the development of a commercial product. In 1996, General Atomics began a long-term relationship with SNL that is still active today, funding Work-for-Others agreements focused on advancing this technology. As a result, SNL has successfully performed in another aspect of its national security mission through leadership in high resolution, miniature, highly responsive SAR.

- *Advanced Turbine Systems.* In supporting the goal of providing "environmentally sound energy," Argonne National Laboratory (ANL) is working with Siemens Westinghouse Power Corporation in its development of advanced gas turbine system. The advanced turbine system is designed to achieve efficiencies well beyond current commercially available technology. To achieve such efficiencies, however, requires higher gas-firing temperatures in the hot sections of the turbines, necessitating the development of new advanced materials systems. Two approaches are evolving, one based on ceramic composites and another directed towards thick thermal barrier coating for metal substrates. Siemens Westinghouse has selected oxide/oxide ceramics as a material system for its work. In a project funded by Siemens Westinghouse, ANL has developed several nondestructive testing technologies that allow estimation of the "health" or condition of these oxide/oxide components. These technologies involve special x-ray computed tomographic imaging and special infrared thermal imaging technologies. Siemens-Westinghouse now relies on the ANL to establish go/no-go decisions about insertion or re-use of components.

These are only a few examples of using WFOs in meeting DOE mission and goals. Another mechanism, funds-in CRADAs, offer similar examples.

Funds-In CRADAs

In FY 2004, about $30 million of private sector funds were received by the DOE laboratories and facilities for the execution of various technology partnering arrangements, one being a "funds-in" CRADA. Such arrangements were undertaken with the intent of meeting the mission of the DOE (and its laboratories and facilities) and benefiting the non-Federal partners.

A CRADA is a legal agreement between a government laboratory and one or more non-Federal parties in which participants agree to provide personnel, services, facilities, or equipment for conducting collaborative research and development. When the Department funds a cost-shared CRADA, those funds can only be used for laboratory staff, facilities and equipment. No federal funding is provided to the industry partner by the laboratory. In a "100 percent funds-in" CRADA, the industry partner pays for 100 percent of the costs, including the laboratory's staff, facilities and equipment. A few examples of 100 percent funds-in CRADA partnerships are highlighted below. The following examples illustrate the motivation and the benefits of utilizing

such mechanisms to advance technology development and to enhance the technical competencies of the DOE participants.

- *Partnership with Goodyear Tire and Rubber Company*. SNL' decade-long partnership with Goodyear Tire and Rubber Company is illustrative of how a funds-in CRADA support development of capabilities in computational mechanics and reliability engineering under DOE/NNSA's weapons manufacturing programs. These capabilities also have commercial application. Under this partnership, Goodyear realized improved tire development and manufacturing performance. Specifically, it: (1) developed and validated computation mechanics (finite element) tools for predicting structural, thermal, and fluid response of their tire and manufacturing systems; (2) enhanced its understanding of elastomeric materials; (3) developed and verified models used in predicting vibration of tires during rotation; and (4) extended its understanding of manufacturing processes. SNL in turn, further developed its computational sciences capabilities, which are essential to fulfilling its missions in weapons design and development. Through its CRADA with Goodyear, SNL improved its simulation tools and expanded its integration in design and qualification activities, improved systems performance of defense weaponry, and enhanced its understanding of materials aging, and manufacturing processes.

- *Initiative for Proliferation Prevention.* Lawrence Livermore National Laboratory is working under a CRADA with the United States Industry Coalition (USIC) and Valley Forge Composite Technologies, Inc., as part of a DOE/NNSA Initiative for Proliferation Prevention (IPP). The IPP is designed to enhance U.S. national security by engaging former Soviet Union scientists, engineers, and technicians to redirect their expertise to peaceful work through partnerships with U.S. industry. The purpose of the CRADA is to develop equipment and procedures for detecting explosive materials concealed in airline checked baggage and cargo. The technology can also be extended to detect nuclear materials, or chemical and biological agents, illegal drugs, and other hazardous contraband that may be shipped via air, sea, or land. The results from this project are expected to benefit and support the objectives of both DOE and the Department of Homeland Security.

- *Technologies for Light-duty Trucks.* Another example is the United States Advanced Battery Consortium (USABC), where the Big Three automobile manufacturers – General Motors, Ford, and DaimlerChrysler – formed a partnership with DOE to develop technologies for use in light-duty electric vehicles. In the early 1990's, this effort was expanded to include hybrid electric vehicles, and in 2001 to include fuel cell electric vehicles. This ongoing partnership is supporting development of the compact, lightweight, high-performance energy storage systems. Advances in the past are now evidenced in current hybrid car technology. Further enhancements are expected to benefit tomorrow's electric and hybrid electric vehicles — including those powered by fuel cells.

- *Development of Lithium Battery Technologies.* ANL entered into several CRADAs with the USABC and other industrial partners to advance the development of the lithium battery technologies. The U.S. auto industry chose not to pursue the development of elevated-temperature lithium battery technologies, but to focus instead on R&D efforts on the ambient-temperature lithium-ion (Li-Ion) battery system. Argonne currently leads a major multi-lab DOE-funded program to overcome remaining key barriers to commercializing this energy storage technology for hybrid electric applications. Many international auto

companies have demonstration hybrid electric vehicles that use high-power Li-Ion batteries and full commercialization is expected in the future. These advances are also beneficial to DOE's energy security mission, which includes finding ways to advance technology in order to reduce vulnerabilities to use on transportation, energy efficiency, and improve environment quality.

- *Risk Assessment of Geologic Carbon Sequestration.* As a final example, LBNL provided important contributions to the nascent field of risk assessment of geologic carbon sequestration under a CRADA with the energy company BP-Amoco. The CRADA enabled LBNL to conduct research on leakage of carbon dioxide from subsurface storage areas. Important results included determining that carbon dioxide seeping slowly from the ground will tend to be dispersed by wind, although concentrations can build up to high levels in the subsurface. In addition, it was demonstrated through modeling that carbon dioxide can be removed from the subsurface by standard pumping technologies. Carbon capture and sequestration is one of a number of strategies being pursued by DOE's Office of Fossil Energy to respond to climate change concerns. The research with BP-Amoco contributed to DOE's understanding of geologic storage of carbon dioxide as part of a greenhouse gas mitigation strategy.

Disposition of Income from Licensing and Royalties

In FY 2004, DOE laboratories and facilities reported receiving about $27 million in licensing income and about $11 million earned royalties. This income must be disposed in accordance with applicable statutes such as 35 USC 202 (c) (7) and 15 USC 3710a(b)(5), as implemented through the M&O contract provisions found at 48 CFR 970.5227-3. As required by the contract provisions, the income is divided among the inventors and the laboratory. The inventor's share is determined by the laboratory operating contractor with DOE approval and typically ranges from 15-35 percent of gross royalties received, with research institutions and corporate M&O contractors providing a lower share, with universities paying a higher share. The remainder of net royalties is retained by the M&O contractor for use at the laboratory, and must be used for scientific research, development, technology transfer, and education, consistent with the research and development mission and objectives of the Laboratory. The Laboratory contractor oftentimes distributes a portion to the laboratory division or program where the inventions are created and to others who contributed to an invention.

The DOE laboratories and facilities have used this authority to expend income in developing creative and innovative approaches that advance the development of promising technologies from a conceptual state to a proof-of-concept or prototype stage. The following examples illustrate the ways that income funds support the Department's mission and toward achieving its goals:

- *Upgrade Advanced Photon Source User Facility.* In support of DOE's science goals, ANL has used royalty funds to upgrade the Advanced Photon Source User Facility Beam Line. New computer workstations, new chillers for cooling sensitive instruments, new instrumentation, and other equipment, and these upgrades enable the research community to conduct basic research and provide improved x-ray analytical capabilities and material sciences.

- *Technology Maturation Fund*. Thee Los Alamos National Laboratory's Technology Maturation Fund (TMF) illustrates how royalty funds can also be used to further develop the technology and attract potential investors in maturing the technologies. The TMF was established to support technologies that are perceived to have high, but unproven, commercial potential. Since the program's inception in December 2002, 23 maturation projects have been funded in amounts ranging from $15,000 to $50.000. One project was the electrochromic rear-view mirror using ionic liquid technology that has as better durability and coloration evenness than conventional mirrors. The mirrors were built and tested in the lab and in automobiles. ElextroChromiX Inc. (ECX), an automobile engineering firm, exclusively licensed patents for the electrochromic rear-view mirror and is now pursuing large-scale manufacturing.

- *Center of Entrepreneurial Growth.* In a third example, Oak Ridge National Laboratory's (ORNL) Center of Entrepreneurial Growth (CEG) illustrates how royalty funds are used to support the growth and long-term development of start-up companies through a multi-stage process, from start-up through early technology validation and market acceptance. The CEG concept has been successful, and other CEGs have been established in other communities in Tennessee. In one case, ImTek, Inc. was founded by two ORNL employees who licensed laboratory technology for small animal imaging. The technology converts two-dimensional views into three-dimensional images of the internal structure of small test animals, such as mice. Because it can image living animals and, as such, eliminates the need for euthanasia, a test subject can live and undergo subsequent imaging studies. This then allows researchers to determine the effectiveness of experimental therapeutic drugs. Commercial sales of the technology have exceeded $2 million, and sales in 2004 were expected to exceed $4 million. ImTek recently was selected to receive the Federal Laboratory Consortium to Technology Transfer's "Project of the Year" award for the Southeast region.

- *Fan Airfoil Technology Development.* The National Renewable Energy Laboratory (NREL) used its royalty income to further develop a fan airfoil technology in association with licensing partners. The airfoil technology was derived from the wind airfoil development program and used in developing fans for large air conditioners and chillers at industrial installations. Royalty funds were used to modify the airfoil designs for chiller fans, resulting in a three to eight percent energy efficiency improvement over existing fans. This significant improvement results in large saving to the owner. The data obtained from the testing and development has helped NREL market this technology to industrial partners.

- *Royalty Returned to Innovator Teams.* As a final example, the Pacific Northwest National Laboratory (PNNL) distributes net returns of royalty income back to the innovator teams that were instrumental in developing the technology that generated the royalty income. The funds are allocated with the intention that the money will be used to inspire and promote the creation of similar successful technologies for commercialization. Many investments have been made, including rapid prototyping equipment and capabilities, updating laboratories needed to support industrial business opportunities, and to support software products and additional capability development of benefit to commercial and government clients. A fundamental objective is to reinvest in those teams that have been responsible for generating technologies with strong commercial benefit in the past. As a second priority, funds are used for technology maturation opportunities, but only after demonstrating that the investment can

be leverage with third party investment funds, from a source closer to the market opportunity. Finally, a portion of the funds is allocated by the Laboratory toward crosscutting strategic investments with broad benefit to the Lab's capabilities.

Conclusion

Technology partnering mechanisms, including WFOs with non-Federal entities, funds-in CRADAs, authority to license intellectual property and collect and dispose of associated income and royalties, add valuable dimensions of technical vibrancy to DOE laboratories and facilities, as well as advance DOE science and technology missions. By partnering with industry, a synergy is created whereby the DOE laboratories and facilities gain access to new capabilities and competencies that contribute to their missions, and non-Federal partners see ways to advance technical knowledge in their respective businesses. Technology is advanced to the marketplace, where its adoption furthers DOE missions and business goals. As the examples in this section and those in Appendix B illustrate, the synergistic nature of technology partnerships serves to advance many innovative technologies that otherwise might not have been realized.

APPENDIX A

TECHNOLOGY TRANSFER INDICATORS FOR FISCAL YEARS 2000-2004

The Technology Transfer Commercialization Act of 2000 (P.L. 106-404) requires each Federal agency that operates or directs Federal laboratories (or engages in patenting or licensing of Federally owned inventions) to provide the Office of Management and Budget (OMB) with an annual report on its technology transfer plans and recent achievements. A copy is also provided to the Technology Administration Office of the Department of Commerce. The Secretary of Commerce then prepares an overall Federal assessment for the President and Congress based on the program information in these agency reports. Specific data requirements to be reported each year are established by the Department of Commerce.

In accordance with the OMB's reporting guidelines, DOE's technology transfer data for fiscal years 2000-2004 are shown in Table 2 below and continues on the following pages.

Table 2: Department of Energy's Technology Transfer Activities, Fiscal Years 2000-2004

	Fiscal Year				
	FY 2000	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**
Collaborative Relationships for Research & Development					
• **CRADAs**, total active in the FY [12, 13]	687	558	680	661	610
▪ New, executed in the FY	151	204	192	140	157
• Traditional CRADAs, total active in the FY	--	--	--	nr	nr
▪ New, executed in the FY	--	--	--	nr	nr
• Non-traditional CRADAs, total active in FY	--	--	--	nr	nr
▪ New, executed in the FY	--	--	--	nr	nr
• **Invention Disclosure and Patenting**					
• **New Inventions** disclosed in the FY	1,371	1,527	1,498	1,469	1,617
• **Patent Applications** filed in the FY	788	792	711	866	661
• **Patents issued** in the FY	515	605	551	627	520

[12] "Active" refers to those agreements in force anytime during the fiscal year.
[13] CRADAs involving collaborative research and development by a Federal laboratory and non-Federal partners.

Table 2 Con't.	Fiscal Year				
	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Licensing					
Profile of Active Licenses[14]					
• **All Licenses**, number total active in the FY	2,070	1,162	3,459	3,687	4,345
▪ New, executed in the FY	169	226	694	711	616
▪ Invention licenses, total active in the FY	1,094	1,162	1,327	1,223	1,362
- New, executed in the FY	169	226	206	172	168
▪ Patent licenses, total active in FY	1,094	1,162	1,327	1,222	1,362
- New, executed in the FY	169	226	206	171	168
▪ Material transfer, total active in FY	--	0	0	0	
- New, executed in the FY	--	0	0	0	0
▪ Other invention licenses, total active in FY	--	--	--	--	0
- New, executed in the FY	--	--	--	--	--
▪ Other IP licenses, total active in the FY	976	843	2,132	2,464	2,983
- New, executed in the FY	--	--	488	539	449
- Copyright licenses (fee bearing)	--	--	1,525	1,823	2,136
New, executed in the FY	--	--	332	348	217
- Material transfer, total active in FY	--	--	581	604	794
New, executed in the FY	--	--	153	180	208
- Other (bailment agreements, trademarks, etc.)			26	37	53
New, executed in the FY			3	11	24
All Income Bearing Licenses [15] total active in FY	--	1,012	2,523	2,523	3,236
▪ Exclusive	--	174	301	246	255
▪ Partially exclusive	--	112	136	235	638
▪ Non-exclusive	--	726	2,086	2,042	2,343
• **Invention Licenses**, income bearing	--	--	1,123	1,056	1,151
▪ Exclusive	--	--	263	215	223
▪ Partially exclusive	--	--	123	196	189
▪ Non-exclusive	--	--	737	645	739
• **Patent Licenses**, income bearing	--	--	1,123	1,056	1,151
▪ Exclusive	--	--	263	215	223

[14] For DOE reporting, "invention" and "patent" licenses are synonymous.
[15] "All income bearing licenses" are equal to the sum of "invention licenses" and "other IP licenses."

Table 2 Con't.	Fiscal Year				
	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
▪ Partially exclusive	--	--	123	196	189
▪ Non-exclusive	--	--	737	645	739
• **Other IP Licenses**, income bearing	--	--	1,400	1,467	2,085
▪ Exclusive	--	--	38	31	32
▪ Partially exclusive	--	--	13	39	449
▪ Non-exclusive	--	--	1,349	1,397	1,604
▪ Copyright licenses	--	--	1,173	1,352	1,993
- Exclusive	--	--	29	25	30
- Partially exclusive	--	--	7	35	448
- Non-exclusive	--	--	1,137	1,292	1,515
▪ Other (material transfer, bailment, trademark)			227	115	92
- Exclusive			9	6	2
- Partially exclusive			6	4	1
- Non-exclusive			212	105	89
All Royalty Bearing Licenses[16] total active in FY	220	1,012	2,523	2,523	3,236
• **Invention Licenses**	--	--	1,123	1,056	1,083
• **Other IP Licenses**	--	--	1,400	1,467	2,085
- Copyright licenses			1173	1352	1,993
- Other (material transfer, bailment, trademark)			227	115	92
Licensing Management					
• **Elapsed Execution Time** (calendar days), licenses granted in FY					
▪ Invention licenses					
- average (or median)	--	--	127	133	62
- minimum	--	--	8	8	0.5
- maximum	--	--	471	745	1,777
▪ Patent licenses					
- average (or median)	--	--	127	133	62
- minimum	--	--	8	8	0.5
- maximum	--	--	471	745	1,777
• **Number of Licenses Terminated** for cause in FY					
▪ Invention licenses					
- Patent licenses	--	60	77	35	31

[16] For this report, "all royalty bearing licenses" are the same as "all income bearing licenses."

Table 2 Con't	Fiscal Year				
	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
License Income ($ thousands)					
• **Total Income**, all licenses active in FY	$15,840	$21,403	$23,477	$25,805	$27,252
▪ Invention licenses	$12,710	$18,922	$21,253	$23,670	$23,321
- Patent licenses	--	--	$21,253	$23,670	$23,321
▪ Other IP licenses, total active in the FY	$2,836	$1,870	$2,223	$2,136	$3,931
- Copyright licenses	--	--	$1,870	$2,101	$2,678
• **Total Earned Royalty Income** (ERI)	$2,228	$7,832	$5,609	$6,612	$10,882
▪ Median ERI	--	--	$4	$3	$4
▪ Minimum ERI	--	$0.002	$0.023	$0.003	$0.004
▪ Maximum ERI	--	$1,585	$794	$913	$2,600
▪ ERI from top 1% of licenses	--	$2,699	$1550	$1,478	$3,977
▪ ERI from top 5% of licenses	--	$5,272	$3,696	$3,789	$8,837
▪ ERI from top 20% of licenses	--	$7,163	$4,571	$5,962	$12,743
• **Invention Licenses**			$5,310	$6,064	$9,581
▪ Median ERI	--	--	$6	$5	$5
▪ Minimum ERI	--	--	$0.025	$0.003	$0.006
▪ Maximum ERI	--	--	$794	$913	$2,600
▪ ERI from top 1% of licenses	--	--	$794	$1,478	$3,977
▪ ERI from top 5% of licenses	--	--	$3,419	$3,197	$7,299
▪ ERI from top 20% of licenses	--	--	$5,068	$5,363	$10,729
• **Patent Licenses**			$5,310	$6,064	$9,581
▪ Median ERI	--	--	$6	$5	$5
▪ Minimum ERI	--	--	$0.025	$0.003	$0.006
▪ Maximum ERI	--	--	$794	$913	$2,600
▪ ERI from top 1% of licenses	--	--	$794	$1,478	$3,977
▪ ERI from top 5% of licenses	--	--	$3,419	$3,197	$7,299
▪ ERI from top 20% of licenses	--	--	$5,068	$5,363	$10,729
• **Other IP Licenses**			$1,300	$1,693	$1,301
▪ Median ERI	--	--	$1	$1	$2
▪ Minimum ERI	--	--	$0.023	$0.010	$0.004
▪ Maximum ERI	--	--	$69	$168	$197

Table 2 Con't.	Fiscal Year				
	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
▪ ERI from top 1% of licenses	--	--	$69	$168	$197
▪ ERI from top 5% of licenses	--	--	$115	$316	$498
▪ ERI from top 20% of licenses	--	--	$197	$480	$660
▪ Copyright licenses					$1,300
- Median ERI	--	--	$2	$1	$2
- Minimum ERI	--	--	$0.023	$0.010	$0.004
- Maximum ERI	--	--	$69	$168	$197
- ERI from top 1% of licenses	--	--	$69	$168	$197
- ERI from top 5% of licenses	--	--	$100	$272	$498
- ERI from top 20% of licenses	--	--	$187	$480	$659
Disposition of License Income ($ thousands)					
• **Income Distributed**					
▪ Invention licenses, total distributed	--	$16,356	$16,423	$19,540	$18,622
- To inventors	--	$5,942	$6,386	$5,624	$4,398
- To other	--	$10,414	$10,036	$13,916	$14,224
▪ Patent licenses, total distributed (see note)	--	$16,356	$16,423	$19,540	$18,622
- To inventors	--	$5,942	$6,386	$5,624	$4,398
- To other	--	$10,414	$10,036	$13,916	$14,224
Other Technology Partnering Measures[17]					
▪ Work-for-Others Agreements (non-federal), active in FY			1,934	1,952	1,884
▪ User Facility Agreements, active in the FY				3,688	3,252
▪ Open Source Software Downloads [18]					263,381

Notes:
-- = Data were not requested.
nr = Data are not reported by DOE

[17] Data not required by OMB but collected by DOE for an additional measure of technology partnering activities.
[18] Includes data from two DOE national laboratories only; Argonne National Laboratory and Lawrence Berkeley National Laboratory.

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APPENDIX B

SELECTED ACCOMPLISHMENTS

There are many examples of technology transfer and industry partnering activities that reflect successful programs at DOE national laboratories and facilities. The following are examples of 37 successes, presented below to illustrate the range and nature of DOE technology transfer activities across the DOE complex. A brief description of each of these examples follows the list below.

- Adaptable Radiation Area Monitor (ARAM) Sodium Iodide Radiation
- Advanced Process Engineering Co-Simulator
- Aerosol Duct Sealing Technology
- Annular Feed Air Breathing Fuel Cell Stack
- Bio-refinery Pilot Process
- Cancer Treatment Technology
- Cepheid's SmartCycler® and GeneXpert® systems
- Chromium project
- Composite Materials for Cargo Containers
- Cumbres & Toltec Scenic Railroad
- Cybersecurity Software Technology
- Decade-long Technology Partnership
- DOE Labs, Universities and Second Sight Partner to Speed Development of Artificial Retina
- Electrodynamic Ion Funnel
- Explosives Detection Personnel Portal
- GP-254 Mercury Removal Process
- Ground Autonomy Platform Enabler (GAPE)
- Inductively Coupled Plasma/Mass Spectrometry Technology
- In Situ Hydrogen Detecting Sensor
- Micro-machined Inertial Sensors and Systems
- Micropower Impulse Radar (MIR) Technology
- Millimeter Wave Holographic Body Scanner
- Multilayer Dielectric (MLD) Diffraction Gratings
- Nano-generation Solar Cells
- Nano-scale Semiconductor Crystals
- Novel chemical sensing technologies for safety
- Pathogen Detection System
- Polymer Coating for Chemical Detection
- Probe Measures Algal Toxins
- RadScout Radiation Detector and Analyzer
- Rule Engine for the Java Platform
- Single-Chain Antibody Library
- SMART System for Radiation Detection
- Soil Gas/Groundwater Sampling Technology
- Technology Maturation Fund
- Technology Screening Initiative
- Website Security Software

Adaptable Radiation Area Monitor (ARAM) Sodium Iodide Radiation Spectrometer Technology

Lawrence Livermore National Laboratory (LLNL) signed a license with Innovative Survivability Technologies to commercialize the Adaptable Radiation Area Monitor (ARAM) Sodium Iodide Radiation Spectrometer technology. ARAM is an automatic, portable system that can detect small amounts of radiation from a distance, even if moving as fast as 70 miles per hour. It is designed to pick out low-energy gamma rays and neutron emissions characteristic of weapons-grade plutonium and highly enriched uranium against a background of naturally occurring radiation. ARAM's time-lapse design permits accurate detection of radiation in fast-moving vehicles or containers, while also permitting smooth flow of traffic and commerce.

While LLNL finalized the multitude of copyright and patent issues related to ARAM, Innovative Survivability Technologies continued development of the technology for commercialization and to meet the stringent requirements of a California state agency. This technology transfer activity fills an essential need for the nation by engaging the commercial sector to make ARAM technology available to those in the public sector responsible for fast, accurate detection of "dirty bombs" and other radiological weaponry. To date, 12 units have been delivered for deployment at California border crossings and another 12 units will be delivered by the end of 2004.

Advanced Process Engineering Co-Simulator

The Advanced Process Engineering Co-Simulator (APECS) is an integrated software suite that combines the power of process simulation with high-fidelity computational fluid dynamics (CFD) for improved design, analysis and optimization of process engineering systems. To facilitate effective technology transfer, developers decided at the beginning of the process to design the APECS system using commercial CFD and process simulation software integrated with the process-industry standard interfaces. A cooperative R&D project between the National Energy Technology Laboratory (NETL), Fluent, and other partners delivered an advanced process engineering co-simulator for the process industries at the end of FY 2003.

For companies in the process industries, the coupling of CFD and process simulation tools can deliver important business benefits by enabling engineers to develop superior plant designs and to optimize existing plants. At NETL, this breakthrough capability allows system analysts to better understand and optimize the fluid mechanics that drive overall power plant performance and efficiency. APECS is now being marketed commercially as the Aspen-Plus FLUENT Integration Toolkit. The result of the APECS technology transfer effort was a commercial software product and services offered by Fluent and Enductive Solutions in FY2004. As evidence of its strong commercial potential, R&D Magazine recognized the Aspen-Plus FLUENT Integration Toolkit as one of the top 100 most technologically significant new products and advancements introduced into the world marketplace in 2004. In July 2004, the CFD and process co-simulation toolkit achieved its first commercial success when a major chemical company purchased training and a software license. The customer's process engineers are using the toolkit to analyze the impact of reactor mixing and fluid flow on overall plant product quality and yield. In the power industry, Alstom Power engineers are routinely employing the APECS technology to design commercial-scale power plants.

Aerosol Duct Sealing Technology

Aerosol duct sealing technology developed at Lawrence Berkeley National Laboratory (LBNL) has been licensed by the world's largest manufacturer of air conditioning equipment, Carrier Corp., to seal leaks in both residential and commercial HVAC systems. The aerosol transport and deposition system seals leaks internally and reaches those that would otherwise be inaccessible, increasing building comfort and helping to reduce heating and cooling energy use by up to 30 percent. The Electric Power Research Institute estimates that duct sealing procedures like this could result in annual energy savings of up to $300 per home, resulting in national savings of approximately $30 billion. Commercial buildings offer even more significant opportunities for energy savings.

Scientists and engineers at LBNL pioneered a technology that injects a fog of aerosolized vinyl polymer particles into a pressurized duct system. The particles stay suspended in the air stream without coating the duct surface until they reach the leaks, where they are deposited and build up at the leak edges until the leaks are sealed. The original technology developed for residential use has been successfully adapted to operate efficiently in the complex HVAC systems of large commercial buildings. In one of its first commercial building trials, the process sealed 77 percent of air leakage in the duct system.

LBNL licensed its small building duct sealing technology to startup company Aeroseal in 1997. The company soon completed commercial development and embarked on a franchising program. Carrier has since acquired Aeroseal and formed Carrier Aeroseal, which licensed the LBNL technologies for large commercial building duct sealing and accelerated residential duct sealing. Approximately 60 franchises are in operation nationwide and thousands of homes throughout the United States have been sealed. Carrier Aeroseal also uses LBNL technology to offer diagnostic and post-sealing measuring capabilities and the sealing work can be conducted with minimal disruption to building users. The nature of the LBNL technology has also enabled Carrier Aeroseal to offer diagnostic and post-sealing measuring capabilities and to seal buildings with minimal disruption to users.

Annular Feed Air Breathing Fuel Cell Stack

Los Alamos National Laboratory (LANL) staff executed a Non-exclusive License Agreement with the Japanese company Daido Metal Co., Ltd., a bearing manufacturer. The company has also developed a fuel cell for cellular phones and is currently marketing lighting fixtures and toy cars powered by fuel cells. The company is also working with Honda Motor on the development of capacitors as a supplementary power source for fuel cell automobiles. The license with LANL covers U.S. patent rights to a portion of its fuel cell portfolio entitled "Annular Feed Air Breathing Fuel Cell Stack." LANL scientists developed the unique, cylindrical fuel cell design that is ideal for low-voltage, low power applications such as flashlights, laptop computers, remote-controlled toys and radios.

Bio-refinery Pilot Process.

A $7.7 million CRADA brought together the National Renewable Energy Laboratory (NREL) and DuPont to collaboratively develop, build, and test a bio-refinery pilot process that will make fuels and chemicals from the entire corn plant, including the fibrous material in the stalks, husks,

leaves, and the starchy material in the kernels. The agreement is part of the larger $38 million DuPont-led consortium known as the Integrated Corn-Based Bioproducts Refinery (ICBR) project. The ICBR project—which includes DuPont, NREL, Diversa Corporation, Michigan State, and Deere & Co.—was awarded $19 million in matching funds from the DOE to design and demonstrate the feasibility and practicality of alternative energy and renewable resource technology.

This technology initiative will develop the world's first fully integrated bio-refinery, which will be capable of producing a range of products from a variety of plant-material feedstocks. Current bio-refineries produce a range of products mainly from starch-rich or protein-rich biomass, while other bio-refineries start with a variety of vegetable oils. Operating like a conventional refinery, the ICBR will make use of the entire corn plant. Purified sugars from the corn kernel will be the primary source of value-added chemicals, while the remainder of the corn plant—commonly called "the stover"—will be converted into fuel-grade ethanol and electrical power.

It is anticipated that one of the chemicals produced by the ICBR biorefinery could be 1,3 propanediol (PDO), the key building block for DuPont's Sorona®—the company's newest polymer platform—which can be used in applications such as textile apparel, carpeting, and packaging.

Cancer Treatment Technology

Cancer Treatment Alpha particle immunotherapy is a groundbreaking technology that makes it possible to treat some types of cancer more effectively and with fewer side effects than conventional treatments, including chemotherapy, radiation therapy and surgery. Immunotherapy combines the power of alpha particle-emitting radioactive isotopes, such as actinium-225 and bismuth-213, with monoclonal antibodies that bind to and destroy specific cancer cells, while sparing nearby healthy tissues.

While researchers at Pacific Northwest National Laboratory (PNNL) developed the enabling chemistry, the primary supplier of the radioisotopes is MedActinium, a small radiopharmaceutical firm in Tennessee. MedActinium holds an exclusive license to the new technology, which allows them to develop immunotherapy products and bring the therapy closer to full-scale clinical use.

Cepheid's SmartCycler® and GeneXpert® systems

Cepheid develops, manufactures, and markets fully-integrated systems that perform genetic analysis, including DNA and RNA analysis, for the clinical genetic assessment, biothreat, and life sciences markets. Cepheid's SmartCycler® and GeneXpert® systems, based on LLNL technology, can perform a broad range of genetic tests that include identifying infectious organisms and evaluating at-risk populations for the early detection of disease. Cepheid's instrument provides for genetic detection possible in minutes, all from unprepared samples.

In July 2004, Cepheid announced that it has executed a non-exclusive distribution agreement with Gene Company for distribution of Cepheid's products in the clinical research and life sciences markets in China and Hong Kong. The agreement is a non-exclusive, three year term for distribution of Cepheid's SmartCycler® Systems. The SmartCycler® System, also based on LLNL technology, is a rapid, real-time thermal cycler used for identifying DNA/RNA from

prepared biological samples. The SmartCycler® delivers highly accurate and consistent test results in as little as 20 minutes.

In May 2004, Cepheid announced that it has been awarded a grant from the National Cancer Institute to validate the use of the GeneXpert® platform for the fully integrated, rapid isolation and detection of tumor markers in tissue sections. The GeneXpert® system is suited for this type of test because of its automated sample processing capability, its ability to detect multiple RNA sequences in the same reaction, and its speed.

Chromium project

A collaboration of LLNL, with Stanford University, the University of Virginia, and Tungsten Graphics, Inc., was started to harness a revolution in computer graphics for PCs in the form of scalable commodity clusters for large, parallel computer applications. In 2004, *LinuxWorld* magazine singled out Chromium software in a list of influential open source graphics tools. Chromium is an application-transparent software library that supports extensible, distributed-memory, parallel, OpenGL graphics rendering to individual or tiled displays on commodity (off-the-self PC) clusters. Its standard-based design and Open Source availability allows Chromium to provide a common, portable environment for new visualization applications.

Chromium provides a number of key capabilities, uniquely combined into a single package: (a) novel method for synchronizing parallel graphics commands; (b) "streaming" graphics pipeline based on the industry standard OpenGL graphics; (c) support for multiple physical display devices clustered together, such as "powerwall" displays; (d) support for aggregation of the output of multiple graphics cards to drive a single display at higher level of performance/capability; and (e) application-transparent plug-in mechanism supporting custom graphics pipelines.

Since its public release, the Chromium infrastructure has been adopted by a large number of users and is rapidly forming the basis of a great deal of clustering research. There have been over 18,000 downloads of the software, and it has been adopted by several large software vendors for a wide variety of applications. In 2004, the Chromium technology was recognized by *R&D Magazine* as one of the 100 most technologically significant new products of the year by winning an R&D 100 Award.

Composite Materials for Cargo Containers

A long-standing, multi-agreement relationship between Sandia National Laboratory (SNL) and a Rio Rancho, New Mexico company, Aerospace Composite Structures, LLC (ACS), has helped develop a product line that is revolutionizing air freight containers.

The early research conducted among the company and SNL largely revolved around the commercial application of U.S. weapons technology, advanced aircraft development and the Strategic Defense Initiative National Defense Project. Efforts to commercially deploy advanced material technology resulted in the identification of a composite whose characteristics of reduced weight and extraordinary durability made it uniquely suited for use in the production of air transportable freight and baggage containers.

ACS then pursued the objective of developing materials, designs, and processes for commercial application. After over four years of research, ACS has developed a new generation air cargo container utilizing composite materials. This new container offers increased strength, excellent impact resistance, easy repair, and reduced heat conductivity when compared to aluminum. ACS units have been certified by the Federal Aviation Administration (FAA) and the European Joint Aviation Authority (JAA). The company has delivered over 100 containers to Aer Lingus and is currently delivering over 250 units to Virgin Atlantic Airways. The Rio Rancho plant, which now employs 33 people, is expected to grow to 100 employees, in addition to the sales staff at John F. Kennedy Airport and sales agents in Asia and Europe.

The thermoplastic composite material is a low cost, high impact and damage tolerant material with exceptional durability, environmental stability and chemical resistance. It is easily thermoformed into sandwich panel structures with integral formed edges and fastening characteristics. This design approach eliminates much of the traditional post and beam structural framework of existing containers, thus, loads are carried by the panel itself instead of the frequently damaged corners and edges. ACS products substantially reduce repair costs and can be easily repaired on site rather than being transported to a repair station. This ease of repair plus a simple procedure for disassembling containers for flat-load shipping and storage will significantly reduce carrier costs, specifically in the area of container maintenance and logistics.

In March 2003, ACS became a wholly owned subsidiary of AeroBox, PLC, a UK based holding company whose shares are traded on the London Stock Exchange. Over 15 airlines based in the United States, South America, Europe, Africa, the Middle East, and Asia have been testing over 100 units since the first deliveries in September 2003. Additional airlines are joining the tests of this evolutionary product. ACS has been asked to submit sales quotes to airlines in the United States, South America, and the Middle East.

Cumbres & Toltec Scenic Railroad

LANL transferred several pieces of high-tech equipment that it no longer needs into the Cumbres and Toltec Railroad's machine shop to help the 19th-century railroad operation enter the 21st century. LANL's donations to the railroad's machine shop are part of an economic development plan to turn the railroad (the economic engine for the 2,100-person town) into a year-round tourist attraction. The first step is the creation of a welding and metallurgy certification program and training center at the machine shop. It is a collaborative effort among LANL, SNL, Northern New Mexico Community College, the Regional Development Corporation; and the railroad. The goal is to build a work force that specializes in repairing and refurbishing historic narrow-gauge locomotives and their parts. The railroad will be able to do virtually all machine work in-house instead of sending out parts, saving both time and money. The ultimate goal is for the railroad to be self-sustaining, not having to rely on Colorado and New Mexico for financial support. Lt. Gov. Diane Denish, whose office has been working closely with LANL and the Railroad Commission, says both New Mexico and Colorado are trying to get the Cumbres & Toltec designated a National Historic Scenic Railroad to receivet federal funding.

Cybersecurity Software Technology

PNNL has licensed a prototype program for systems administrator simulation training (SAST), a program that rapidly evaluates the cyber security experience of system administrators to identify, circumvent or recover from hacker activity. The program consists of a network of training tools that simulate the cyber environment and are launched through an automated system. The licensee of SAST is an independent software vendor and professional consulting services company that addresses the rapidly expanding IT security, IT compliance, and regulatory compliance marketplace for enterprise customers.

Decade-long Technology Partnership

For decades, DOE has invested in Engineering Sciences at SNL for application to weapons programs. Through these investments and those of other federal and nonfederal partners, SNL has developed advanced tools for computational mechanics and reliability engineering methodologies applicable to all aspects of weapons development and manufacturing processes.

Through a partnership with Goodyear Tire and Rubber Company, SNL has validated its methodologies and made them more robust for SNL's high-reliability applications. Working with Goodyear allows SNL to apply reliability analysis and optimization tools from the initial design through manufacturing phases; an exceptional opportunity to advance the state of the art.

Specific outcomes of the relationship include developing and validating computational mechanics (finite element) tools for predicting structural, thermal, and fluid response of viscoelastic systems during manufacturing and use; enhancing understanding of elastomeric materials; developing and verifying models to predict vibration of rotating systems; and understanding and simulating advanced manufacturing systems.

SNL applies its validated simulation capabilities to DOE/National Nuclear Security Administration (NNSA) mission work in weapon component performance; system performance, including radiation effects, reentry, penetration/laydown, flight, transportation, and storage; materials aging, including corrosion solder fatigue, polymer embrittlement, stress voiding, and adhesion ceramic failure; system response to credible events; and manufacturing, including encapsulation, brazing, forging/forming, welding, and soldering.

In a recent Cooperative Research and Development Agreement (CRADA), SNL and Goodyear collaborated on a project that applies reliability methodologies and capabilities to manufacturing processes, including total asset effectiveness encompassing the total life cycle of all equipment components, including optimized equipment availability, production effectiveness, and quality. Another project under that CRADA addressed passive sensing, which allows low-cost miniature sensors without their own source of power to be queried at a distance. Besides Goodyear's automotive applications, the technology is a platform that can be used to detect a variety of substances and conditions, making it a technology of interest to NNSA. The project provides SNL an opportunity to apply and demonstrate the technologies over a wide range of environments and production constraints.

DOE Labs, Universities and Second Sight Partner to Speed Development of "Artificial Retina"

Five DOE national laboratories, a private company and three universities have executed a CRADA, and associated licensing agreements, to speed the design and development of an artificial retina that could potentially help millions of people blinded by retinal diseases. The agreements allow Second Sight Medical Products Inc., to obtain a limited exclusive license for inventions developed during the artificial retina project.

Under the research agreements, the institutions will jointly share intellectual property rights and royalties from their research. The artificial retina could help those blinded by age-related macular degeneration or retinitis pigmentosa where neural wiring from the eye to brain is intact, but the eyes lack photoreceptor activity. The artificial retina is a device that captures visual signals and sends them to the brain in the form of electrical impulses.

Using the unique resources of the DOE national laboratories in materials sciences, micro-fabrication, microelectrode construction, photochemistry and computer modeling, the project's goal is to construct a device, capable of restoring vision, with materials that will last for the lifetime of a blind person. DOE's Office of Science plans to fund the artificial retina project at $20 million over the next three years as part of its medical applications technology program. Additional information on the artificial retina project is available at www.science.doe.gov.

Electrodynamic Ion Funnel

The PNNL-developed Electrodynamic Ion Funnel significantly improves the sensitivity of analytical instruments such as mass spectrometers by improving the focusing and transmission of gaseous ions. Sensitivity is a key measure of the analytical value of a mass spectrometer. Enhanced sensitivity allows, for example, the detection of many new proteins from blood plasma and the possibility of discovering new biomarkers for the early detection of cancer.

Through non-exclusive licensing agreements, PNNL has transferred the technology to three companies— Waters Corp., Milford, Mass., and Bruker Daltonics, Bellerica, Mass., manufacturers of mass spectrometers; and Biospect, San Francisco, Calif., which is developing a new class of instruments for human clinical applications.

Explosives Detection Personnel Portal

For the difficult problem of detecting trace explosives on personnel, SNL used a systems approach to integrate sample collection and preconcentration, detection, and operator notification. The resulting Explosives Detection Personnel Portal is a walk-through system for rapidly screening personnel for trace amounts of explosives. The portal uses a SNL-patented air-flow design and air sampling technique to capture trace explosives. The system has demonstrated 90 percent efficiency in collecting explosives particles.

A chemical sensor called an ion mobility spectrometer recognizes the chemical signatures of a variety of explosives. If a person has even a minute amount of explosive residue on his or her skin or clothing, an alarm displays on an adjacent computer screen. SNL's preconcentration technology solved the problem of the "mismatching inlet flows"—commercial detectors have relatively small inlet flows compared to the volume of air that must be generated to obtain a head-to-toe sample from a person.

The Explosives Detection Personnel Portal was designed to prevent terrorist acts and to save lives. Unlike bulk explosives detection technology, which looks for the actual bomb, trace detection looks for bomb indicators—traces of contamination on the person who has handled the explosives. Whether the terrorist has packed explosives in his or her checked baggage, or is hiding explosives underneath clothing, the trace explosives detection process can single that person out. While the FAA (and now the Transportation Security Administration) saw the need for an explosives detection personnel portal in airports and funded the development of the prototype, the agency also saw the need for quick technology transfer to enable mass production on a commercial scale. The technology transfer recipient was originally Barringer Instruments, Inc., a company that specialized in security tools, especially explosives detection, via its desktop detector, the IONSCAN®. Commercialization began under Barringer's lead and continued after Barringer's acquisition by Smiths Detection.

GP-254 Mercury Removal Process

Through developments in the mercury research, the NETL scientists have patented a novel technique to enhance the removal of elemental mercury from flue gas. The technique uses the capability of mercury to photochemically react in the presence of ultraviolet light of a specific wavelength, a less costly process than similar processes being used today. A license was signed by Powerspan and NETL for commercial development of the NETL GP-254 Process for application to coal-burning power plants. Powerspan has successfully demonstrated the technology at bench-scale at its New Hampshire facility, with over 90 percent oxidation and removal of elemental mercury from simulated subbituminous flue gases. Powerspan will build and test at least one GP-254 pilot-scale unit at a host power plant in 2005, and plans to have the technology ready for sale in time for the expected final federal regulations in 2007. New markets may be developed for the manufacture/installation of ultraviolet lamps, and engineering design and development of the GP-254 Process for coal-burning power plants.

Many U.S. power plants burn abundant and locally available low value coals. The mercury contained within the flue gases from these power plants is predominantly difficult to remove. The GP-254 Process is designed to allow for a high level of mercury removal from the flue gases derived from the combustion of these important, inexpensive, and locally available U.S. coal. The GP-254 Process will enable utilities to economically remove a large percentage of elemental mercury from flue gas in a simple manner. Removal of mercury from coal-derived flue gases may reduce the bioaccumulation of mercury within the food chain. This would be a great benefit for the American public, especially the population most susceptible to mercury toxicity, pregnant woman and young children.

Ground Autonomy Platform Enabler (GAPE)

The Ground Autonomy Platform Enabler (GAPE) CRADA effort focused the expertise of Lockheed Martin Corporation and SNL on an investigation of key technologies and strategies for autonomous land navigation. The team considered perception of obstacles, vehicle localization, path planning, and system requirements during the 21-month effort. New algorithms to classify objects as detected by vision and ranging sensors were developed that can be used for path planning. Techniques for locating the vehicle using data from on-board sensing without the aid of GPS were developed. State-of-the-art video compression was applied to narrow-band radio transmission and demonstrated on unmanned ground vehicle (UGV) platforms. The

government's requirements and operational tactics for unmanned systems were deconstructed into lower-level requirements for hardware and software entities.

The collaborative project resulted in a design for a custom LAser Detection And Ranging (LADAR) sensor which, when built, should achieve unsurpassed performance for UGV applications. SNL has already integrated some of these technologies into existing projects and will continue to apply it in the areas of Emerging Threats and Nonproliferation and Material Control.

One possible future application might be that of a "robo-scout" autonomous vehicle that could be used singly or in swarms for reconnaissance missions in high risk locations such as heavily fortified or mined areas where human scouts or Special Forces would be at risk. A potential use is mapping highly radioactive contaminated areas such as DOE nuclear waste sites, settling tanks, or during decommissioning of DOE nuclear reactors where human health physics technicians would be at risk of significant exposure to ionizing radiation.

In an emergency response mission, these technologies will enable or enhance the ability of response teams to remotely (more safely) and rapidly search areas for radioactive and special nuclear materials, insert precision instrumentation for device diagnosis, field communication gear to assure rapid transmission of the data to experts, and to enable precise, remote, direct action on a device. Likewise, it will enable safer, rapid recovery of samples in a post-detonation situation to determine the nature and origins of the device. This technology base will also enhance unattended autonomous systems able to gather surveillance data in remote areas. By enhancing an inspector's ability to reposition sensors to collect critical monitoring data, this technology can support treaty verification through the use of remote control of surveillance robots from half-a-world away.

Inductively Coupled Plasma/Mass Spectrometry Technology

PNNL's development of the Inductively Coupled Plasma/Mass Spectrometry (ICP/MS) Collision/Reaction Cell (CRC) Technology has resulted in a new generation of elemental and isotopic analysis instruments. CRC removes interferences, enabling the mass spectrometer to better detect and measure environmentally significant metals, such as heavy metals, toxic pollutants and radionuclides, compared with conventional technology. The CRC technology, which can be used by environmental monitoring and testing firms, semiconductor manufacturers, forensics laboratories, pharmaceutical companies and agencies involved in national security, will enable faster, more cost-effective characterization of samples and materials.

The technology has been licensed to ThermoElectron, Waltham, Mass., and Agilent Technologies, Palo Alto, Calif., manufacturers of high-performance elemental analysis instruments. Today, more than 60 percent of ICP/ MS instruments sold incorporate PNNL's CRC technology.

In Situ Hydrogen Detecting Sensor

H2scan Corporation manufactures and sells sensor devices for the detection and measurement of hydrogen. Using a sensor technology licensed from SNL, and working in collaboration with SNL through a CRADA, H2scan has developed a small, *in situ* sensor with the capability of detecting hydrogen down to 10 parts per million (ppm) and up to 100 percent. With its unique

design and low price point per unit, H2scan is poised to deliver its sensors to over 200 government and industry customers.

SNL's sensor technology was initially licensed by a company called DCH Technology in 1996. This technology used a field effect transistor/resistor combination on the same die and promised to deliver a sensor with the capability of detecting hydrogen from 10 ppm to 100 percent. At the time, nothing like it existed on the market. In 2002, DCH Technology sold off its hydrogen sensor assets.

H2scan Corporation acquired the technology from DCH Technology and chose to collaborate with Sandia under a CRADA. H2scan developed its first retail product based on SNL's patents, a hand-held hydrogen leak detector with the capability of detecting hydrogen from 10 ppm to 100 percent. By August 2004, the company introduced a fixed area monitoring product based on SNL's capacitor/resistor technology. H2scan's sensors are cost effective, fast, extremely sensitive, and can operate in a wide range of extreme conditions and works with or without the presence of oxygen.

Micro-machined Inertial Sensors and Systems

For a number of years, SNL and Northrop Grumman Electronic Systems Division (NGESD) have collaborated to design, model, simulate, develop, prototype, and evaluate new micromachined inertial sensors and systems for use in military and aerospace applications. SNL brings to the partnership its well-developed expertise in fabricating microelectromechanical systems (MEMS) using several processing methods. Under this CRADA, the focus was on the bulk silicon micromachining process and DOE/NNSA's programmatic interest in guidance/control of weapon systems.

SNL's defense programs encompass a wide range of experiments and monitoring that require the level of precise location information that can be delivered by inertial navigation systems. In all of the systems, a very small, rugged, low-power, highly reliable, and low-cost Inertial Measurement Unit (IMU) will provide the foundation for SNL's ability to achieve the desired system capability. SNL's internal program has leveraged the work with NGESD to support and enhance the laboratories' ongoing efforts to develop an IMU that provides improved performance and reliability.

The work with NGESD greatly increases the laboratories' expertise in the dynamic modeling and simulation of very small mechanical systems made from silicon. These capabilities directly benefit SNL's work in the Nuclear Weapons and Military Technologies & Applications Strategic Management Units. This work also advances SNL's precision fabrication capability to assure that it will continue as a leader in the microelectromechanical systems (MEMS) area.

Micropower Impulse Radar (MIR) Technology

GE Security (formerly GE Interlogix, and a division of General Electric Company) manufactures motion sensors for industrial and home security and has developed an advanced system based on LLNL Micropower Impulse Radar (MIR) technology. GE Security obtained rights to the MIR technology through its purchase of Interlogix from Berwind Corporation. In 2004, GE Security announced the availability of its RCR-90 motion sensor. The addition of the RCR-90 to the company's dual technology PrecisionLine series offers customers a better choice for broader

coverage in commercial applications like auditoriums, cinemas, ballrooms, and large classes. PrecisionLine dual technology motion sensors offer new, easy solutions for the most challenging residential or commercial applications. Using a sophisticated combination of precision controlled radar and passive infrared technologies, the sensors provide extensive motion detection coverage. The PrecisionLine dual technology sensors cover anything from 9 to 90 feet and thousands of units are sold every year. GE security has operations in more than 25 countries.

Millimeter Wave Holographic Body Scanner

The Millimeter Wave Holographic Body Scanner for Custom Fitting Apparel is a patented novel holographic imager that creates a 360-degree high-resolution 3-D scan of a body in less than ten seconds. Intellifit Corporation in Philadelphia has licensed the technology to create a scanner that uses the PNNL-developed technology to illuminate the fully clothed human body and create a true measurement of the body.

By creating accurate measurements of consumers, Intellifit allows designers to understand their customers' shapes, sizes and proportions, and intends to help manufacturers worldwide create better fitting off-the-rack clothing as well as custom-fit apparel. The technology has the potential to minimize product markdown, alterations and returns, which represent over $150 billion annually for the U.S. apparel market. The harmless millimeter waves penetrate clothing and reflect off the body, sending signals back to a transceiver. The signal is then sent to a high-speed computer, which creates a high-resolution image of the body.

Millimeter wave holographic scanning and imaging technology also has the potential for use in security applications. Safeview, Inc. of Santa Clara, Calif., has commercialized the technology for use in security applications in aviation, prisons, government and commercial buildings, and border crossings. The technology can quickly show the presence of non-metallic threats such as plastic and ceramic weapons as well as metal objects, and can minimize the need for personal body searches.

Multilayer Dielectric (MLD) Diffraction Gratings

Jobin Yvon, Inc. reported its first commercial sale of the Multilayer Dielectric (MLD) Diffraction Gratings in December 2003. Short pulse laser systems require the use of Diffraction Gratings to stretch a laser pulse for amplification and then to compress the pulse back to its original shape. LLNL's MLD Gratings perform this stretching and compressing function with higher efficiency and with a higher damage threshold than traditional gold Diffraction Gratings.

Jobin Yvon signed a license with LLNL for this technology in June 2002 to enable Jobin Yvon to supply diffraction gratings to universities, companies, and U.S. government research and development laboratories. The technology is useful for developing multi-wavelength laser systems such as those used in telecommunications systems with short-pulsed and pulse-compressed lasers.

Nano-generation Solar Cells

Nano-generation solar cells invented at LBNL combine the best properties of inorganic and organic materials to lower the production costs of photovoltaics while offering high efficiencies

and more creative applications. Products based on the hybrid inorganic nanocrystal/organic polymer solar cells are being developed by Nanosys, a LBNL–MIT start-up company that has garnered an investment of $850,000 from the National Science Foundation and significant venture capital backing because of the technology's promise. Within the next few years, Nanosys solar cells are expected to attain a conversion efficiency of 15 percent and to produce electricity at less than $1 per watt - a cost that is competitive with conventional power generation. Presently, photovoltaic energy costs between $5 and $30 per watt.

The LBNL hybrid solar cell technology offers the excellent, well established electronic properties of inorganic semiconducting materials with the less expensive production costs and the flexibility of conducting plastics, which can be fashioned into virtually any size or shape on virtually any material, including glass, plastic, and clothing. These hybrid devices have higher efficiencies than photovoltaics made only with polymers, yet are much less expensive and easier to manufacture than their semiconductor counterparts.

Nano-scale Semiconductor Crystals

Quantum Dots (Qdots), nano-scale semiconductor crystals that emit a range of bright colors when excited by a light source such as a laser, are shining brightly these days. LBNL developed technology has been licensed by Quantum Dot Corporation and is being used as fluorescence probes for biomedical assays. The technology just won an R & D 100 Award and Quantum Dot Corporation was named by *Fortune* magazine as one of 2004's "Cool Companies." *Science* honored the technology as one of the Top 10 Breakthroughs of the Year in 2003, and *Nanotechnology Now* named Quantum Dots as the Best Nanotech Product in 2003, among other honors.

Quantum Dot Corporation (QDC) is a 1998 start-up biotechnology company which licensed nanocrystal technologies developed at LBNL. Due to their unique light emitting properties, Qdots are superior to dye molecules now in use since they allow the simultaneous, color-coded identification of multiple cell structures. The LBNL technology was first optioned to Quantum Dot in 1998 and then exclusively licensed to them in 1999. Qdots were commercially available in 2002.

QDC has risen over $37.5M in venture capital financing. This has been supplemented by corporate partnerships and major government grants, and product revenue is ramping up. Quantum Dot Corp. recently announced the award of a $2 million grant from the National Institute of Standards and Technology to develop clinical grade quantum dots with initial applications in ocular and cancer imaging.

In a groundbreaking application, Researchers at Max Planck Institute in Germany recently used Quantum Dots to capture movies of cells transmitting messages. The dramatic video images mark the first time researchers have been able to see moving images of a cell's basic means of communication with its environment. Quantum Dots are expected to help pharmaceutical companies speed the process of drug development.

Qdots have potential applications in genotyping, DNA expression analysis, protein expression analysis, DNA sequencing, biological assays, imaging systems, research instrumentation, and optical bar-coding of chemical and biological materials, tagging systems, and high-throughput

screening. Quantum Dot Corporation has already developed products and services that speed the process of drug discovery and development.

Novel chemical sensing technologies for safety

Development of novel chemical sensing technologies, and especially novel sorbents for surface acoustic array (SAW) sensors, is a long standing aim of researchers at PNNL. Arising out of this work is a patented novel hydrogen bonding polymer sorbent directed towards the detection of nerve agents that has recently been licensed by Battelle, operator of PNNL, to BAE Systems Integrated Defense Solutions.

BAE Systems uses this polymer in the "JCAD *Chem Sentry*™" (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.

Pathogen Detection System

LLNL signed a CRADA with GE Ion Track, Inc. (GEIT) a wholly-owned subsidiary of General Electric Company, to develop a commercial prototype of the Autonomous Pathogen Detection System (APDS), an instrument that monitors the air for all three types of biological threat agents (bacteria, viruses and toxins). This technology can potentially perform multiple analyses for multiple pathogens, either chemical or biological, in real-time. LLNL also signed a license with GE Ion Track, Inc. to transfer LLNL's APDS technology to GEIT for commercialization. LLNL will combine its extensive research and development on autonomous pathogen detection with GEIT's expertise in developing and manufacturing commercial production instruments for security applications. In 2004, the Autonomous Pathogen Detection System technology was recognized by *R&D Magazine* as one of the 100 most technologically significant new products of the year by winning an R&D 100 Award.

Polymer Coating for Chemical Detection

A unique polymer coating, BSP3, developed by PNNL, can be used in chemical detector systems to detect airborne chemical agents, such as nerve agents, that might be used in terrorist attacks. BSP3 coats the surface of a sensor chip in the detector and absorbs vapor molecules from the air for detection by the sensor. Compared to its predecessor, BSP3 made sensors four times more sensitive to nerve agents and in some systems has enabled faster detection at lower concentrations than was previously possible. Sensors with this coating could be used to monitor air quality in subways and buildings, and to protect first responders at terrorist or chemical incidents.

Probe Measures Algal Toxins

Scientists at Excite Optics Corporation and the Savannah River National Laboratory (SRNL) have designed a field deployable instrument that could provide rapid measurements of algal toxins in aqueous matrices. By applying a molecularly imprinted polymer (MIP) to a surface plasmon resonance (SPR) probe, the researchers developed a new sensor to detect and quantify these potentially harmful toxins.

Formed from cyanobacteria, algal toxins have a wide variety of economic impacts that include the costs of public water monitoring, short- and long-term losses of aquaculture shrimp and fish stocks, losses of submerged aquatic vegetation, and medical treatment of exposed populations. Of particular interest is the cyanobacterial toxin known as microcystin-LR for which World Health Organization guidelines have been established for water treatment plants. There is a need for a rapid field deployable instrument to replace laboratory methods that are costly and time-consuming.

Funded by an Environmental Protection Agency Small Business Innovative Research grant, Excite Optics produced and tested a thin film that can be applied to a fiber optic probe lens that can detect and quantify a microcystin toxin. Using SRNL's patented SPR technology, Excite Optics was able to successfully complete its Phase I feasibility study. By preparing gold-coated microscope slides with blank and microcystin-specific MIPs (ms-MIPs), the company was able to generate profiling data by SPR imaging to show that the toxin could be detected. Also, by coating ms-MIPs on the tip of the SRNL SPR probe, the company was able to sense the presence of toxin in spiked lake water samples. Future work is expected to generate calibration data and determine durability and sensitivity.

RadScout Radiation Detector and Analyzer

In 2004, ORTEC, a business unit of AMETEK, Inc., reported its first commercial sale of its new instrument for homeland security, the radiation detector and analyzer device known as the "Detective." LLNL signed a license with ORTEC in April 2003 to commercialize LLNL's RadScout radiation detector and analyzer. RadScout represents a breakthrough in radiation detection and identification technology. RadScout is a handheld radiation detector that identifies the type of radioisotopes present in a location with the precision that until now was only found in large laboratory instruments.

ORTEC has produced three different units in the Detective product line which is the first commercialized radiation detector manufactured with its capability, and it responds to a critical need of first responders in every field. The Detective reduces existing bulky equipment to a compact, lightweight, battery-powered device that can be permanently mounted or fully portable and can be operated by workers or first-responders with minimal additional training. This technology won the 2004 Federal Laboratory Consortium (FLC) Award, which recognizes achievement in technology transfer in the federal laboratory sector. ORTEC is currently negotiating with the Department of Homeland Security for proposals addressing use of the RadScout technology in portal monitors for use at international ports.

Rule Engine for the Java Platform

A tool for building a type of intelligent software has been developed by SNL scientists. Called Jess, the Rule Engine for the Java Platform, is a set of rules that can be repeatedly applied to a collection of facts about the world. Jess is a declarative programming environment that lets the programmer describe the problem explicitly; Jess then decides what steps to follow to reach a solution. Users of Jess can build Java software that has the capacity to "reason," using knowledge the user supplies in the form of declarative rules.

Jess has been licensed for use by local, state, and federal government agencies, academic laboratories, classrooms, and public and private commercial entities from small start-ups to Fortune 50 companies. Jess's problem-solving abilities have been applied to an extremely varied range of problems in the technology, insurance, and financial services industries, and in academic artificial intelligence research. The source code is available to licensees, making Jess an attractive choice where security, mission-criticality, or customization is paramount.

As of September 2004, SNL has issued in excess of 1,500 licenses granting rights to use Jess source code. More than 1,450 of these licenses were issued to business entities, each with anywhere from five to 500 individual users. These users in turn may develop, design, and implement operating systems, products, and applications that benefit tens or even hundreds of thousands of end users.

This technology transfer effort has resulted in a continually improved commercial software application that fills a critical need in information technology development. Jess has been applied in numerous areas and its impact has been far-reaching. There are more than 1,500 Jess licensees in total with a minimum of 25 licenses pending at any given time.

Single-Chain Antibody Library

The Single-Chain Antibody Library, developed by PNNL provides researchers with a user-friendly expandable library of over one-billion artificial antibodies. These are produced from brewer's yeast and offer an inexpensive method for creating antibodies for medical and biological research. Antibodies are used in cancer therapy to seek out specific proteins in cancerous cells and direct therapy to those cells, and can be used in biowarfare sensors to detect proteins of harmful agents. The Single-Chain Antibody Library could replace the current practice of using animals to produce antibodies and could tailor medical treatments more accurately to an individual's immune system. The Department of Homeland Security has provided funding for the application of the library to security technologies and has been recognized it as a valuable tool to the Department of Homeland Security for the detection of antibodies in bioterrorism weapons and to the National Cancer Institute for bio-marker development.

SMART System for Radiation Detection

The SMART system detects radioactive materials passing within a few meters of the detector. It automatically identifies the radioactive isotope(s), including mixed sources, in real time and indicates the level of confidence (low, fair, high) that the material has been identified correctly, with particular attention paid to identification of special nuclear material (SNM). A video imager captures the image of the person or vehicle carrying the radioactive material when the detector alarms. The SMART system consists of commercial hardware (gamma-ray and neutron detectors) combined with customized electronics and software developed at SNL. FitToDB is copyrighted software for isotope identification and PASSBY is copyrighted software for command, control, and communication of isotope identification data.

The SMART systems will be a key component in the protection of military assets and the homeland. The systems, when fully commercialized and proven, can be deployed in environments, for example military bases, high-profile civilian sites, and transportation hubs that

could be targets for terrorist nuclear attacks. The commercial licensee, Thermo Electron, is the recipient of the transferred technology.

Four programs are in place for commercializing and deploying the SMART systems. License agreements with Thermo Electron Corporation, Radiation Measurement & Protection business unit have been in place since May 2003 for the FitToDB and PASSBY software. Thermo Electron is incorporating the SNL software into existing Thermo Electron hardware platforms.

The licensee, Thermo Electron, is conducting market research and assessing possible applications at U.S. ports. Thermo Electron is also building eight units for use by the Defense Threat Reduction Agency (DTRA), who has deployed the systems at military bases, and has contracted with SNL to supply additional units.

Using licensed SNL software, Thermo Electron plans to combine SNL algorithms with existing Thermo Electron algorithms to create a value-added platform, based on the proprietary Thermo Electron architecture. The ThermoX-Channel architecture, combined with SNL intellectual property, will yield the ultimate system for detecting and unambiguously identifying radionuclides in motion. This will result in a revolutionary new approach to detecting and identifying isotopes, with superior background compensation over a wide variety of background (shielding) conditions, combined with superior pile-up rejection and dead-time compensation. X-Channel architecture will also, in the future, allow several detectors (rad/nuc, chem, bio, etc.) to be supported off a single-board architecture, yielding simplicity and total integration of multi-analyte detectors. The ultimate goal is to scan/monitor 10,000 containers/day per location at a vehicular speed of three mph.

Thermo Electron has invested significantly in market research, identified several port/border locations, tested/demonstrated setup locations, and taken opportunities to team with three other major DOE labs to validate performance in the field (at port/border/airport locations, police departments, first responders), in order to ultimately generate customers, sales, and use. A number of these activities are tied to NA-25, Department of Homeland Security Second Line of Defense missions. In addition to these projects, Thermo Electron plans to team with three different major systems integrators in their ongoing product development and deployment efforts. All this represents a significant financial commitment on the part of Thermo Electron to make the total effort an unqualified success.

Soil Gas/Groundwater Sampling Technology

To lower drilling costs and reduce investigative-derived waste, the SRNL developed the Depth Discrete Sampling Port (DDSP). This invention collects subsurface water and/or soil gas samples and transports them to the surface for analysis. The DDSP is designed to collect simultaneous samples from multiple locations within a single borehole. Traditional methods for obtaining subsurface samples from variable depths involve the installation of "cluster wells," including individual wells for each depth to be sampled. The use of the DDSP reduces the number of bore holes, the volume of well construction materials, and the amount of investigative-derived waste. Drilling and waste disposal costs are typically reduced by a factor of three to five over conventional methods.

Under a nonexclusive license agreement, Best Environmental Subsurface Sampling Technologies, Inc. (BESST IN_2C), will manufacture and sell the DDSP. BESST IN_2C is currently customizing the DDSP with newly integrated components that make the system more efficient, allow for more sampling ports, and permit deeper installations.

Technology Maturation Fund

The goal of the Technology Maturation Fund at LANL is to turn small financial investments (no more than $50K per project) into future licensable technologies by maturing the technologies to the point that a commercial entity becomes interested in licensing or further development of the technology. This Fund is comprised, in part, by a portion of LANL's licensing income.

Through September 2004, a LANL review panel evaluated eight proposals from LANL inventors. Of the eight projects proposed, four proposals were funded, and a fifth is currently being considered. A total of $387,950 was requested to support the maturation of early stage LANL technologies with $183,000 approved.

During the same period in the 2003 calendar year, six projects were approved for funding. Of these projects, two of the technologies have now been licensed out to companies, one CRADA project was extended for a year with Hyper Tech, and two of the other projects are in negotiations to enter into CRADAs with commercial entities. One inventor, as a result of the work he did with the Technology Maturation funding, is considering a possible start-up with his technology.

Technology Screening Initiative

Eight MBA summer interns from LANL presented eleven projects to a panel of reviewers at the Los Alamos Technology Screening Initiative (LATSI) at the Los Alamos Research Park on Friday, August 13, 2004. As a joint project between LANL's 2004 Summer MBA Internship and local business developers, including Los Alamos Commerce and Development Corporation and Technology Ventures Corporation, LATSI's primary goal was to give some commercial exposure and critical feedback to LANL inventions and to facilitate the process of technology sourcing, screening and portfolio development in northern New Mexico. The outcome of the presentations and review was a "diagnostic" on each technology or idea, evaluating the future commercial potential and recommendations for specific next steps to further the development. It is anticipated that this project will contribute to current licensing and commercialization efforts at LANL as well as to the formation of a northern New Mexico 'deal pipeline' in support of new technology business development. The review panel included venture capitalists, entrepreneurs, economic development professionals, and market experts.

Website Security Software

Developed by researchers at PNNL, Mozart™ software was created as a security tool to quickly archive and analyze entire websites based on built-in or user-developed search libraries containing hundreds of key phrases designed to find web pages containing sensitive information. The output goes into a hyperlinked report that includes a prioritized listing of those web pages containing potentially strategic or sensitive information.

PNNL has licensed the patent pending Mozart™ software to Web Safe Technologies, Inc., which was recently acquired by ZKids Network Company. ZKids will use the Mozart™ software to quickly archive and analyze entire websites based on search terms provided by ZKids and built-in search libraries containing key phrases designed to find information which may be inappropriate for children.