
Secretary of Energy Advisory Board

Recommendations Regarding Industry Partnering/Technology Transfer Within the Department of Energy

Report of the External Members
The Laboratory Operations Board

December 31, 2002

Laboratory Operations Board
U.S. Department of Energy

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The Laboratory Operations Board
Industry Partnering/Technology Transfer
Working Group**

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Laboratory Operations Board

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Recommendations Regarding Industry Partnering/Technology Transfer Within the Department of Energy

Abstract

Purpose

The Laboratory Operations Board was charged with assessing the Department of Energy's policies and practices regarding industry partnering and technology transfer within the Department of Energy. In response, the Board established an Industry Partnering/ Technology Transfer Working Group to assess opportunities to enhance the Department's mission by partnering with industry.

Specifically, the Working Group was to identify barriers to industry partnering, as well as strategies for attracting and working with industry. It was to recommend steps to facilitate participation of small business. In addition, it was to address management and oversight requirements to facilitate industry partnering. The following were among the set of issues to be addressed:

- Intellectual Property Rights;
- Federal Acquisition Regulations/Contracting and "Other Transactions Authority;"
- Legislation and Budgetary Regulations;
- Human Resources; and
- Management and Oversight.

Recommendations Regarding Industry Partnering and Technology Transfer

In this letter report, the Working Group makes recommendations that address the key barriers to industry partnering and technology transfer within the Department of Energy. The recommendations are:

- 1. The Department should state, in an unequivocal fashion, its support for industry partnering and technology transfer across the departmental complex. Mission Statements, at all levels, should include industry partnering and technology transfer as an objective.**

Industry partnering and technology transfer - the diffusion of knowledge and inventions created by federal funds - is an essential activity of the Department of Energy in carrying out its numerous missions. Industry partnering and technology transfer also has substantial strategic value as a mechanism to assist the Department in accomplishing the totality of its multi-faceted missions. The value, however, that industry partnering and technology transfer has to the Department and to the Nation goes considerably beyond monetary return from inventions that are licensed. By partnering with industry, Federal

labs create new competencies and capabilities to help achieve their missions, as well as the Department's missions, ensuring that their work generates maximum benefit for our nation.

The United States benefits greatly from the interaction of the Department of Energy's national laboratory system with private sector industry partners. The synergistic nature of national laboratory partnerships with industry has served to advance significantly a number of innovative technologies that otherwise may not have been developed.

- 2. A senior-level staff person, with a small, permanent staff, reporting directly to the Deputy Secretary should be given the portfolio as advocate and champion for industry partnering and technology transfer within the Department of Energy and its associated national laboratories.**

This individual should also be the focal point for addressing process improvement and other administrative issues identified by the industry partnering and technology transfer participants. However, if an industry partnering and technology transfer advocate is not appointed, the responsible Program Secretarial Officers should, in a coordinated fashion, address those issues in order to make the process more streamlined and flexible.

- 3. Program Secretarial Officers must demonstrate a clear commitment to an enhanced integrated industry partnering and technology transfer program consistent with Departmental and Program Office Missions. Program Secretarial Officers, beginning with the Department's Corporate Review Budget, will be held accountable by the Deputy Secretary for identifying and funding an industry partnering and technology transfer portfolio related to mission objectives.**

The IP/TT WG envisions that budget proposals made by the Program Secretarial Officer's (presented initially in the Department's Corporate Review Budget) would be the result of a crosscutting departmental peer review based on proposals from program offices and national laboratories. The IP/TT WG envisions that the industry partnering and technology transfer advocate from the staff of the Deputy Secretary would play a significant role in assisting in the development of such a Departmental industry partnering and technology transfer portfolio. Emphasis would be placed on selections targeting small and medium sized businesses, but not to the exclusion of large companies.

Recommendations Regarding "Other Transactions Authority"

As discussed, the charge to the IP/TT WG included instructions to consider and address the issue of "Other Transactions Authority," its relationship to Intellectual Property issues, and some aspects of required legislation. Because of Congressional interest, this issue was addressed early in the IP/TT WG's investigation. This effort resulted in a letter report to the Laboratory Operations Board entitled "Recommendations Regarding the Application of 'Other Transactions Authority' within the Department of Energy (September 17, 2002)." The Report was approved by the full Laboratory Operations

Board on September 17, 2002, and has been submitted to the Secretary of Energy Advisory Board for their consideration.

The principal recommendations were:

- **The Working Group recommends that the Department of Energy would benefit from special contracting authority such as “Other Transactions Authority;”**
- **The Working Group further recommends that the National Laboratories also be given the right to utilize “Other Transactions Authority;” and**
- **The Working Group can see no reason to limit the application of “Other Transactions Authority” to only the National Nuclear Security Administration to the exclusion of the rest of the Departmental complex.**

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RECOMMENDATIONS REGARDING INDUSTRY PARTNERING/TECHNOLOGY TRANSFER WITHIN THE DEPARTMENT OF ENERGY

INTRODUCTION

Transfer of the results of federally sponsored research from national laboratories and universities to the defense industry and the commercial market place for the public's benefit is a public policy goal with a long history of debate. Congressional intent, as expressed repeatedly through the enactment of enabling legislation over the course of the last two decades, has been to encourage and facilitate the transfer of technology from federal laboratories to U.S. businesses through a variety of industry partnering mechanisms.

However, an April 2002 General Accounting Office (GAO), in its report reviewing the Department of Energy's (DOE) industry partnering and technology transfer program, noted that cooperative research partnerships and technical assistance to small businesses had declined greatly in recent years. In its report, the GAO examined 12 DOE national laboratories that have historically been most active in transferring technology to U.S. businesses. The report identified a number of barriers to industry partnering and technology transfer cited by the laboratories. This report and the interest expressed in Congress prompted DOE to request the Laboratory Operations Board undertake a review of industry partnering and technology transfer within the departmental complex.

PURPOSE

The Laboratory Operations Board was charged with assessing the Department of Energy's policies and practices regarding industry partnering and technology transfer within the DOE. In response, the Board established an Industry Partnering/ Technology Transfer Working Group (IP/TT WG) to assess opportunities to enhance the Department's mission by partnering with industry.

Specifically, the IP/TT WG was to identify barriers to industry partnering, as well as strategies for attracting and working with industry. It was to recommend steps to facilitate participation of small business. In addition, it was to address management and oversight requirements to facilitate industry partnering. The following were among the set of issues to be addressed:

- Intellectual Property Rights;
- Federal Acquisition Regulations/Contracting and "Other Transactions Authority;"

- Legislation and Budgetary Regulations;
- Human Resources; and
- Management and Oversight.

APPROACH

The IP/TT WG obtained input from the laboratories through a survey that asked for their recommendations on ways to enhance partnering and technology transfer. The industry representatives to the IP/TT WG also collected data from their colleagues concerning their experiences in partnering with the laboratories.

The IP/TT WG sponsored a workshop to bring together key participants in the industry partnering and technology transfer community. Those attending the July 2002 workshop included senior policy officials, managers, and staff representing the Department of Commerce, DOE Headquarters and Field Offices, national laboratories, and industry. The participants shared valuable insights and perspectives regarding industry partnering and technology transfer in their presentations.

The IP/TT WG reviewed the history of DOE industry partnering and technology transfer policy and activity in terms of Congressional legislation and Departmental and laboratory activity since 1991. In addition, they reviewed DOE and laboratory mission statements to determine if policies supporting industry partnering and technology transfer were clearly expressed as a mission of government-sponsored research and development.

The following pages provide a synthesis of this information to serve as background and substantiating material to the recommendations that conclude this report.

BACKGROUND

General Accounting Office Reports

The General Accounting Office has reported on DOE's industry partnering and technology transfer activities in two separate reports.¹

The first report, issued in 2001, examined technology transfer activities at DOE's national defense laboratories - Lawrence Livermore, Los Alamos, and Sandia national laboratories - and nuclear weapons production facilities - the Kansas City, Oak Ridge Y-12, and Pantex plants. In the mid 1990s, these labs and facilities were among the leading federal entities participating in Cooperative Research and Development Agreements (CRADAs) with businesses, universities, and other private partners. Congress had established the 1991 Technology Transfer Initiative (renamed the

¹*Technology Transfer: DOE Has Fewer Partnerships, and They Rely More on Private Funding*, GAO-01-568; July 2001, and *Technology Transfer: Several Factors have Led to a Decline in Partnerships at DOE's Laboratories*, GAO-02-465; April 2002.

Technology Partnership Program in FY 1998) to provide funding specifically designated for supporting CRADAs and other types of partnerships (see Appendix 1 for a list of types of partnering arrangements used by the DOE laboratories. However, in FY 1996, Congress began to phase out dedicated funding and began to rely on program managers to use regular research funding for partnerships.

In response, support by the laboratories and by private partners of technology partnerships declined substantially. The GAO report concluded that technology transfer in general, and CRADAs and technical assistance agreements in particular, had declined to an unacceptable level by 2001.

In 2002, GAO, based on concerns articulated by Senator Jeff Bingaman (Chairman, Senate Committee on Energy and Natural Resources), broadened its review of industry partnering and technology transfer to encompass 12 DOE national laboratories. The second report focused on both defense and science laboratories that have historically been most active in transferring technology to U.S. businesses.

The 2002 GAO report indicated that there had been a substantial reduction in funding for and the number of CRADA partnerships and technical assistance to small businesses at the national laboratories. In FY 1995, funding reached a high point within the Department with over \$260 million being made available for CRADAs and other technology partnership activities through the Technology Partnership Program and the Laboratory Technology Research Program. In FY 2001, CRADAs and other technology partnership activities totaled only \$10 million and declined further to only \$3 million in FY 2002. The total number of CRADAs declined as well, from a high of 1,111 in FY 1996 to 606 in FY 2001—a decrease of more than 40 percent.

However, Work-for-Others increased from \$31 million in FY 1992 to \$188 million in FY 1999 before dropping to \$147 million in FY 2001. The GAO report noted that technologies are increasingly being transferred through agreements that do not involve collaborative research. Non-federal entities are the source of funding for Work for Others projects. With the decline in dedicated funding for CRADAs, the bulk of support has come from the laboratories' partners. The decline in funding for CRADAs has also had a particularly significant adverse effect on small businesses. GAO found, from FY 1999 to FY 2001, that participation by small businesses in CRADAs dropped from 227 participants to only 179. That was a more substantial decline than observed in the intermediate or large business category of CRADA participants.

The current agreements have enabled the Department's national laboratories to leverage resources, but funding limitations have caused some CRADAs to be terminated early, and some CRADA negotiations were abandoned. On the other hand, as noted previously, technology transfer activities that do not require federal funding have grown. Work for Others, technology licensing, and user facility agreements have all increased substantially. (see Appendices 2 and 3 for a history of legislation addressing industry partnering and technology transfer and a more complete description of DOE activities in this arena)

The change in the nature of the relationship between DOE laboratories and their industry partners may have negative consequences for the laboratories. In the new agreements, typically some form of Work for Others agreement, the opportunities for laboratory scientists to collaborate with industry and university researchers are reduced. These collaborations are valued by scientists who view opportunities to collaborate with their colleagues in universities and industry as valuable opportunities to remain current in their fields.

Barriers to Industry Partnering and Technology Transfer Identified

The 2002 GAO report concludes that the most important barrier to effective technology transfer is the lack of dedicated funding for technology partnerships. According to the GAO report, the laboratory managers viewed the uncertainty in the continuation or level of funding as creating a serious barrier to industry participation, particularly with respect to small businesses.

Other barriers identified in the 2002 GAO report were the absence of a high-level, effective advocate for technology partnerships at DOE headquarters and the lack of a DOE institutional commitment to technology partnerships as a way to accomplish agency missions. The survey identified other associated administrative issues, such as advance payment requirements, U.S. competitiveness and U.S. Trade Representative reviews, and administrative burdens and time delays as additional barriers to industry participation. With respect to the U.S. competitiveness requirements, GAO found that large U.S. based multinational companies are often unwilling to enter agreements because of possible implications in the out-years on the company's strategic manufacturing decisions. The issue regarding U.S. Trade Representative reviews principally were the delays – up to six months – caused by the requirement to consult with the Office of the U.S. Trade Representative for CRADAs involving a company controlled by a foreign company or government.

National And Departmental Focus

As is discussed in some depth in Appendices 2 and 3, there has been specific Congressional direction on industry partnering and technology transfer. The sections that follow examine the Department of Energy's mission statements to trace how the Executive Branch has translated the Congressional direction and philosophy into action.

Presidential and Secretarial Statements on Technology and Technology Transfer

President Bush has addressed the role of technology in our Nation's energy policy. He said, in an address delivered at the Department of Energy shortly after he issued his National Energy Policy Report (May 2001), that "our Nation must have a broad, comprehensive energy strategy that . . . helps us develop the technologies necessary to make wise choices in the marketplace as well as call upon our nation's innovative technologies to help us find new sources of energy."

Secretary Abraham has spoken directly on the issue of industry partnering and technology transfer. In an address at the Department's Quarterly Leadership Meeting in October 2001, he indicated, with respect to ensuring energy security that one of his priorities was to direct "**research and development budgets at ideas and innovations that are relatively immature in their development, and ensuring the greater application of mature technologies** (emphasis added)." On the occasion of the rollout of the FY 2003 budget request in February 2002, the Secretary said that "we will direct our research and development toward new ideas that will bring us tomorrow's energy and **we will move mature technologies from the laboratory to the marketplace** (emphasis added) for today's energy needs."

DOE Order 482.1

The Department of Energy issued DOE Order 482.1 in January 2001. This order states that it is Departmental policy to "facilitate the efficient and expeditious development, transfer and exploitation of Federally owned or originated technology to non-DOE entities for the public benefit and to enhance the accomplishment of DOE missions."

DOE Annual Performance Plan

The Department of Energy's Annual Performance Plan for FY 2003 states the Department of Energy's mission is "to foster a secure and reliable energy system that is environmentally and economically sustainable . . . and to lead in the physical sciences and advance the biological, environmental and computational sciences; and provide premiere instruments of science for the Nation's research enterprise."²

Goals and objectives for each of the Department's five mission areas were reviewed for applicable statements. Statements of overall goals for three of the DOE mission areas, National Nuclear Security, Environmental Quality, and Corporate Management indicate no relevance to industry partnering and technology transfer.

The Department's mission for the Science mission is the following:

"Deliver the scientific knowledge and discoveries for DOE's applied missions; advance the frontiers of the physical sciences and areas of the biological, environmental, and computational sciences; and, provide world-class research facilities and essential scientific human capital to the Nation's overall science enterprise."

Throughout the Science statements of objectives, there are references to the provision of user facilities. In expository sections, the Performance Plan describes the Office of

² The Department's Strategic Plan is expected to be published in the fall of 2002 and will link performance goals to higher level Departmental goals and Strategic Objectives. In order to reflect the priorities of the current Administration, the FY 2003 Performance Plan revised the goals and objectives outlined in the Department's September 2000 Strategic Plan and are reviewed here.

Science as promoting “the transfer of the results of basic research to a broad set of technologies involving advanced materials, national defense, medicine, space science and exploration, and industrial processes.” This paragraph concludes that when other Federal agencies and industry utilize the high energy physics user facilities “the involved industry or Federal agency supports such studies.” A similar statement is found with regard to other Science area user facilities.

These statements reflect the current Congressional legislation that requires industry partners provide the support for partnering activities. The role for the Science mission is to perform basic science, provide the knowledge to applied missions, and make its research [user] facilities available to other researchers under specified conditions. The Energy Resources mission area contains multiple statements supporting industry partnering and technology transfer. For example, the first strategic objective is to “use public-private partnerships to promote energy efficiency and productivity technologies in order to enhance the energy choices and quality of life of Americans”

Program Secretarial Officer Mission Statements

References to industry partnering and technology transfer in the mission statements at the Program Secretarial Officer (PSO) level vary considerably.

Neither the Office of Science nor the National Nuclear Security Administration mission statements contain specific reference to industry partnering and technology transfer. In fact, a program that supported technology transfer within the Office of Science, the Laboratory Technology Research Program, will be discontinued in 2004. Dedicated funding has been provided through 2004 only to support several previously funded CRADAs.

On the other hand, the mission statements of the Office of Energy Efficiency and Renewable Energy and the Office of Fossil Energy, contain relatively explicit statements regarding developing “public-private partnerships” or “partnering with industry.”

National Laboratory Mission Statements

The national laboratories include statements on the importance of technology transfer and industry partnering in their mission statements and strategic plans. The national laboratories associated with the Office of Science have a great deal of specificity with respect to industry partnering and technology transfer. For example, Lawrence Berkeley National Laboratory’s mission statement says, in part, that one of their goals is to

“transfer knowledge and technological innovations [emphasis added] and to foster productive relationships among Berkeley Lab’s research programs, universities, and industry in order to promote national economic competitiveness.”

The Lawrence Berkeley Lab is not unusual in noting the importance of industry partnering and technology transfer in its mission statement. Other national laboratories associated with the Office of Science do so as well.

In addition, for example, when we turn to the mission statements of the Department's nuclear weapons laboratories, we find that one of the key goals at Sandia National Laboratory is to optimize strategic partnerships. At Lawrence Livermore National Laboratory there is a clear reference to industry partnering and technology transfer in the Laboratory's mission statement. That mission statement reads, in part, as follows:

*“Our primary mission is to ensure that the nation's nuclear weapons remain safe, secure, and reliable and to prevent the spread and use of nuclear weapons worldwide The Laboratory serves as a resource to U.S. government and a **partner with industry and academia** [emphasis added].”*

The mission statement of the national laboratory that principally supports the Energy Efficiency and Renewable Energy programs, the National Renewable Energy Laboratory (NREL), contains explicit statements about industry partnering and technology transfer. The Laboratory's mission statement includes the following:

*“**NREL develops renewable energy and energy efficiency technologies and practices, advances related science and engineering, and transfers knowledge and innovations** [emphasis added] to address the nation's energy and environmental goals.”*

Conclusions Regarding Departmental Mission Statements

Within the Departmental complex, there is an inconsistent flow-down with respect to mission statements regarding the role of industry partnering and technology transfer. Despite Presidential and Secretarial statement affirming the importance of industry partnering and technology transfer, that importance is not currently reflected in documents at the Departmental level (*i.e.*, Annual Performance Plan). Nor is industry partnering and technology transfer reflected in all Program Secretarial Office mission statements. However, at the implementation level, national laboratory mission statements generally reflect the importance of industry partnering and technology transfer.

INDUSTRY AND LABORATORY INPUTS

Industry Viewpoints

The industry representatives to the IP/TT WG collected data from their colleagues concerning their experiences in partnering with the laboratories. Their survey results provide a qualitative industry viewpoint on industry partnering and technology transfer. Honeywell, Delphi Auto, Rohm Haas, Caterpillar, General Motors (GM), General Electric (GE), and DuPont participated in the survey.

The survey queried participants about the laboratory(s) they had experience with; the grade of the interactions (scale of 1-3, with 1 being the best grade); barriers having an adverse effect on technology transfer; and, lastly, recommendations with respect to laboratory/industry interactions.

Results of Survey

As might be expected, experiences varied depending on the laboratory and the industry participant. On a scale of 1-3, a number of laboratories received 1s, indicating that their experience in partnering with the laboratory was “good.” Based on observations of other participants, however, the same laboratory received a 3.

Perceived barriers also varied. Noted most frequently were inflexibility with regard to Intellectual Property rights; time required to initiate projects; requirements associated with U.S. manufacturing and competitiveness provisions, and dissimilar “cultures” of work.

Industry Recommendations

Recommendations on how to improve industry partnering and technology transfer also varied. Among them were to streamline paperwork/develop common templates; provide more Intellectual Property flexibility; develop new measures and rewards aimed at enhancing the likelihood of industry partnering/technology transfer successes, and change the mindset of laboratory staff.

In reviewing industry perspectives on barriers, the respondents did not generally identify the same barriers identified by national laboratory managers or reported by GAO. Both the industry respondents and GAO reported that time delays and U.S. competitiveness requirements were barriers that needed to be addressed. The industry focus was related more to barriers that they could obviously identify as impediments to progress and results.

At the July 2002 Workshop, an industry representative presented an innovative approach that focused on an initiative related to the transfer of technology from a for-profit commercial R&D activity to other commercial entities. This “commercialization engine,” which identified opportunities and potential partners to move potentially commercializable technologies to the market place rapidly, was of great interest to the IP/TT WG.

This mechanism potentially represents “out of the box” thinking and may be more agile and focused in generating opportunities for more industry partnering and technology transfer than is currently the case within the Department’s laboratory complex. The industry-based technology transfer activity appears fundamentally to be more proactive in its activities than some national laboratory efforts. The IP/TT WG believed that an

aggressive industry partnering technology transfer mechanism, as a pilot program, would be appropriate for the Department and the LOB to investigate.

National Laboratory Views

The IP/TT WG surveyed the DOE national laboratories that historically have been the most active in industry partnering and technology transfer.

The questions sought responses regarding Organization/Funding, Process/ Management, Metrics, Incentives, Success Stories, and a request for other information. The results are summarized below.

Organization/Funding

The national laboratories surveyed have stand-alone offices responsible for the broad scope of industry partnering and technology transfer activities. The specific organizational location, reporting relationships, and range of responsibilities vary from national laboratory to national laboratory. Many report directly to the Laboratory Director; others report at very senior levels of the laboratory organization. The key point is that the national laboratories have recognized the importance of industry partnering and technology transfer and have put in place organizations whose principal responsibility is to enhance and encourage such activities within the laboratory complex.

In response to the question regarding the level of support that the national laboratories receive from Headquarters program offices and field offices, the responses were very positive. Headquarters and field offices were supportive of industry partnering and technology transfer activities undertaken by the national laboratories. Differences were observed, however, when the response was couched in terms of resources or funding. For example, one national laboratory noted that the Department seemed to recognize that working with industry is synergistic with mission programs. They have been given flexibility to execute both cost-shared and 100 percent funds-in agreements, and they have not received any adverse comments from either Headquarters or field offices when making decisions to expend program funds on cost-shared CRADAs. On the other hand, another program office that is a major client of a laboratory has not funded any CRADAs since 1996. This approach is in accordance with Congressional intent in that decisions regarding funding should be made by program managers using program funds as the source rather than relying on funds specifically dedicated to funding CRADAs.

While there is considerable enthusiasm for industry partnering and technology transfer throughout the laboratory complex, the repetitive theme is that the lack of dedicated funding is a barrier to an effective and robust industry partnering and technology transfer program. The issue of dedicated funding, both for CRADAs and technology transfer activities with small businesses, was also observed by GAO as being the most significant barrier to effective industry partnering and technology transfer in their most recent report.

Program direction funding for industry partnering and technology transfer functions at the national laboratories (including intellectual property management and licensing agreements negotiation and administration, technology commercialization, etc.) has remained relatively steady over the last seven fiscal years (FY 1995 - FY 2002). This has been the case despite a significant fall off in the dedicated funding available for industry partnering and technology transfer (CRADAs) and a reduction in the Office of Science's Laboratory Technology Research program.

Process/Management

The national laboratories are using a wide range of mechanisms to identify opportunities for industry partnering and technology transfer. They range from publishing notices in the *Federal Business Opportunities* (formerly the *Commerce Business Daily*); putting notices on the Federal Laboratory Consortium for Technology Transfer Web Site, as well as on their own WEB sites; making announcements at technical meetings and presentations; interacting at technical conferences; and publishing notices of inquiries for Small Business Innovative Research (SBIR) or Small Business Technology Transfer (STTR) partners, etc. Unsolicited proposals from potential industry partners are also a mechanism leading to industry partnering and technology transfer agreements.

Metrics

A set of "value based" metrics to demonstrate the contribution of industry partnering and technology transfer to the Department would assist the national laboratories in convincing the Department of the worth of these activities.

Current metrics are fairly universal among the laboratories: numbers of agreements, licenses, patents, citations, annual and total value of agreements, annual value of licenses, annual royalty income, new products introduced, new companies started up, etc. The point was continually made that quantitative metrics tend to track activities that are easy to measure, rather than the quality or outcomes desired.

The contributions of the partnering effort in accomplishing Departmental and national laboratory mission objectives, the commercial success and value attributable to products/processes developed as a result of partnering activities, other societal benefits, etc. are all measures that should be applied in attempting to "value" industry partnering and technology transfer contributions. There was wide agreement that qualitative measures of success were difficult to define.

Incentives

Current legislation suggests that funding for industry partnering and technology transfer should come out of program funds. Because there was a general perception that project managers were not interested or did not encourage industry partnering and technology transfer opportunities, the Laboratory Operations Board was interested in identifying incentives that could be or were used to encourage participation.

Incentives identified at the national laboratories include royalty sharing (royalties are shared by the inventor, contributors, and the organizations responsible for the invention – the Laboratory portion stays within the Laboratory to support more research, industry partnering and technology transfer, or scientific education); cash awards for individual performance, patent incentive awards; and other cash incentive awards for achievement of specific objectives. It was clear from the responses that the level of monetary incentivization (*i.e.*, percentage of royalties to the inventor) was different from laboratory to laboratory.

In addition to tangible rewards, the national laboratories cited a number of intangible, but nonetheless important rewards. They are opportunities for Laboratory staff to learn from industry counterparts, near-term application by industry of scientific concepts developed by the national laboratory staff, enhanced prestige of the individual and institution based on the public’s awareness of successful industry partnering and technology transfer efforts, development of new laboratory competencies and knowledge and understanding of industry best-practices, personal and professional satisfaction when the laboratory is successful in competing for R&D 100 awards, etc.

Conclusions

The vast majority of the national laboratories agreed with the findings of the 2002 GAO Report regarding technology transfer activities within the Department and the barriers that needed to be overcome.

The laboratory respondents focused principally on the need to reestablish industry partnering and technology transfer as a core departmental mission. They also emphasized their belief that there is a need to have a senior-level industry partnering and technology transfer advocate in the Secretary’s office to act as a coordinating focal point, and they strongly advocated that dedicated funding be provided for industry partnering and technology transfer activities.

The laboratory respondents also echoed some of industry’s observations regarding the following:

- There needs to be a better understanding of differences in “cultures” between government and industry;
- Administrative processes need to be reviewed and streamlined; and
- Issues associated with U.S. manufacturing and Intellectual Property also need to be addressed.

Laboratory Success Stories

Industry partnering and technology transfer have yielded, over the past several decades, a number of significant successes that highlight how the results of federally sponsored research has been transferred from the national laboratories to the commercial market

place for the public's benefit. Among the examples the laboratories cited were the following:

- Lawrence Livermore, Sandia, and Lawrence Berkeley National Laboratories formed a Virtual National Laboratory to work on the development of Extreme Ultraviolet Lithography. The Cooperative Research and Development Agreement (CRADA) is with Intel Corporation, Motorola, Advanced Micro Devices, Micron Technologies, Infineon Technologies and IBM. This next-generation lithography system is on the cutting-edge of semiconductor chip technology. The CRADA has a current budget of \$250 million over five years funded by the industry partners, and a workforce of about 150.
- Sandia National Laboratory has partnered with Intel, National Aeronautics and Space Administration's Jet Propulsion Laboratory, the Air Force Research Laboratory, and the National Reconnaissance Office to redesign Intel's Pentium® processor for radiation-hardened space and defense applications. Radiation hardening helps to protect chips from the harsh effects of cosmic and nuclear radiation, ensuring reliable performance.
- Los Alamos National Laboratory collaborated with Procter & Gamble on a CRADA related to Manufacturing Reliability and Rapid Response. Los Alamos developed a technology to collect and fuse a number of different types and sources of data on the projected reliability of complex manufacturing systems. Procter & Gamble has applied the technology to its internal manufacturing systems while Los Alamos has applied it to improve the statistical capabilities needed for the nuclear weapons program.
- The National Renewable Energy Laboratory has partnered with Spectrolab and Emcore – the two largest companies involved in making photovoltaic power systems for space – in pioneering innovative photovoltaic devices that are lighter, more powerful, and more efficient than all previous photovoltaic power systems. They have developed the Tandem Cell Photovoltaic Device which is a stacked cell made of compatible materials (silicon or gallium arsenide) that can use more of the spectrum to produce more electricity more efficiently. The tandem concept is now the foundation of the power system of choice for earth orbiting satellites.
- Oak Ridge National Laboratory, in partnership with Southwire Company, has co-developed a high-temperature superconducting cable system. This work stemmed from a CRADA that was initiated in 1995. Superconducting cables may carry 3 to 5 times the power of comparable underground copper or aluminum cable. The cable system, which can carry enough electricity to power a city of 20,000 residents, has been powering three industrial plants in Carrollton, Georgia, for nearly three years and is world's longest running high-temperature superconducting cable system. With the success of this first industrial installation, the Southwire/ORNL team has now invented, designed and built a 5-meter long tri-axial cable with 3-phase terminations. The 3-phase, cold dielectric cable and termination design is nearly as compact as one of the single-phase, co-axial cables operating at Southwire and represents the highest cable current density achievable in an electric AC power cable.
- Argonne National Laboratory partnered with Compaq, Cray, SGI, Sun, Viridian, Fujitsu, Hitachi, NEC, Entropia, IBM, and Microsoft in developing the Globus

Toolkit™. The Globus Toolkit™ is an open architecture, open-source set of software services and libraries that support computational “grids” allowing computers far apart to work on the same problem at the same time. The toolkit is central to distributed computing. The Globus Toolkit™ was named the most promising technology development of the year by R&D Magazine and was chosen the best of the best at the 2002 annual R&D 100 Awards presentation in October 2002.

- The Pacific Northwest National Laboratory developed a radio frequency (RF) identification system. This system included RF tags (wireless communication devices using a unique backscatter communications protocol) that have exceptionally long range, vary in size, and can be designed to identify and locate or monitor items for inventory and asset tracking. Wave ID, a wholly owned subsidiary of Battelle, was established in 2000 to market the technology. In late 2001, Alien Technology purchased Wave ID. They have estimated that 550 billion RF tags will be sold by 2006.
- The National Energy Technology Laboratory has developed a Combustion Control and Diagnostics Sensor (CCADS). Tests, in partnership with Woodward Governor’s Advanced Combustion Controls Group are focused on both research and design issues for commercialization. CCADS has the potential to improve the reliability, availability, and maintainability of low emission gas turbine engines.

Issues for Further Consideration

The presentations and discussions at the July 2002 workshop produced some interesting ideas that may warrant follow-up by the Department and the Laboratory Operations Board.

The private sector is moving to take greater advantage of their investment in research and development programs by developing “commercialization engines” to identify opportunities and potential partners to move potentially commercializable technologies to the market place rapidly. These commercial entities attempt to identify potential applications of technologies under development; evaluate their commercial potential; identify and interest venture capitalists and strategic partners; and structure a business arrangement.

The objective of creating sustainable businesses lines up well with the objectives of departmental industry partnering and technology transfer activities. The process of “mining” R&D outputs and identifying potential applications of technologies under development; evaluating their commercial potential; identifying and interesting venture capitalists and strategic partners; and structuring a business arrangement appears to be of considerable utility to the Department.

The IP/TT WG suggests that the Department further investigate an initiative of this type and the Laboratory Operations Board for use in the industry partnering and technology transfer arena.

Further, the IP/TT WG suggests that the Department and the Laboratory Operations Board examine, in greater detail, the role of incentives in stimulating industry partnering and technology transfer activities at national laboratories.

Both the national laboratories and industry were in favor of using incentives as a mechanism to aid in the industry partnering and technology transfer effort. The national laboratories do use incentives (*e.g.*, royalty sharing with inventors and their divisions, awards for patents, performance bonuses, etc.). However, the reward structure appears to be uneven across the laboratory complex.

OTHER TRANSACTIONS AUTHORITY

The charge to the IP/TT WG included instructions to consider and address the issue of “Other Transactions Authority”, its relationship intellectual property issues, and some aspects of required legislation. Because of Congressional interest, this issue was addressed early on in the IP/TT WG’s investigation. This effort resulted in a letter report to the Laboratory Operations Board entitled “Recommendations Regarding the Application of ‘Other Transactions Authority’ within the Department of Energy (September 17, 2002).” The Report was approved by the full Laboratory Operations Board on September 17, 2002, and has been submitted to the Secretary of Energy Advisory Board for their consideration at their next meeting.

Other Transactions Authority is a special contracting authority that does not require reliance upon Federal Acquisition Regulations. It has a number of advantages for the Department and its national laboratories. The IP/TT WG concluded that Other Transactions Authority could provide the Department the following: new industrial resources, better management of risk and uncertainties, better definition of goals and objectives, enhanced opportunities to establish partnerships and consortia, better insights into status of projects, and better leveraging of government resources.

Of particular interest, with respect to the scope of this industry partnering and technology transfer report, is that it also permits the Department and national laboratories to negotiate aspects of intellectual property. Both industry and the national laboratories in their responses to survey questions raised the issue of intellectual property as a barrier to industry partnering and technology transfer. The IP/TT WG believes that should the use of Other Transactions Authority agreements be authorized and used appropriately then the issue of intellectual property rights will become significantly less of an issue than before and may well become an incentive to partner with the Department.

RECOMMENDATIONS

Recommendations Regarding “Other Transactions Authority”³

- **The Working Group recommends that the Department of Energy would benefit from special contracting authority such as “Other Transactions Authority.”** The Working Group believes that, as discussed, there are important benefits for the Department and other public agencies and/or private organizations and individuals to be derived from the use of innovative contracting vehicles such as “Other Transactions Authority.” **The contracting vehicle should be limited to research and development programs, prototype development, and demonstration projects;**
- **The Working Group further recommends that the National Laboratories also be given the right to utilize “Other Transactions Authority;” and**
- **The Working Group can see no reason to limit the application of “Other Transactions Authority” to only the National Nuclear Security Administration to the exclusion of the rest of the Departmental complex.** It appears to have equal validity for use by all elements of the Department of Energy and we would so recommend.

Recommendations Regarding Industry Partnering and Technology Transfer

The following recommendations address the key barriers identified by the national laboratories and the GAO report. Members of the IP/TT WG believe that if these recommendations are implemented the administrative and “process” barriers otherwise noted by industry, national laboratories, and GAO and will be effectively addressed. The IP/TT WG recommends that:

1. **The Department should state, in an unequivocal fashion, its support for industry partnering and technology transfer across the departmental complex. Mission Statements, at all levels, should include industry partnering and technology transfer as an objective.**

Industry partnering and technology transfer - the diffusion of knowledge and inventions created by federal funds - is an essential activity of the Department of Energy in carrying out its numerous missions. Industry partnering and technology transfer also has substantial strategic value as a mechanism to assist the Department in accomplishing the totality of its multi-faceted missions. The value, however, that industry partnering and technology transfer has to the Department and to the Nation goes considerably beyond monetary return from inventions that are licensed. By partnering with industry, Federal labs create new competencies and capabilities to help achieve their missions, as well as

³ “Recommendations Regarding the Application of ‘Other Transactions Authority’ Within the Department of Energy;” Letter Report approved by the Laboratory Operations Board, September 17, 2002

the Department's missions, ensuring that their work generates maximum benefit for our nation.

The United States benefits greatly from the interaction of the Department of Energy's national laboratory system with private sector industry partners. The synergistic nature of national laboratory partnerships with industry has served to advance significantly a number of innovative technologies that otherwise may not have been developed.

President Bush and Secretary Abraham have both recognized and supported industry partnering and technology transfer within the Department of Energy. Further, Congress has underscored the importance of industry partnering and technology transfer by explicitly providing for it through a number of statutes.

The IP/TT WG has taken note of recent Secretarial support for industry partnering and technology transfer. As discussed before, upon the rollout of the FY 2003 budget request in February 2002, and previously, in remarks made at the Department's Quarterly Leadership Meeting in October, 2001, Secretary Abraham indicated that moving mature technologies to the marketplace has a role in the Department's mission and priorities.

The Secretary's statement reflected a clarification of the Department's mission based on what had transpired during the course of the previous twelve months. The Secretary indicated that severe energy supply shortages in California; heating oil, natural gas, and gasoline price spikes; the attacks of 9/11; and the collapse of the nation's largest energy trader all played a role in reevaluating mission requirements. Despite the overwhelming focus on the Department's core mission – national security – and how its programs, other than Nuclear National Security Administration programs, also contribute to our Nation's energy security – and hence, national security, a focus on moving technologies from the laboratories to the marketplace still made the priority list.

The IP/TT WG takes note of the fact that the Department's Strategic Plan is undergoing revision and is to be published in the spring of 2003. The IP/TT WG recommends that the role and importance of industry partnering and technology transfer be emphasized in that document. The IP/TT WG further recommends that industry partnering and technology transfer be highlighted in all Principal Secretarial Officer level mission statements. This would serve to clarify expectations to departmental program managers, national laboratories, and potential industry partners.

2. A senior-level staff person, with a small, permanent staff, reporting directly to the Deputy Secretary should be given the portfolio as advocate and champion for industry partnering and technology transfer within the Department of Energy and its associated national laboratories.

Such an advocate, with immediate and significant access to departmental decision-makers, could serve as an effective voice during discussions and debates about departmental priorities, including resource allocations. Having a knowledgeable, persuasive advocate present during the formative stages of crosscutting departmental

decisions affecting industry partnering and technology transfer activities could ensure that the long-term benefits to the Department and the Nation of those activities are not overlooked in deference to short-term programmatic interests.

This individual should also be the focal point for addressing process improvement and other administrative issues identified by the industry partnering and technology transfer participants. However, if an industry partnering and technology transfer advocate is not appointed, the responsible Principal Secretarial Officers should, in a coordinated fashion, address those issues in order to make the process more streamlined and flexible.

3. Program Secretarial Officers must demonstrate a clear commitment to an enhanced integrated industry partnering and technology transfer program consistent with Departmental and Program Office Missions. Program Secretarial Officers, beginning at the time of the Department's Corporate Review Budget, should be held accountable by the Deputy Secretary of Energy for identifying and funding an industry partnering and technology transfer portfolio related to mission objectives.

The IP/TT WG took note of the discussions at the workshop held in July 2002 related to industry partnering and technology transfer funding. The participants at the workshop echoed the findings of GAO in their report (GAO-02-465; April 2002) regarding the adverse effects the reduction of that funding had on industry partnering and technology transfer activities throughout the DOE complex.

The IP/TT WG envisions that budget proposals made by the Principal Secretarial Officers (presented initially in the Department's Corporate Review Budget) would be the result of a crosscutting departmental peer review based on proposals from program offices and national laboratories. The IP/TT WG envisions that the industry partnering and technology transfer advocate from the staff of the Deputy Secretary would play a significant role in assisting in the development of such a Departmental industry partnering and technology transfer portfolio. Emphasis would be placed on selections targeting small and medium sized businesses, but not to the exclusion of large companies.

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APPENDIX 1

INDUSTRY PARTNERING/TECHNOLOGY TRANSFER VEHICLES USED BY THE DEPARTMENT OF ENERGY

The primary industry partnering and technology transfer vehicles the Department of Energy and its associated national laboratories have used to transfer technology to U.S. businesses and other entities are:

CRADAs (Cooperative Research and Development Agreements) - These are formal agreements between the Department or a national laboratory and one or more industry partners to develop jointly a product or process. These are structured agreements, with mutually agreed upon statements of work with task responsibilities, milestone schedules, and intellectual property rights defined.

Technical Assistance – Short-term activities directed at solving a specific technical problem for which a national laboratory has special expertise and/or facilities.

Work-for-Others Agreements – A defined scope of work is carried out in these activities. The work must be consistent with departmental missions and not place the national laboratory in direct competition with the private sector.

Technology Licensing Agreements - Exclusive or non-exclusive licenses can be granted to a company for development and production of a product or use of a process. The Department in exchange for such a license receives a licensing fee or Royalties.

User Facility Agreements - National laboratories may permit outside organizations to use its unique research equipment or facilities to conduct research. Depending on whether the research is proprietary or non-proprietary, the full cost of such use is paid for either by the private organization or by grants.

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APPENDIX 2

LEGISLATION AND EXECUTIVE ORDERS RELATED TO INDUSTRY PARTNERING AND TECHNOLOGY TRANSFER

Industry partnering and technology transfer has been a major legislative theme for over two decades. Since 1980, Congress has enacted a number of statutes designed to facilitate the transfer of technology from federal laboratories to U.S. businesses and improve the United States' competitive position in the world economy by such technology transfer. In addition, the Executive Branch has also addressed industry partnering and technology transfer through the issuance of Executive Orders. The key industry partnering and technology transfer legislative vehicles are as follows:

Specifically, Congress enacted, in 1980, the Stevenson-Wydler Technology Innovation Act of 1980, Public Law 96-480. This seminal piece of legislation established Offices of Research and Technology Applications at Federal laboratories and established technology transfer as a mission of the Federal government. The Stevenson-Wydler Act also required that preference be given to industrial technology transfer partners agreeing to substantially manufacture in the U.S. any products resulting from technology transfer.

In 1980, Congress also passed the Patent and Trademark Amendments Act (Bayh-Dole) of 1980, Public Law 96-517. This Act, among other provisions, gives exclusive rights to inventions arising under funding agreements with Federal agencies to small businesses and nonprofit contractors that agree that products embodying the invention will be manufactured substantially in the U.S.

In 1982 the Small Business Innovation Development Act, Public Law 97-219, established the Small Business Innovation Research (SBIR) Program and required federal agencies to provide funds to small business R&D connected to the agencies' mission.

Executive Order 12591, issued in April 1987, entitled "Facilitating Access to Science and Technology," requires that Executive Branch departments and agencies, to the extent permitted by law, transfer Federally funded technology to the commercial sector, and specifically addresses Government-Owned, Government-Operated (GOGO) facilities entering into Cooperative Research and Development Agreements (CRADAs) and licensing, assigning, and waiving intellectual property developed under such CRADAs. This Executive Order served to emphasize the Federal government's commitment to facilitating access to science and technology.

The Trademark Clarification Act of 1984 (which amended Bayh-Dole), Public Law 98-620, extended the substantial manufacture in the U.S. provision to all partners of industry partnering and technology transfer agreements including DOE's Government-Owned, Contractor-Operated (GOCO) contractors.

The Federal Technology Transfer Act of 1986, Public Law 99-502, authorizes CRADAs for GOGOs and establishes the Federal Laboratory Consortium for Technology. The Act requires that preference be given to CRADA partners located in the U.S. and reinforces that products embodying inventions under the CRADA will be manufactured substantially in the U.S. This was the second major piece of legislation focusing directly on technology transfer.

Again, in 1989, Congress, through the enactment of the National Competitiveness Technology Transfer Act, Public Law 96-480, made technology transfer a mission of government-owned, contractor-operated (GOCO) laboratories and their employees. The legislation further clarified the manner in which CRADAs are implemented, *i.e.*, they were to be utilized in a manner that fostered the competitiveness of U.S. industry.

And, in 1992, Congress again emphasized their belief, through enactment of the Small Business Technology Transfer Act, Public Law 102-564, that some priority should be given to small businesses and universities, Federally funded R&D centers, or nonprofits in funding cooperative R&D projects.

And again, Congress has under consideration industry partnering and technology transfer in a bill (the Energy Policy Act of 2002; H.R. 4), that provides for, among a number of other provisions: improved coordination of technology transfer activities; establishment of a technology infrastructure program; the appointment, at national laboratories, of a small business advocate; and the submission of a number of reports relating to industry partnering and technology transfer.

APPENDIX 3

INDUSTRY PARTNERING AND TECHNOLOGY TRANSFER WITHIN THE DEPARTMENT OF ENERGY

Departmental Initiatives

In 1990, the Department created a dedicated technology transfer organization and underscored its importance by having it managed by a Deputy Under Secretary for Research and Development Management. This heightened visibility and emphasis, combined with increased Congressional support and attention, had a salutary effect with respect to industry partnering and technology transfer activities within the Department.

By Fiscal Year 1992, the Department's national laboratories were among the leading federal laboratories participating in CRADAs with business, universities, and other partners. CRADAs by their very nature are partnerships. The national laboratories also began using non-partnership arrangements to transfer technology to businesses and other non-federal entities. These arrangements included: 1) "work-for-others" agreements, in which laboratory scientists perform specified research and the business pays full costs; 2) licensing of technologies to businesses; and 3) making specialized user facilities available to non-federal entities. In the early 1990s, Congress provided funding specifically designated for technology partnerships.

Decline of Industry Partnering and Technology Transfer

Congressional action yet again dramatically affected the Department's industry partnering and technology transfer programs and activities at the national laboratories. In FY-1996, Congressional action explicitly targeted the Technology Transfer office for elimination and began to phase out the dedicated funding that had been provided for previously. Congressional appropriators compromised on an \$18 million funding level. The Senate, in their mark-up, had provided for a funding level of \$25 million. The House, on the other hand, zeroed the program out. In addition, the Conference Committee Report that accompanied the FY 1996 Energy and Water Development Appropriations Act specifically indicated that, of the \$18 million appropriated, \$1.5 million was made available to pay severance costs for the DOE employees who staffed the Technology Transfer office.

That action eliminated a focal point for industry partnering and technology transfer within the Department. The results were predictable. With reduced funding, there was, over the course of the next several years, a substantial reduction in the number of CRADA partnerships and technical assistance to small businesses across the Laboratory complex.

A number of other problems began to arise with respect to industry partnering and technology transfer. Because there was no focal point for policy resolution, there was a fall off of consistency in how national laboratories treated issues as they arose and there was no single point for accountability for decisions or resolution of problems.

In response to the lack of focus, the Department, in 1999, established a Technology Transfer Working Group (TTWG), composed of representatives from program offices at Headquarters, Field Offices, and national laboratories and chaired by representatives from the Office of Policy and International Affairs and the Office of General Counsel. The TTWG, although having no permanent staff positions has served as a “virtual” Technology Transfer organization working to oversee and coordinate industry partnering and technology transfer polices within the Departmental complex.

There has been an increase in technology transfer through agreements that did not involve collaborative research and were funded by businesses or other non-federal entities. By fiscal year 2001, most of the 12 Departmental laboratories did not provide technical assistance for small businesses, unless they were willing to pay for the service. There has also been a dramatic increase in “work-for-others” agreements, licenses, and user facility agreements. While in of itself, that is not a negative, the research generally conducted under “work-for-others” agreements is not as beneficial to the laboratory as is CRADA work because the laboratory’s scientists do not have the opportunity to collaborate and work closely with the non-federal entity’s research team.

Continuing Efforts to Facilitate Industry Partnering and Technology Transfer

In January 2001, the Department recognized further that industry partnering and technology transfer within the Departmental complex was suffering and in response issued a Departmental Order – DOE Facilities Technology Partnering Programs (DOE Order 482.1). This Order underlined that it was Departmental policy to

1. Facilitate the efficient and expeditious development, transfer, and exploitation of Federally owned or originated technology to non-DOE entities for the public benefit and to enhance the accomplishment of DOE missions;
2. Leverage DOE resources, through its programs and facilities, by partnering with industry and universities; and
3. 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 partnering activities.

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