THE NATIONAL TECHNOLOGY INITIATIVE

MAKING TECHNOLOGY PARTNERSHIPS WITH GOVERNMENT WORK

Donald W. Pearman, Jr.
Manager, Department of Energy
San Francisco Field Office
1333 Broadway
Oakland, CA 94612

INTRODUCTION

This morning I'm going to be talking to you about a subject that is vital to many of us today, Technology Transfer. I'll begin with a brief recent history to help put in context why technology transfer has suddenly become one of the hottest subjects in government. Then, I want to tell you about an exciting new technology transfer concept called the National Technology Initiative, or NTI.

The NTI is a series of regional conferences at which senior representatives of the Federal Government and the Government laboratory community meet with business leaders to discuss opportunities for the transfer of Federally developed technology to the private sector. This initiative has been made possible through an unprecedented cooperative effort between the Administration, the Congress and the private sector. The U. S. Government spends tens of billions of dollars each year to develop technologies related to its various mission activities. The NTI reflects the Government's commitment to ensure that industry and academia have access to this technology.

Since Don Thompson has assured me that "Specific examples always go well with a technical group", I'm also going to tell you about just a few of the impressive technologies available from the 700-plus federal laboratories, for cooperative ventures with the private sector. You will probably not be surprised to realize that the examples I have picked from the thousands available tend to focus on Nondestructive Evaluation (NDE)! The National

Review of Progress in Quantitative Nondestructive Evaluation, Vol. 12
Edited by D.O. Thompson and D.E. Chimenti, Plenum Press, New York, 1993

Laboratories are pioneering some fascinating new concepts in NDE. They are also putting some new twists on some very old NDE technologies, such as Radiography, Tomography, and Ultrasonics, and are using these technologies to quantitatively characterize items as diverse as roads, bridges and nuclear waste containers. However, the labs do not have all of the answers... in one sense, that is what technology transfer is all about... putting together partnerships that will help us fully realize our national R&D goals.

LEGISLATIVE BACKGROUND

Let me take just a moment and look at the recent legislative background that is the basis for the current interest in technology transfer. Developing advanced technology and fully exploiting its capabilities in products, processes, and services are key to ensuring that U. S. business can compete successfully at home and abroad. In recognition of this fact, and of the increasing importance to U. S. national security represented by a strong economy, during the past ten years, the Federal government has put in place a set of laws and policies that have dramatically improved the private sector's ability to commercialize federally funded research. Principal among these laws and policies are:

- The Federal Technology Transfer Act of 1986 or FTTA, which:
  - Enabled government owned, government operated laboratories, which are often referred to as GOGOs, to participate in Cooperative Research and Development Agreements, commonly called CRADAs, with the private sector.
  - In addition, this law established The Federal Laboratory Consortium for Technology Transfer; and,
- A second statute of particular importance was the National Competitiveness Technology Transfer Act of 1989, or NCTTA, which:
  - Enabled government owned, contractor operated (GOCO) laboratories, (including the Department of Energy's GOCO system of laboratories) to also participate in CRADAs.

Just the fact that it took two laws spaced over a period of three years to recognize and allow the Federal labs to enter into the relatively new CRADA concept with the private sector is an indication that real technology transfer has had some significant obstacles to overcome.

CRADAs provide a means to leverage R&D efforts and to create teams for solving technological and industrial problems. Through CRADAs, companies, groups of companies, universities, and/or state and local governments can work with one or more federal laboratories to pool resources and share risks in developing technologies. The CRADA is an especially useful R&D relationship when the transfer of technology and subsequent transfer of rights are expected to be important to the collaborating parties in commercializing the technology.

CRADAs are potentially very flexible and provide benefits to both Government and private sector parties. The FTTA and NCTTA set the following conditions for a CRADA:

- First, the Federal contribution to the collaboration can involve the expenditure of Federal funds and the use of federal and contractor personnel, services, facilities, equipment, intellectual property and/or other resources. Under current law, no federal funds may flow directly to the CRADA partner, but the CRADA results do. The partner has the potential for substantial profits from commercializing these CRADA results.

- Second, non-federal participant contributions may, in addition to funds, include personnel, services, facilities, equipment, intellectual property and/or other resources.

- Third, preference is given to businesses that are located in the United States and undertake to manufacture substantially in the United States products that embody intellectual property developed under the CRADA or products that are produced using intellectual property developed under the CRADA.

- Fourth, the United States Government has a right to retain a nonexclusive, nontransferable, irrevocable, and paid-up license to practice any intellectual property developed under a CRADA for governmental purposes only. This does not mean that the Government will compete with the private sector. A major purpose of CRADAs is the profitable commercialization of CRADA results in the United States, and for the benefit of U. S. firms.

- This leads me to the fifth point, in fact, Federal laboratories may protect from public access commercially valuable information produced under CRADAs by both federal and non-federal participants for up to five years, as negotiated for each CRADA. Moreover, trade secrets or commercially valuable information that is privileged, or confidential information which is obtained in the conduct of research, or as a result of activities under a CRADA from a non-federal participant, will not be disclosed.

- And finally, the federal laboratory may in advance grant or agree to grant to a collaborating party exclusive patent licenses or assignments for all laboratory employee inventions made under the CRADA, further enhancing potential profitability.

Because of the efforts by the federal government and an increasing awareness by industry and academia of the importance of effective cooperative action to improve U. S. competitiveness, government-private sector ties have improved dramatically. But it hasn't been easy. In addition to the statutorily mandated specific requirements for CRADAs, there are a number of important principles that must be addressed whenever transfers of valuable property rights in high technology are considered. These include: fairness of opportunity, including small business, avoidance of conflicts of interest, assurance of a genuine collaborative effort, and national security considerations, including export control issues. Finally, a major "culture change" has been required.

CHANGING THE CULTURE

For years, Federal law required and government culture reinforced, stringent protection of technology that was classified or "sensitive", the definition of "sensitive was often broad and all-encompassing. Where "sensitive" or "classified" technology was not the issue, the concept that prevailed was that information generated by taxpayer funds was available to everyone, thereby demotivating private domestic R&D investment and partnerships with the government. Exclusive licensing of technology to a specific company, or protection of technology developed as a result of joint ventures was more than discouraged; it was prohibited. This policy worked well for the industrial competitors of the U. S., who were able to acquire free, technology developed at U. S. taxpayer expense. The FTTA and NCTTA changed the law, but changing the culture has taken rather longer. I know, I've been a part of the state of the art government technology system for almost twenty-five years. Real change is traumatic and we've been experiencing some trauma. But this is good, because real change is actually beginning to occur.

In one instance, Government Contracting Officers and Patent Lawyers, who previously had specific directions to prohibit preferential technology transfers, were asked to promote them. Government contractors, who had been encouraged to disseminate technology as widely as possible to anyone interested, were now asked to consider the intellectual property value and commercial potential of the technology before making dissemination decisions. Contracts had to be modified to allow costs for technology transfer. And the entire Government structure has had to learn, with little experience upon which to draw, how to deal effectively and cooperatively with industry. Industry also has had to learn about dealing cooperatively with Government. Finally, Government employees at all levels have had to learn to deal with a concept that is <u>really</u> foreign to their experience and training -- and that is the concept of <u>Risk</u>! And when I say "all levels" of government, I mean <u>all</u> levels ... right up to the top. A lot of you in industry, academia and the laboratory community are often times frustrated by the unwillingness of the typical government contracting officer to firmly embrace the concept of risk. Well let me tell you, you haven't lived until you've had to explain a failure, a mistake or an apparent inconsistency to the GAO, an IG, or a Congressional oversight or investigative committee. This results in what I call the "chicken" factor ... it's very real and just as sure as I'm standing here in front of you today, there will be a mistake, or a failure or an apparent inconsistency ... that's the nature of risk.

Admiral Watkins would probably draw an analogy at this point about the difficulty of trying to turn a battleship or aircraft carrier rapidly. The relationship between Government and industry works the same way. Major culture changes don't happen instantaneously, it takes time. But on the positive side, we're really changing direction.

For example, in the first two years after the passage of the NCTTA, the San Francisco Field Office, which encompasses 13,000 National Laboratory employees and 400 Federal employees, completed just two CRADAs. However, in the past six months, we have made technology transfer a management priority, applied significantly more resources to the effort, and have been able to approve more than 20 CRADAs, with at least that many in the negotiation process. We have also spent a great deal of productive time learning cooperatively with industry, and applying the lessons learned. Other Federal Departments and Agencies have had similar experiences.

This enhanced spirit of cooperation between Government and industry promises to be remarkably effective in eliminating what were formerly major barriers to the private sector's commercialization of new technologies, especially those developed by the federal laboratories.

The Federal Government's increased emphasis on technology transfer has not gone unnoticed by the media. A recent clip from ABC News is just a sample of an increasing amount of such media interest.

OVERVIEW OF THE NTI

The National Technology Initiative, or NTI, is an excellent example of the new cooperative spirit between government and industry. It is the most comprehensive government/private sector technology partnership program in U. S. history. The NTI is intended to promote a better understanding of opportunities for industry to commercialize new technology advances, through highlighting the Federal government's investment in science and technology with commercial potential. The NTI is an impressive across-the-board federal effort, principally initiated by the Secretaries of Energy and Commerce, and currently involving ten federal agencies: Commerce, Energy, Transportation, Agriculture, Defense, Interior, Health and Human Services, the Environmental Protection Agency, NASA, and the Office of Science and Technology Policy. Major independent roles are also played by semi-autonomous components of these principal agencies, such as the Small Business Administration and the National Institute of Science and Technology. Simply put, the goal of the NTI is to improve America's competitiveness in the global marketplace, through productive partnerships between the federal government and the private sector. I am particularly proud to have been a member of the group that met in Leesburg, Virginia last December and initially conceptualized the NTI.

Just two months later, on February 12, 1992, the NTI was announced by President Bush. The announcement was concurrent with the first NTI Conference, which was held at the Massachusetts Institute of Technology (MIT). In kicking off the NTI, the President said, "Look to the long-term, and we've got work to do . . . [There are] steps we can take right now to guarantee progress and prosperity into the next American Century. We get there by investing in the technologies of tomorrow, with federal support of R&D at record levels. We need to share the results, get the ideas generated by public funds out into the private sector, off the drawing board and onto store shelves. Our National Technology Initiative will do just that."

Admiral Watkins has emphasized consistently the importance of collaboration between the public and private sectors in achieving the goals of the NTI, saying, "Our NTI mission is straight-forward. We want to open up the research strength of the nation's 700-plus national laboratories to American industry. We want to get government, industry and academia all pulling in the same direction to improve America's industrial and manufacturing competitiveness. . . We're serious about this, the NTI truly represents a new and positive way for government to 'do business'. It's a 'Manhattan Project for American Competitiveness'".

The NTI conferences are one of the most visible and successful portions of a comprehensive government-wide initiative, which is intended to spur U. S. economic competitiveness by promoting a better understanding of the opportunities available for the private sector to commercialize new technology advances. A major feature and advantage of the NTI conference format is the opportunity it provides for representatives from Government, including its laboratories, industry and academia to discuss important issues "face to face". It has been said by a number of people that technology transfer is a "contact sport". NTI conferences provide an important forum for this essential contact. The current series of conferences has been held throughout the U. S. and culminated with the NTI Conference in Gaithersburg, Maryland on July 9.

Each NTI conference addresses manufacturing excellence, mechanisms for cooperative R&D, long-term investment and financing, and intellectual property. The program and technology focus for each conference has been different, with themes appropriate to the region of the country in which it was held. Featured technology areas have included: Environment, Biotechnology, Energy, Electronics, Aerospace, Food, Materials, Advanced Manufacturing, Communications, Life Sciences, and others.These conferences have proven to be so popular and beneficial that a second series has been scheduled, beginning in the Fall, at various other locations.

Also, beginning in September, in conjunction with the NTI, DOE and EPA will also host a series of workshops on environmental technology. These workshops will showcase existing DOE and EPA technologies and capabilities in the environmental sciences, with the goal of forming cooperative R&D efforts in this all-important and rapidly growing area of American expertise. In fact, when I think of the job that lies ahead for just DOE to clean up its sites, these workshops could not be more timely. We must have a cleaner America and it will take a successful partnership with industry and academia if we are going to be able to commercialize the technological advances and reduce the ultimate bill, which would otherwise be tens or even hundreds of billions of dollars.

OTHER TECHNOLOGY TRANSFER MECHANISMS

I've talked an awful lot about CRADAs, and they are the principal tool of both the NTI and related technology transfer programs. However, a great variety of previously existing technology transfer mechanisms continue to exist and should be used as appropriate. Some of these are:

- Information dissemination through publications or other documentation
- Federal financial assistance in the form of grants and cooperative agreements
- Cost-shared contracts and subcontracts
- R&D consortia
- Development of designated "User Facilities"
- Use of unique laboratory facilities
- Laboratory "Work For Others" programs
- Consulting services, visits and personnel exchanges
- Workshops, conferences and symposia
- Licensing of patents and other intellectual property
- Sponsored research where industry reimburses the laboratory for R&D
- Other jointly sponsored collaborative research projects

As you can see, we have an impressive array of assets at our disposal in the Government laboratory system and we must be as creative and persistent as possible if we are to fully utilize these taxpayers' investments.

AGENCY ROLES

Don Thompson asked that I tell you a bit about the roles that the various agencies play in the NTI, how they implement those rolès, and something about the coordination between agencies involved in the NTI. I'll briefly do that, however, what is perhaps most important, is the fact that if you have a particular interest, you contact the agency directly. Each agency operates a bit differently, but the goals are all the same, as I've noted ... to get the R&D out of the laboratories and into the U. S. market place. The contact points for each agency are included in Attachment 1.

First, at the Department of Commerce, technology and technology transfer are major missions. Within the Federal Government, Commerce has the lead technology transfer role. The principal vehicle for these activities is the Interagency Committee for Federal Laboratory Technology Transfer, which was established in 1987 by former Commerce Secretary Baldrige, and is comprised of Assistant Secretry-level representatives from all Federal agencies and departments involved in R&D. The committee's efforts are supported by a working group of senior personnel from each agency and department represented on the Committee. Consistent with these facts, Commerce has been a major sponsor and supporter of NTI activities. In-house technology transfer activities at Commerce are primarily carried out through its National Institute of Standards and Technology (NIST). Since launching the NTI, NIST has signed 43 additional CRADAs, bringing the Institutes's total number of such agreements to 224.

The National Aeronautics and Space Administration, more commonly known as NASA, has played a major role in the NTI since the beginning of the initiative. NASA has had a long and rich tradition of technology transfer, virtually from its inception. The 1958 Space Act, the law which established NASA, provides a broad mandate for NASA to direct space technologies for the general welfare of the country. Technology transfer activities are facilitated by 6 NASA Regional Technology Transfer Centers (RTTCs), and 17 Centers for the Commercial Development of Space, which are consortia of industry, university and government to conduct research on space-related technologies that have potential commercial application. NASA has also initiated an extensive review of its technology transfer program to determine additional opportunities to assist industry, and other government agencies, in leveraging NASA's technology assets. Administrator Goldin has directed his key officials to expand their technology transfer activities, particularly as they develop and employ advanced technologies in aeronautical research and space exploration.

The Environmental Protection Agency (EPA) believes that it has unique expertise to offer to industrial participants interested in doing collaborative R&D in environmental technology areas. EPA technical capability combines world-class expertise in environmental areas, with state-of-the-art equipment, fully permitted testing facilities and substantial experience in working efficiently and effectively in a regulatory environment. EPA has 35 CRADAs currently in place, with another 25 now being negotiated. Technologies addressed by these CRADAs range from air pollution reduction to methods for cleaning up oil spills, including bioremediation, a technology that uses bacteria to break down hazardous chemicals.

As might be expected, the Department of Defense (DoD), as the largest federal agency, plays a major role in the government's technology transfer program. DoD currently has more than 320 CRADAs with the private sector. Most technology transfer from DoD takes place through its R&D program, which is the largest of any federal agency's. The most active part of the DoD R&D program, from a technology transfer standpoint, is the science and technology portion, budgeted at about $11.5 billion per year.

Seventy percent of DoD's R&D is carried out in the private sector, so you might say that technology transfer takes place even before the work starts. In addition to contract work related to specific systems, there are two particularly noteworthy and effective DoD technology transfer activities; the Independent Research and Development (IRAD) and Small Business Innovation Research (SBIR) programs. IRAD performed by large defense contractors amounts to $5 billion annually, to which DoD contributes more than $2 billion. Of the $500 million per year contributed by Federal agencies to the SBIR, more than half comes from DoD.

The Department of Transportation (DOT), a very active participant in the NTI, has had scientific research and development, in partnership with the private sector, as one of its cornerstones since DOT's creation 25 years ago. DOT currently spends nearly half a billion dollars annually on research and development activities. One of the principal purposes of this R&D is to stimulate demonstration and commercialization actions by the private sector. With the passage of the new Surface Transportation Act, which further encourages technological research, DOT will be even more involved with the private sector in commercializing transportation technology. Since the NTI began, DOT has more than doubled its CRADA activity. Five new CRADAs have been signed, and six additional agreements are being developed.

At the Department of the Interior, most NTI and other technology transfer activity takes place through the Bureau of Mines, which is Interior's primary R&D organization. The Bureau of Mines' Office of Technology Transfer in Washington coordinates the activities at nine field locations across the country. In addition to 20 CRADAs currently in place, Interior is experiencing increasing interest from industry in licensing patents and other intellectual property.

Participation in the NTI and other technology transfer program activities at the Department of Health and Human Services (HHS) is principally through the National Institutes of Health (NIH). Although primarily a basic biomedical research agency, NIH has a very active and effective technology transfer program. The NIH program stresses both NIH's basic biomedical research mission and the principle that public health and U. S. industrial competitiveness are served by the efficient transfer of technology to U. S. industry. NIH is seeking to successfully balance their commitment to technology transfer and U. S. competitiveness against the need for free exchange of basic research findings and information. NIH technology transfer policy requires public disclosure of NIH sponsored research results and does not permit research findings to be treated as trade secrets, made available only to corporate collaborators, such as CRADA partners.

The Department of Agriculture (USDA) now has 276 CRADAs, with another 35 in process. The principal in-house research agency of the USDA, the Agricultural Research Service (ARS), with 120 locations nation-wide, has entered into 246 of these CRADAs. During the past year, ARS has also negotiated more than 25 licenses with industry, and a half-dozen new business enterprises have been launched based upon ARS technology. To further facilitate its technology transfer program, ARS has established four Product Utilization Centers, strategically located around the country. With the mounting public interest in "green consumerism", the USDA believes that it is in an excellent position to satisfy consumer needs with its technology.

I'm sure you'd be disappointed, and I would surely be delinquent, if I didn't also tell you a little bit about the DOE's efforts in support of the NTI. Because I am a DOE Field Office Manager, I can speak first-hand about this. Admiral Watkins, one of the government's most ardent advocates of improving the government's technology transfer programs, has made technology transfer a principal mission of the DOE and its laboratories. Because of his intense personal interest and support, he has:

- Attended almost all of the NTI conferences; and
- Given major speeches at each that he has attended; and,

- Used the occasions to memorialize a large number of CRADAs with industry, academia and a variety of consortia.

I can tell you that all of this personal interest and activity on the part of the Admiral has really kept all DOE Offices extremely involved in this effort. Other DOE activities in support of the NTI include:

- Major participation in all of the NTI conferences.

- A Memorandum of Understanding with NASA to improve technology development and cooperation among DOE & NASA scientists and engineers located in laboratories across the country. Similar agreements are being worked out with the Environmental Protection Agency, the Strategic Defense Initiative Agency and the Department of Transportation. What we're trying to do is to pool our resources and not artificially segregate our policies, practices or research activities. We all have a lot to learn from each other.

- Exploration with NASA on opportunities for DOE and NASA to jointly collaborate with industry. A recent example of such a collaboration is the CRADA recently developed by DOE's Oak Ridge National Laboratory with ABAXIS, Inc., a small Mountain View California biomedical company. Utilizing technology developed for NASA by the Oak Ridge National Laboratory, as part of a space mission, ABAXIS will soon be marketing a blood analyzer that will enable doctors to perform 13 in-office blood tests during a patient's visit, avoiding the expense and delay of sending blood samples to laboratories for later analysis.

THE NTI AT WORK

To date, we have used the NTI seminars to bring together more than 3,500 CEOs, entrepreneurs, small business owners, corporate managers, and academicians, and Federal program and laboratory officials. The response has been overwhelmingly positive. In fact, as a result of the NTI and related technology transfer efforts by government and the private sector, the federal government to date has entered into more than 1,000 CRADAs with private firms, consortia and state & local government agencies. DOE alone has approved more than 170 CRADAs, worth more than $225 million.

However, the success so far is just a beginning. Government technology transfer efforts are expanding and accelerating, as word of the NTI reaches more and more private sector entities. Those of us in the DOE technology transfer program tend to liken the current status of the NTI as being like "the tip of an iceberg". As more companies realize the potential advantages of cooperative arrangements with the national laboratories, including the potential for major profits, resulting from dramatic new and improved products and capabilities, we expect even more explosive program growth.

It's important to note that the NTI is not a give-away program. It is definitely a two-way street. Both government and the private sector profit from collaborative R&D, as do the taxpayers, who experience a much more substantial "return" on their past and present investment in government research. Part of that return comes from a very substantial R&D synergism which is beginning to develop between the Federal laboratories and industry.

The National Laboratories, in many cases, have world-class, multi -disciplinary research and computer modeling capability, but lack major facilities for parallel empirical testing, especially on an industrial scale, of the many innovative concepts they are so well-equipped to develop. They also lack industrial know-how and current commercial information which could potentially increase the relevance of their research direction. Industry, on the other hand, is well equipped to provide the industrial-scale test bed & commercial know-how that the labs lack, but often is not able to muster the large multi-disciplinary research teams and computer support which the National Laboratories possess in abundance.

Just the other day, one of my staff was telling me about a Lawrence Livermore National Laboratory scientist who was marveling at the capability of a company with which he was working, for simultaneous parametric testing of large numbers of sample ceramic-coated pistons. On a normal laboratory scale, the scientist might be able to test one, or at most a few samples at a time, limited by both production and testing facilities. The company, on the other hand, could produce 60 pistons an hour, and test an entire batch of items simultaneously. These differences are the basis for profitable relationships and possibly successful technology transfer.

There are two additional points that I'd like to make about the NTI. The first is that small business plays an important and growing role in the NTI. About 25% of the CRADAs now in effect are with small businesses, and we in government are working to make this number even larger. Working with the national laboratories, small businesses can gain access to equipment, techniques, materials, technology and know-how that they otherwise might never be able to afford. The laboratories benefit from the fresh and innovative thinking common in small business, and American taxpayers also benefit, because small businesses have a history of creating two to three times their proportionate share of new jobs, compared to other economic sectors.

We are also strongly encouraging participation in the NTI by businesses owned or operated by minorities and women. America will begin to reach its full potential only when all segments of our society have the opportunity to reach their full potential. Only when <u>all</u> of the best talents and abilities of <u>all</u> of our people are fully realized and utilized will the rest of the world realize just how productive America can be.

The agencies involved in the NTI are preparing an interim report which will document the goals of the NTI and the major issues identified by NTI participants. It will also summarize events and evaluate accomplishments to date.

SOME TECHNOLOGY EXAMPLES

I am not an expert in the NDE technology arena, however, Don Thompson asked that I give you just a small sample of some of the technology that is currently being developed cooperatively with the private sector and/or is available from the Federal Laboratories for further collaborative R&D arrangements. I'm grateful to the many laboratories which have shared examples with me.

I've identified the laboratory involved in the technology examples which follow, so that you'll know where to go and whom to contact if you'd like more information regarding the specific application described.

MAGNETOENCEPHALOGRAPHY

The National Institute of Neurological Disorders and Stroke, in cooperation with researchers at other Department of Health and Human Services facilities and contractors, has been exploring a number of new non-invasive brain imaging techniques. The techniques, which allow direct observation of deep brain structures and their functional activities, are part of a major emphasis on basic brain sciences during the "Decade of the Brain". These new techniques for imaging and diagnosing brain disorders include positron emission tomography (PET), magnetic resonance imaging (MRI), and magnetoencephalography (MEG), of which MEG is the newest. MEG makes use of a magnetometer to measure, outside the brain, the magnetic fields created by the small electrical currents produced by nerve cells in the brain. Extraordinary three-dimensional localizations of brain lesions are being made possible by this new physiologic technique.

NON-CONTACT THERMOGRAPHY

The NASA Langley Research Center has developed an advanced, portable, thermographic technique for field inspection of aging aircraft. The technique measures the thermal energy flux passing into the aircraft skin and bonded substructures, and enables the identification, external to the aircraft fuselage, of disbonded stringers and stiffeners, as well as other defects, hidden from view within an airplane skin. In addition to its portability, the technique is rapid, requiring less than a minute per square meter of surface to be tested.

RESONANT ULTRASONIC INSPECTION

Los Alamos National Laboratory has developed a new ultrasonic inspection technique which substantially increases the speed and reliability of such testing, while decreasing cost by more than half. Whereas mass-produced electronics and software for conventional ultrasonic testing would sell for more than \$10,000, electronics and software for the Los Alamos technique could sell for as little as \$4,000. The Los Alamos technique also allows the examination of objects previously impossible to inspect ultrasonically. Finally, because the technique measures resonances, much as one might measure the ring of a bell, the flaw being searched for does not need to be near or on the line of sight of either transducer, as it must be for all other ultrasonic tests. Thus a complex or difficult-to-access object can be scanned for flaws from a single transducer setup.

HYDROPHYSICAL LOGGING PROCEDURE FOR CHARACTERIZING GROUNDWATER CONTAMINATION

A recently developed Lawrence Berkeley Laboratory (LBL) technology combines unique interpretation software with advanced downhole hydrophysical logging instrumentation to quantify inflow locations, flow rates and basic water parameters, such as pH, oxidation-reduction potential, fluid electrical conductivity, dissolved oxygen and temperature. By coupling the hydrophysical logging technique with downhole fluid sampling, a complete assessment of contaminant concentration and point of origin is possible.

LUNG DENSITY MONITOR FOR MEASUREMENT OF PULMONARY EDEMA

Another LBL advance involves a non-invasive lung density monitor. The device monitors small amounts of backscattered radiation, with a risk of radiation exposure to the patient that is a thousand times less than that from a typical chest X-Ray. Accurate lung density measurements with great sensitivity are achieved by the incorporation of a unique scheme that extracts pertinent data while minimizing background "noise" caused by multiple scattering off the variable chest wall.

CHARACTERIZATION OF HETEROGENEOUS MATERIALS BY POSITRON EMISSION

Brookhaven National Laboratory is developing a technique for a non -destructive probe of heterostructures, such as semiconductor devices, by using a variable-energy positron beam to annihilate electrons at structure interfaces. The gamma ray emissions which result are then quantified by measuring the Doppler broadening of resultant photopeaks.

MAGNETIC RESONANCE IMAGING

To supplement the physical density distribution information provided by computed tomography, Argonne National Laboratory has been experimenting with ways to use magnetic resonance imaging, to determine the chemical composition of solids. To do this, Argonne researchers have used the fact that different materials have different nuclear magnetic resonance response characteristics, to develop a technique to nondestructively probe the complex chemistry in ceramics throughout the manufacturing process. Using the MRI data, technicians can examine the uniformity of distribution of chemicals, such as binders, and make adjustments in the processing steps until consistent results are achieved.

CHARACTERIZATION OF WASTE CONTAINERS BY REAL-TIME RADIOGRAPHY AND COMPUTED TOMOGRAPHY

It's probably obvious that our nuclear weapons design laboratories have a very active interest in non-proliferation and verification. What may not be so obvious is that the entire nuclear community must get its collective act together regarding the characterization and disposal of mixed waste. A technique combining active and passive computed tomography has enabled Lawrence Livermore National Laboratory (LLNL) to address effectively a difficult problem, namely, the nondestructive, quantitative characterization of radioactive waste materials in 55-gallon waste drums and other containers. This technique is potentially very important in minimizing the amount of waste that must be assumed to be transuranic, and disposed of consistent with that assumption, because of the lack of a method to demonstrate, through accurate quantification, a more benign characterization. Non-radioactive waste containers can also be inspected by radiography and computed tomography to determine their proper disposal category.

X-RAY TOMOGRAPHIC MICROSCOPY

LLNL has developed an X-Ray tomographic microscope, or XTM, which permits NDE characterization of microstructures of materials, with 100 times better resolution than possible with conventional computed tomography. The XTM allows researchers to actually witness the formation and growth of cracks and delaminations as a test specimen is subjected to distortion or deformation. This technique has proven especially useful in locating fundamental failure mechanisms in composite materials.

HOLOGRAPHIC INTERFEROMETRY

Sandia National Laboratories (SNL) has developed a technique using holographic interferometry to measure residual tensile stress in manufactured parts. The method uses the interference of laser light to determine microscopic changes in the shape of a surface, as residual stress is relieved in a small region. The technique is not, strictly speaking, a non-destructive test, since a small hole (about 1 mm deep and 1 mm in diameter) is drilled in the part being tested. However, holographic interferometry shows great promise for industrial application because it is extremely accurate and can be performed in minutes, in contrast to the hours required to gather comparable data by conventional residual stress measurement techniques.

REAL-TIME ULTRASONIC IMAGING

Pacific Northwest Laboratory has developed a real-time ultrasonic imaging system, called RTUIS, which allows characterization of large-area composite materials by combining ultrasonic inspection with optical and video technology. Sample-induced changes in the RTUIS beam are quantified by means of a holographic interference pattern of the sample-transmitted beam and an ultrasonic reference beam. Standard video equipment is used to record, view, manipulate, and analyze the resulting images.

USING NDE FOR INTELLIGENT PROCESS CONTROL

NDE research at the Idaho National Engineering Laboratory (INEL) has produced very specialized capabilities for using noncontacting sensors for intelligent control of advanced materials processes. The basic idea behind this research is simple, but powerful. Instead of using NDE in the traditional sense to find flaws after they occur, the thrust of this research is to <u>prevent</u> the formation of defects by using sensors and intelligent process control schemes, such as fuzzy logic control systems. Much of the research at the INEL has been directed toward the development of laser acoustic sensors to provide control information for processes such as metals casting, welding, ceramic sintering and composite fabrication.

USING COMPUTERS TO COMBINE AND ENHANCE NDE TECHNIQUES

The explosive growth in computer capability over the past ten years, and the word-class experts available at the National Laboratories in a wide range of scientific and engineering disciplines, have allowed the laboratories to combine synergistically, for parallel analysis, a number of NDE techniques. Thus, material and defect characterization that previously required serial analysis, and frequently time consuming empirical experimentation, can now be accomplished through computer analysis of multimode NDE images. A typical synergism of this sort might include parallel analysis of digitized, simultaneous, radiography, computed tomography, infrared, and ultrasonics.

CONCURRENT ENGINEERING

Another concept that is a natural for the multi-disciplinary capabilities of the

National Laboratories is concurrent engineering, the simultaneous design of a product and the processes required to produce and inspect it. Although the concept itself is not new, effective use of concurrent engineering has benefited greatly from recent advances in computer speed and capability. Because of its promise to optimize design, manufacturability and inspectability, while minimizing defects, cost, and time, concurrent engineering is increasingly being seen by both industry and the National Laboratories as a potential key to improved U. S. industrial competitiveness.

Typical interdisciplinary concurrent engineering teams at the National Laboratories might include physicists, chemists, electronic engineers, and of course, NDE engineers. Such a team brings to bear capabilities ranging from signal and image processing, to gauging and sensor design and, utilizing the powerful computational tools now available, should be able, according to a recent study by the National Institute of Standards & Technology, to reduce development time by up to 70%, while significantly improving quality and productivity.

THE CONSORTIUM PHENOMENON

Consortia carry the concept of interdisciplinary cooperation a step further. Even though the concept of industry consortia is not per se new to the technology transfer program, lately we have been noticing an increasing tendency for both government and industry groups to cooperate on the same project. An example of this phenomenon in the realm of NDE is a project recently proposed jointly by the four National Weapons Laboratories, Idaho National Engineering Laboratory, the Allied Signal Kansas City DOE production plant, and an industry group, initially comprising several General Motors divisions, but also expected to involve Ford, Chrysler and other U. S. based transportation industry manufacturers.

As I previously indicated, these technology examples represent only a small sample of those which are available from the Federal Laboratories for cooperative ventures with the private sector. To assist you in accessing the Federal laboratories, I have provided as attachments to the transcript of this talk:

- A list of principal NTI Points of Contact, through whom more specific information about the NTI is available.
- A list of the Offices of Research and Technology Application (ORTAs) at the National Laboratories; and,
- A list of principal Federal Laboratory Consortium (FLC) contacts, through whom all of the Federal laboratories can be accessed, as well as background information on the FLC's history and purpose.

- A List of the just concluded series of NTI conferences, as well as the additional NTI conferences planned for this fall, and the related DOE/EPA Environmental Technology Workshops.

I have left copies of the transcript with the Conference staff for reproduction, and have a limited number of separate copies of the attachments, which will be available at the conclusion of this session. Some of you might want to get on DOE's mailing list for technology transfer publications. To do so, just call DOE's Office of Technology Utilization at the telephone number which is provided in Attachment 1.

CONCLUSION

As you can see, the NTI is more than just Government agencies and conferences, and in some respects is only a first step toward coordinating and improving Government/industry collaboration. The next step is to act on what we have learned at NTI conferences and as a result of other interactions with industry. If we can do this well, the future looks very promising for increasing the effective cooperation between industry and Government. Such cooperation has the promise of substantially improving U. S. competitiveness, while building on the synergistic skills available in industry and the government laboratories, to realize dramatic new advances in technology.

The world in the 21st century will almost certainly be very different from today. Some changes will be positive, such as:

- Instant world-wide communication.
- Elimination of many national political and trade barriers; and,
- Vastly increased technological capabilities.

However, we will be called upon to use these positive changes and capabilities, to address much more effectively than we have been able to do to date, major challenges, including:

- Large increases in population, coupled with limited food and fossil energy supplies.
- Increasing costs to find and develop increasingly scarce natural resources.
- Global warming and increasing pollution; and,
- An increasingly bi-modal class structure between educated industrial societies and under-educated agrarian societies.

The NTI has a crucial role in addressing these issues and in implementing U. S. technology transfer policy, as articulated in the NCTTA and related statutes. This role is to provide an effective interface between Government and industry, as they work together to improve U. S. competitiveness in the global marketplace. The billions of dollars invested in Federal laboratory R&D

programs over the decades have made them a world-class resource for science and technology, and the "crown jewels" of U. S. scientific capability. The taxpayers of this country have a right to expect that this capability, so vital to U. S. competitiveness, is developed effectively and synergistically with the private sector.

In conclusion, I have a vision of Government, industry and academia working together, to translate the incredible potential for intellectual innovation that has long been a hallmark of U. S. technical leadership, into products and capabilities that will effectively address these challenges, and lead the world into the 21st century. I invite you to share in this vision and in the opportunities which it presents. Thank you.

Attachment 1:	NTI Agency Points of Contact
Attachment 2:	National Laboratory Offices of Research and Technology Application (ORTAs)
Attachment 3:	List of Federal Laboratory Consortium (FLC) Points of Contact

NATIONAL TECHNOLOGY INITIATIVE

TECHNOLOGY COMMERCIALIZATION CONTACTS

Department of Commerce

Jon Paugh
Acting Director,
Office Technology Commercialization
Technology Administration
(202) 377-8100

David Edgerly
Deputy Director,
Technology ServicesNational Institute
of Standards and Technology
Technology Administration
(301) 975-4500

Walter L. Finch
Associate Director
Office of Program and Product
Management National Technical
Information Service
Technology Administration
(703) 487-4674

Department of Energy

Cherri J. Langenfeld
Director of Technology Utilization
(202) 586-5388

Antionette Grayson Joseph
Deputy Science and Technology Advisor
for Civilian Laboratories
Office of Energy Research
(202) 586-5447

Warren P. Chernock
Deputy Science and Technology Advisor
for Defense Programs
(202) 586-7590

Department of Agriculture

Dr. William H. Tallent
Assistant Administrator
Agricultural Research Services
(202) 720-3973

Louise Brunsdale
Confidential Assistant to the
Administrator
Agricultural Research Service
(202) 205-7836

Department of Health and
Human Services

Frank Young, M. D.
Deputy Assistant Secretary for
Health, Science and Environment
(202) 690-6811

Reid Adler
Director, Division of
Technology Transfer
National Institutes of Health
301-496-0750

Department of Defense

Dr. Leo Young
Office of the Director of Defense
Research and Engineering/
Engineering Technology
(703) 697-7922

Attachment 1

National Aeronautics and
Space Administration

Frank E. Penaranda
Acting Director, Technology Utilization
Office of Commercial Programs
NASA Headquarters
(703) 557-8160

Dr. William Gasko
Director
Center for Technology Commercialization
Northeast Regional Technology Transfer
Network
(508) 870-0042

NASA Scientific and Technical
Information Facility
Technology Utilization Office
(301) 859-5300, ext. 242 or 243

Department of Transportation

Alfonso Linhares
Director
Office of Research Policy and
Technology Transfer, Research and
Special Programs Administration
(202) 366-4208

John Hohl
Office of Research Policy and
Technology Transfer
Special Programs Administration
(202) 366-4978

Environmental Protection
Agency

Michael G. Moore
Director, Technology Transfer Staff
(202) 260-7671

Office of Science and Technology
Policy

Dr. Eugene Wong
Associate Director For Industrial
Technology
(202) 456-7710

Department of the Interior

Donald Ralston
Technology Transfer Officer
U. S. Bureau of Mines
(202) 501-9316

Philip Koltos
Patent Attorney
Office of the Solicitor
(202) 208-4471

Attachment 1

NATIONAL LABORATORY OFFICES OF RESEARCH AND TECHNOLOGY APPLICATIONS (ORTAs)

Dr. Paul Betten
Argonne National Laboratory
9700 South Cass Avenue, Bldg., 900
Argonne, IL 60439-4841
(708) 252-5361

Ms. Margaret C. Bogosian
Office Technology Transfer
Bldg., 902C
Brookhaven National Laboratory
Upton, NY 11973
(516) 282-1571

Mr. Richard D. Holman
Office of Research and Technology Applications
Idaho National Engineering Laboratory
EG&G Idaho, Inc.
P. O. Box 1625
Idaho Falls, ID 83415-3551
(208) 526-1571

Ms. Cheryl Fragiadakis
Technology Transfer Program Manager
Lawrence Berkeley Laboratory
1 Cyclotron Road, MS-90-1070
Berkeley, CA 94720
(510) 486-7020

Mr. Marv Clement
Pacific Northwest Laboratory
P. O. Box 999
Richland, WA 99352
(509) 375-2739

Mr. Dallas Martin
National Renewable Energy Laboratory
1617 Cole Blvd.
Golden, CO 80401
(303) 231-1198

Mr. Gilbert Marguth
Lawrence Livermore National Laboratory
P. O. Box 808, L-795
Livermore, CA 94551
(510) 422-6416

Ms. Charryl Berger
Los Alamos National Laboratory
P. O. 1663, MS M899
Los Almos, NM 87545
(505) 665-9092

Mr. Jon Soderstrom
Martin Marietta Energy Systems, Inc.
Oak Ridge National Laboratory
P. O. Box 2009
Oak Ridge, TN 37831-8218
(615) 576-4680

Dr. Roy Hamil, Dept. 4201
Technology Transfer Applications
Sandia National Laboratories
P. O. Box 5800
Albuquerque, NM 87185
(505) 845-8415

Attachment 2

EASY ACCESS TO THE FLC
THROUGH REGIONAL CONTACTS

To take advantage of the FLC network and access the federal R&D laboratories and centers, contact the FLC Regional Coordinator responsible for your area. The Regional Coordinator working with the FLC Locator will assist you in locating a specific laboratory to help meet your requests or solve your problem.

FLC NATIONAL CONTACTS

FLC CHAIRMAN
Dr. Loren Schmid
DOE-Pacific Northwest Laboratory
P.O. Box 999 - K1-34
Richland, WA 99352
(509) 375-2559

FLC VICE-CHAIRMAN
Ms. Margaret McNamara
DOD-Naval Undersea Warfare Ctr. Div., Newport (RI)
New London Detachment, Code 105, Bldg. 80T
New London, CT 06320
(203) 440-4590

FLC ADMINISTRATOR
Mr. George Linsteadt
DelaBarre & Associates, Inc.
P.O. Box 545
Sequim, WA 98382
(206) 683-1005

FLC LOCATOR
Dr. Andrew Cowan
DelaBarre & Associates, Inc.
P.O. Box 545
Sequim, WA 98382
(206) 683-1005

FLC REGIONAL CONTACTS

FAR WEST REGION
REGIONAL COORDINATOR
Ms. Diana Jackson
DOD-Naval Command Control
Ocean Surveillance Center
(619) 553-2101
DEPUTY COORDINATOR
Mr. Charles Newmyer
Naval Air Warfare Center-
Weapons Division
(619) 939-1074

MIDWEST REGION
REGIONAL COORDINATOR
Dr. Paul Betten
DOE-Argonne National Laboratory
(708) 252-5361
DEPUTY COORDINATOR
Mr. T. F. Schoenborn
HHS-Nat'l Inst. for Occupational
Safety & Health
(513) 841-4305

NORTHEAST REGION
REGIONAL COORDINATOR
Mr. Al Lupinetti
DOT-Federal Aviation Administration
Technical Center
(609) 484-6689
DEPUTY COORDINATOR
Ms. Dorry Tooker
DOE-Brookhaven Nat'l Laboratory
(516) 282-2078

MID-ATLANTIC REGION
REGIONAL COORDINATOR
Dr. Richard Rein
DOD-Naval Research Laboratory
(202) 767-3744
DEPUTY COORDINATOR
Ms. Norma Vaught
Army Harry Diamond Laboratories
(301) 394-2952

MIDCONTINENT REGION
DEPUTY COORDINATOR NORTH
Mr. Joseph Berke
DOC-NIST
(303) 497-7038
DEPUTY COORDINATOR SOUTH
Mr. Douglas Blair
Air Force Armstrong Lagoratory
(512) 536-2838

SOUTHEAST REGION
REGIONAL COORDINATOR
Mr. H. Brown Wright
Tennessee Valley Authority
(615) 632-6435
DEPUTY COORDINATOR
Mr. Eric Greene
HHS-Centers for Disease Control
(404) 639-3812

WASHINGTON, DC REP
Dr. Beverly Berger
1550 M Street, N.W.
11th Floor
Washington, DC 20005
(202) 331-4220

Attachment 3