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Technology Transfer at the Department of Energy Laboratories -Selected Case Studies from the Lawrence Livermore Laboratory

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TECHNOLOGY TRANSFER AT DEPARTMENT OF ENERGY LABORATORIES - SELECTED CASE STUDIES FROM THE LAWRENCE LIVERMORE LABORATORY

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ABSTRACT

The U.S. Department of Energy has, by transfer from the U.S. Energy and Research Development Administration, continued the policy of programs for dissemination of information. By the language of the charter, this extends to scientific, technical and practical information. Thus, DOE has a statutory responsibility to ensure full and widespread transfer of its technology.

Each Laboratory conducts its own Technology Transfer Program as an integral part of the National Program, and the activities of the Laboratories are directed towards the National Goals. Because of specific and sometimes different needs in the various geographical regions and the different styles of technology transfer, the methods used by each DOE Laboratory to achieve technology transfer vary. This paper describes the DOE Laboratory Technology Transfer Programs and, in general terms, some of the activities of the various participants. In addition, a discussion of some of Lawrence Livermore Laboratory's accomplishments in technology transfer is presented.

INTRODUCTION

The legislation which authorized the establishment of the U.S. Department of Energy was passed by Congress on July 26, 1977.[1] The legislation had references to the necessity of "disseminating information," "dissemination to the public of all available information on energy conservation programs and measures," "disseminating information on the commercial feasibility and use of energy from fossil, nuclear, solar, geothermal, and other energy technologies," and other strong admonitions to ensure that technology developed by DOE be transferred to places where it can do some good. In addition, it said, "there are hereby transferred to ... the Secretary all of the functions vested by law in the Administrator of the Federal Energy Administration or the Federal Energy Administration, the Administrator of the Energy Research and Development Administration..." This statement transferred intact all of the mandates to transfer technology which existed in the previous organizations. An example of this for the Energy Research and Development Administration is: "...the Administration shall disseminate scientific, technical and practical information programs and other appropriate means, and shall encourage the dissemination of scientific, technical and practical information relating to energy so as to enlarge the fund of such information and to provide that free interchange of ideas and criticism which is essential to scientific and industrial progress and public understanding."[2]

In addition to those programs with inherent technology transfer elements, DOE is committed to achieving maximum utilization of all technologies arising from its research activities. Each DOE Laboratory is encouraged to support efforts to spinoff specific and useful DOE technologies from the Laboratory to the general public, to industry, and to state and local governmental entities. The technologies may consist of ideas, hardware, processes, special facilities, technical projects, developments, and individual expertise.

The various DOE Laboratories conduct their own Technology Transfer Programs as an integral part of the National Program. Because of the specific and sometimes different needs in the various geographical regions, and the different styles of technology transfer, the methods used by each DOE Laboratory to achieve technology transfer vary. This paper describes some of the DOE Laboratory technology transfer programs to illustrate various approaches. It also gives a brief discussion of a few selected items from the Lawrence Livermore Laboratory experience in technology transfer.

VARIOUS TECHNOLOGY TRANSFER APPROACHES

There are a variety of different techniques that have been used in technology transfer. The first is the passive, "respond to requests made." This can have various modifications including wide distribution of "Fact Sheets" or "Industrial Cooperation Bulletins" to stimulate interest in the target community. Among other mechanisms are the use of existing, non-governmental information distribution networks such as local libraries or short courses at community colleges. Increasing levels of active involvement are also possible. Some laboratories have polled local groups as, for example, local chapters of the American Institute of Architects or the American Society of Plumbing Engineers as to their spectrum of needs. Such a polling can allow the sponsoring laboratory to target their information very effectively. Finally, at the most active level, laboratories have sponsored or co-sponsored workshops or seminars in the specific technology area. These workshops or seminars have been held at the laboratory, at a remote site convenient to the user community, or in conjunction with a regional or national professional meeting.

Spin-Off

An example of the technology spin-off approach is that followed by Oak Ridge National Laboratory with their Industrial Cooperation Bulletins. A wide distribution of these bulletins is made and inquires are handled in a responsive way.

Sandia Laboratories at Albuquerque, New Mexico also looks for technological developments which may have industrial applications and then uses a variety of means to publicize these developments. Key to this method of technology transfer is a good knowledge of laboratory capability as well as a feel for industrial needs. In some cases, laboratory needs have given rise to industrial developments which have, in turn, given rise to new, vigorous small businesses.

Use of Existing Networks

In many cases, an effective means of technology transfer is through existing information networks. For example, Oak Ridge National Laboratory has begun the establishment of statewide solar information networks by using the resources of state library systems, state energy offices and university energy centers. They are coordinating their program through the Southeastern Library Association who in turn work with the state library systems. Strangely enough, the public library system has been largely ignored by many of the federal programs concerned with disseminating technological information. ORNL has found these channels to be extremely cost effective and the people very enthusiastic.

Sensitivity to Local Needs

With all technology transfer activities, it is essential to understand local or regional special situations. Battelle Pacific Northwest Laboratories has developed a solar technology transfer program which is specific to their region and which has placed heavy reliance on input from local target groups. As an example, they have developed, in cooperation with the American Institute of Architects, an architect's solar short course. This came about largely because the cost of electric energy in the Pacific Northwest is so low that commercially installed active solar systems do not appear to be economically viable. On the other hand, passive solar systems may pay out more quickly. Since passive solar design tends to be a function of building structural features, floor plans, siting and landscaping, it was decided to focus on architects. PNL has also discovered that local and county building officials, assessors and appraisers have a need for technical information so that they can effectively consider the solar designs that architects bring to them. In developing this new technological field, PNL has remained sensitive to the local situation and has designed their technology transfer program to address the most appropriate points of need.

Active Outreach

Many of the U.S. Department of Energy Laboratories have technology transfer elements which can be classified under the active outreach category. Examples of these are the workshops and seminars which have been held under the auspices of the Lawrence Livermore Laboratory. For very well defined, programmatic needs, symposia have been scheduled at the Laboratory. This gives ready access to large or sensitive equipment which may be required for good information transfer. Sometimes, however, the target community may be more easily addressed at a site remote from the Laboratory but convenient to them. In such a case, we have found that co-sponsorship of the workshop with the local target community makes the workshop more effective. Finally, regional or national meetings have proved to be extremely effective mechanisms to address a user group which may be both homogeneous and interested. It may be that presentations at the sessions are a good way to expose the technology offered or a booth in the exhibit area featuring one or more specific, targeted technologies may be better. We have used both techniques with success.

SELECTED EXAMPLES FROM THE LAWRENCE LIVERMORE LABORATORY EXPERIENCE

The Lawrence Livermore Laboratory, located in the Livermore valley about 50 miles east of San Francisco, has experimented with a variety of technology transfer techniques over the years. While we use all of the technology transfer approaches mentioned, we are currently emphasizing active outreach. Three areas where we have effectively done this are:

- High technology laser development
- Solar technology transfer program
- Computer assisted pattern recognition

Exploitation of each of these areas utilized different technology transfer techniques, but they all relied heavily on very active interactions with contacts from outside of the Laboratory.

High Technology Laser Development[3]

The technology transfer technique used here was an intensive two-day symposium for top-level managers from firms with an interest in laser technology. The purpose, in this case, was to consolidate information and to transfer practical technology to industry from the 16-year-old laser fusion program at the Lawrence Livermore Laboratory. The range of developments in this program includes coordinated engineering and fabrication projects in optical components, greatly improved optical materials and processing techniques, and major advances in several supporting technologies (e.g., precision machining, fast-transient diagnostic systems, and large high-energy pulsed power systems) originally devised for nuclear weapons work. LLL spearheaded these laser-related developments but, wherever possible, through regular procurement procedures, contracted for the production designs and the actual building of components and subsystems by outside companies. Several firms thus became proficient as suppliers of advanced-state components and subsystems built to LLL specifications, but none had enough information or experiences to build complete high-power systems of the kind needed by LLL or others engaged in laser fusion research.

We wanted to eliminate this gap by transferring the necessary technology to industry in order to foster a broader and stronger industrial base for laser technology of the future.

As the first step, LLL prepared a special set of technical papers describing its current solid-state laser technology, to the level of detail needed by hardware manufacturers, for distribution at a special symposium. This was an intensive one-month task. LLL's legal and patent offices and ERDA's San Francisco Operations Office completed arrangements for authorizing the symposium, clearing the papers for public release, and providing standard agreement forms for use by companies seeking further information and assistance through continuing consulting arrangements with LLL and its employees.

LLL then conducted an intensive two-day symposium on solid-state laser components, assembly problems, and design details of a specific high-power laser amplifier. Invitations were sent to 250 top-level managers at firms and institutions with a known interest in laser technology. The meeting was advertised in The Wall Street Journal to reach firms whose possible interest in lasers was unknown. In all, 32 companies and institutions responded, sending 56 representatives to Livermore for the meeting.

It is now known that--as a result of the symposium, previous experience with LLL as a vendor, and subsequent exchanges of information--at least one of the attending companies successfully bid on delivery of a high-power laser amplifier system to the United Kingdom and another to Japan. Two or more of the other attending companies are expected to receive commercial subcontracts for components and to receive prime contracts for commercial systems. Nearly all of the companies attending the symposium continue to use the person-to-person communication links opened up by the symposium. Thus there has been a commercial innovation for LLL laser technology and indications are that the technology is continuing to diffuse in the marketplace under its own momentum.

Solar Technology Transfer Program[4]

The Solar Technology Transfer Program at the Lawrence Livermore Laboratory is an example of use of technology transfer techniques in transferring technologies from all of the DOE Laboratories, not just one. Strategies we are using in this program include:

- Customized information dissemination.
- Customized hands-on training.
- Building upon existing technology delivery systems.
- Establishment of self-sustaining infrastructures for a permanent solar industry.

Since the LLL/STTP effort started in May 1977, we have contacted various solar "multiplier groups" in California, Arizona, Nevada, and Hawaii, sponsored or co-sponsored a number of training activities, have provided technical assistance to numerous groups, and have made commitments for similar activities through March 1978.

Some examples of completed activities are:

1. California/Nevada Community Action Association (CAA)

LLL/STTP and CAA jointly sponsored a two-week program, held at San Jose City College on August 8-19, 1977, to train some 30 members of the CAA weatherization teams in the construction and installation of simple solar systems for producing hot water. About 40% of the program was spent in classroom instruction; the remaining time was devoted to shop training in appropriate manual skills and the construction of two breadbox and five thermosiphon hot water systems. These units will be circulated among the various local CAA units for further on-the-job training of the workshops attendees and initial training of other members of the weatherization teams. The two-week program was developed and presented by staff members of the San Jose City College, which provided the necessary space facilities. STTP funds provided the instructors, training materials, and the hardware used in the thermosiphon systems. CAA underwrote the attendees' living expenses. A syllabus of the course is being prepared by the instructors; it will be made available to any interested agencies and institutions. It is anticipated that, after some field experience, the trainees will be given further training and technical upgrading. Development of these follow-on activities is now in progress.

2. Arizona Community Action Association (ACAA)

Two, one-week training courses in simple low technology thermosiphon water heaters were held, one in Tucson and one in Flagstaff, Arizona. Community Action energy specialists were target students. The first offering was in Tucson, Arizona on October 3-7, 1977. Forty-nine were in attendance and the enthusiasm was high. The second session was held October 17-21 in Flagstaff, Arizona. While the attendance was somewhat reduced (~30), again the students were very enthusiastic. With these two workshops, seventeen out of nineteen of the Indian tribes in Arizona have been reached.

3. American Society of Plumbing Engineers (ASPE) - Los Angeles Chapter

A successful two-day workshop was held November 11-12, 1977 at the Marina City Club, Marina del Rey, California. The 35 attendees reported that the information presented by the workshop speakers, and the material distributed, greatly increased their competence to assess potential solar applications and to design cost effective solar systems. A custom, targeted workbook, which was assembled prior to the meeting and distributed to each participant, was judged to be an important part of this effective information transfer. The sessions were video taped for possible reuse in

other workshops. Interest is so high in this Chapter that plans are being developed to conduct a similar workshop on March 10-11, 1978.

4. Small Business Administration (SBA) and the Technology Transfer Society (T2S)

A one-day symposium "New Business Opportunities in the Solar Industry: Markets, Applications, Products, Services, Financing and Regulations" was held at the Los Angeles Bonaventure Hotel on January 19, 1978. Material was covered by experts in each of the areas, speaking from their personal experiences. The symposium was judged to be very successful by the 180 attendees. Based on the evaluation sheets, everyone felt that his time and money had been well spent and that the program should be presented again during the year. The three topics which were judged to be most useful to the audience were "markets," "applications" and "regulations." The specially assembled, targeted workbook was viewed as a critically important reference book by the majority of the audience.

5. American Institute of Plant Engineers (AIPE) - Santa Clara Section

The one-day meeting "Solar Workshop for the Plant Engineer" was held at the Bold Knight Restaurant in Sunnyvale, California on January 21, 1978. In this workshop, we attempted to cover those technical areas of interest to plant engineers as well as operating experience of installed systems. The success achieved can be illustrated by the fact that, based on the evaluation sheets, nearly everyone felt that his time and money had been well spent and that the program material was important to his business responsibilities. The topics considered to be most useful to the audience were "fundamentals of collector systems," "applications," and "lessons learned." The regional solar handbook was considered by most of the audience to be an important reference.

Computer Assisted Pattern Recognition[5]

The last example of an LLL technology transfer effort focuses on individual expertise and laboratory capability. Because of the data-analysis problems of several LLL research projects, a computer pattern recognition capability was developed at the Laboratory. The potential demonstrated by pattern recognition techniques in various physical and social sciences suggested that substantial advantages might be realized through applying these methods to crime analysis. LLL was requested to participate in a technology transfer effort with the City of San Diego, to investigate the usefulness of computerized pattern recognition in the context of police operations and crime analysis.

The goal of our program was to optimize the correlation model's variables to yield that information best suited to the police department in allocating manpower. Two hundred cases spanning the entire range of criminal activity represent a valid example of a single day's case load for the San Diego Police Department. Every day, supervisory personnel are faced with such case loads and must decide how best to allocate their limited manpower resources to resolve these crimes. If pattern recognition techniques could establish a priority list for case assignments, police supervisors would be freed from a large part of their routine administrative burden.

The actual prediction algorithm, once developed by a large general purpose computer, is simple enough to be implemented on the portable, programmable calculators now on the market. One of these calculators was programmed for use by the assignments officer of the San Diego Police Burglary Division and makes available to him, 24 hours a day, in real time, these predictive numbers. The effects of this operational application of pattern recognition techniques to the problem of manpower allocation of investigative personnel are still being studied.

There yet remains one last step in the San Diego/LLL program. This last step is the actual selection, refinement and implementation of the various techniques for use. When the appropriate pattern recognition techniques have been integrated into the regional justice system in an effective and usable manner, only then will this technology transfer project have been completed.

CONCLUSIONS

In support of the DOE emphasis on making technology readily available to the public, each of the DOE Laboratories has a technology transfer emphasis. Because of the differing laboratory missions, as well as differing local and regional situations, means of carrying out these efforts vary from laboratory to laboratory. In spite of these variations in technique, there are certain basic principles which underlie most successful technology transfer efforts.[3,6] In our experience most important basic principles are:

- The technology transfer effort must be a full-time, supported and directed effort on the part of the technology source.
- Technology transfer agents, in the field, with access to adequate technical resources and with a high degree of freedom for independent action are essential.
- Person-to-person contacts, over a long period of time, between the transfer agents and the receptors in the field, are necessary for effective transfer.
- These agents must have the freedom and the motivation to aggressively seek opportunities and to respond satisfactorily and in a timely manner to all requests for assistance.
- Participation of the recipient early in the transfer process is most useful.
- Merely providing information in the form of reports is usually not sufficient to

effect transfers. Often, additional development work (tailoring a solution to a problem) and/or training the receptor in the use of a technical fix is required. Support for this must be available.

- The transfer of a technology will be completed when the technology becomes generally accepted practice, or when the chief officer of a receiving unit routinely assesses available technology when presented with a problem, or when the technology is readily available in the marketplace.
- The transfer of technologies to receptors is an integrating process, involving considerable effort on the part of the receptor as well as the source and sometimes involving assistance from other sources, receptors, or technology "brokers."
- The rewards of being an effective change agent are intangible but are, nonetheless, extremely gratifying.

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