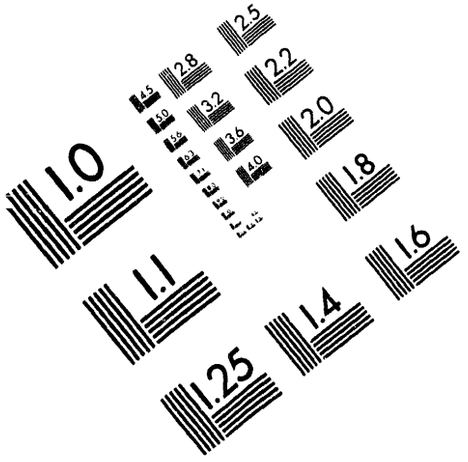

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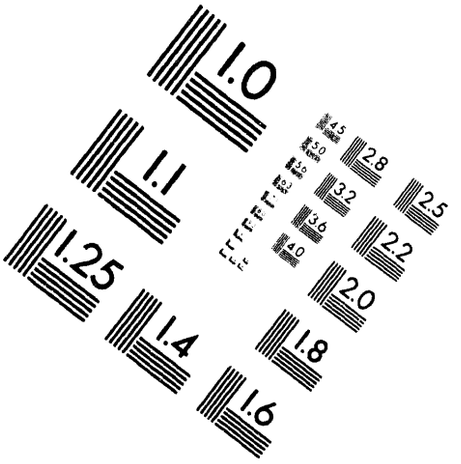

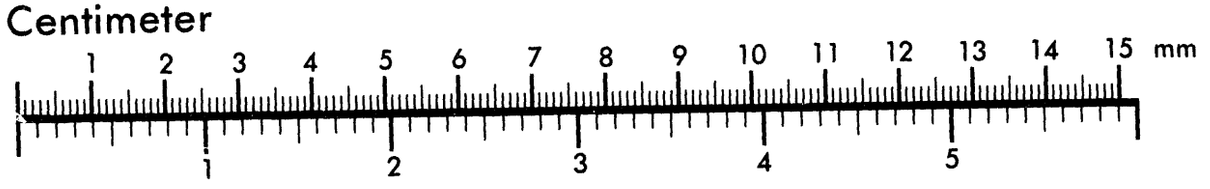

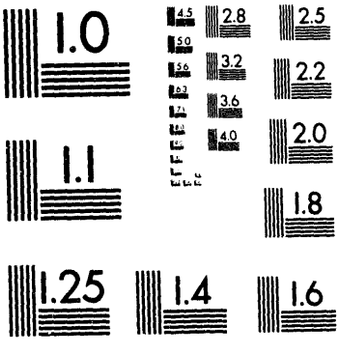

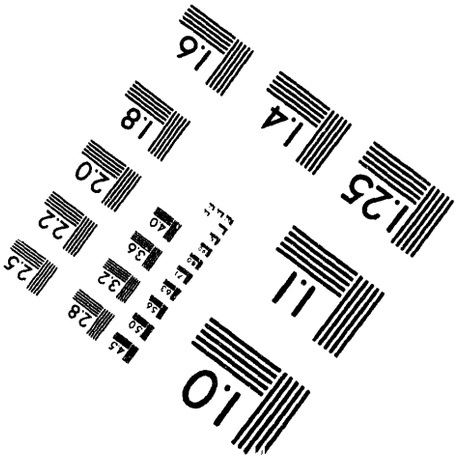

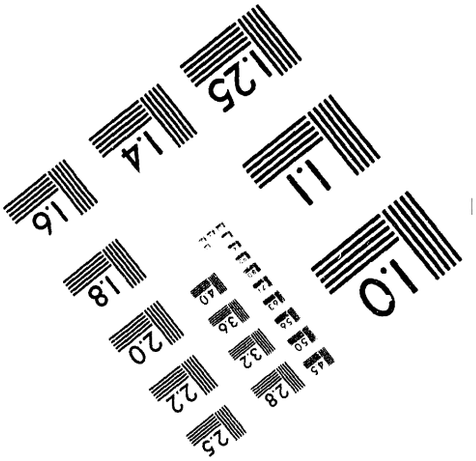

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TRANSFERRING NEW TECHNOLOGIES WITHIN THE FEDERAL SECTOR: THE NEW TECHNOLOGY DEMONSTRATION PROGRAM

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DISCLAIMER

Transferring New Technologies Within the Federal Sector: The New Technology Demonstration Program

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H:1. SYNOPSIS

Within the context of the U.S. Department of Energy New Technology Demonstration Program, this paper explains how a new technology demonstration project is identified, supported, and implemented at a federal site, and the results communicated throughout the federal sector.

H:2. ABSTRACT

The federal sector is the largest consumer of products in the United States and annually purchases almost 1.5 quads of energy measured at the building site at a cost of almost $10 billion (U.S. Department of Energy 1991). A review of design, construction, and procurement practices in the federal sector, as well as discussions with manufacturers and vendors, indicated that new technologies are not utilized in as timely a manner as possible. As a consequence of this technology transfer lag, the federal sector loses valuable energy and environmental benefits that can be derived through the application of new technologies. In addition, opportunities are lost to reduce federal energy expenditures and spur U.S. economic growth through the procurement of such technologies.

In 1990, under the direction of the U.S. Department of Energy (DOE) Federal Energy Management Program, the Pacific Northwest Laboratory began the design of a program to accelerate the introduction of new U.S. technologies into the federal sector. Designated first as the Test Bed Demonstration Program and more recently the New Technology Demonstration Program, it sought to shorten the acceptance period of new technologies within the federal sector. By installing and evaluating various new technologies at federal facilities, the Program attempts to increase the acceptance of those new technologies through the results of "real-world" federal installations. Since that time, the Program has conducted new technology demonstrations and evaluations, evolved to address the need for more timely information transfer, and explored collaborative opportunities with other DOE offices and laboratories. This paper explains the processes by which a new technology demonstration project is implemented and presents a general description of the Program results to date.

H:3. INTRODUCTION

The increased use of new technologies can improve the efficiency of energy resource use, leading to reduced facility operating costs and environmental benefits. When focused on U.S. technologies, economic growth also can occur. Manufacturers of new technologies must work with the investment community, utilities, and other parties interested in the technologies' development and application. Through various market forces and sales efforts, those new technologies are typically adopted more quickly in the private than in the federal sector.

To improve the rate of technology transfer within the federal sector, the U.S. Department of Energy (DOE) Federal Energy Management Program (FEMP) has been involved in numerous activities. One program, begun in 1990, is the New Technology Demonstration Program (formerly called the Test

Bed Demonstration Program). The purpose of the Program is to secure more timely adoption and widespread use of new U.S. technologies within the federal sector. This recognizes that the U.S. government is the largest consumer of products in the United States and has a significant impact on U.S. energy, economic, and environmental interests. One constraint in securing federal-sector adoption of new technologies is the lack of relevant data from federal installations upon which to base life-cycle cost analyses and procurement decisions.

It was decided that performance monitoring data and other information resulting from a sample installation of a new technology in a federal facility could help support required life-cycle cost analyses of future procurement decisions. However, a creative method to finance installation and evaluation of new technologies was needed; funds are typically not available to provide them to the sites because they are not recognized within the procurement system.

The National Competitiveness Technology Transfer Act (NCTTA) of 1989 formalizes the opportunity for the government and private industry to collaborate on technology development and transfer activities. A Cooperative Research and Development Agreement (CRADA), authorized under the NCTTA, is a contract between a federal laboratory representing the government and participant(s) from industry and/or a university who agree to collaborate and share costs and results. A CRADA provides a vehicle for making new technologies available to the federal sector for installation and evaluation.

Working with private industry, the New Technology Demonstration Program set out to identify relevant new U.S. technologies, secure public and private partners for demonstrations, evaluate the technologies, and communicate the results to the federal sector. Through cooperative relationships, the inability of the procurement process to readily recognize a new technology does not become a critical factor because the technology is not paid for by the federal government. With the installation and evaluation results, the procurement issue can be addressed, leading to more timely and increased use of new technologies.

Initial activities concentrated on the design of the Program and how it could be implemented most effectively. Through interaction with public and private interests, an initial program design was fashioned and new technologies were installed and evaluated. Based on almost 3 years of conducting new technology demonstrations, the program design was recently modified to address the amount of information available and the time it takes to get to the federal sector.

H:4. PROGRAM DESIGN

The Program has resource and manpower limitations. In addition, willing federal sites and private sector participants must be identified. Discussions in 1992 with representative manufacturers of new technologies indicated that they view this program as assisting their efforts to break into the federal market. With a virtually unlimited number of new technologies, technology areas for Program participation must be identified and prioritized. From those technology areas that promise the greatest benefits to the federal sector, willing participants in a demonstration project must be identified. A viable demonstration site must be selected, and the "business" side of the agreement negotiated.

Once a CRADA outlining all the details of the agreement is signed, the parties begin to implement the project. They plan the installation and how it will be evaluated. After the technology is instrumented

and installed, data are collected and analyzed. Following evaluation of the data, the results are compiled and communicated to the federal sector.

Because of the need to provide more timely information to the federal sector and to better utilize available resources, the Program added a technology digest component in April 1994. This addition recognizes that some "new" technologies may have been installed in the private sector and have some limited experience in the federal sector. Rather than evaluate another technology installation, the results of installations to date are gathered and reviewed, and a summary of those results, directed at the federal facility manager and procurement official, is written and distributed. This allows the installation and evaluation portion of the Program to focus on technologies just coming to market while facilitating concurrent evaluation and technology transfer efforts on "new" technologies with which there is some federal experience but which have yet to be widely adopted.

H:4.1. Technology Selections

Once the Program was established, new technologies had to be selected, installed, and evaluated. It was necessary to focus on a limited number of new technologies at first because of limited resources and the need to see how the Program would function. The first technology area chosen was natural-gas-engine-driven cooling equipment. This choice was based on numerous discussions with federal agencies, primarily the Department of Defense (DoD), which cited energy use reduction, cost reduction, and environmental benefits that such technologies could provide.

In 1991, a solicitation outlining the Program and seeking participants for a technology demonstration project on natural-gas-engine-driven chillers was forwarded to utilities, federal sites, and manufacturers of cooling equipment. Ten utilities, four manufacturers, three federal sites, and two trade/research organizations responded. From those responses, a project at the Naval Air Station, Willow Grove (NASWG), Pennsylvania, was designed and initiated in 1992. This project is described in more detail following the outline of the paper.

Under the Strategic Research and Development Program (SERDP) of DoD, additional funds to augment those of DOE FEMP were made available for new technology installations and evaluations in 1993. A list of new technologies was developed, and their potential benefit to the federal sector estimated. In discussions with staff from DOE and DoD, this list was reviewed and four technologies chosen as candidates for future installations. The technologies were (1) advanced controls for thermal storage systems, (2) advanced heating and cooling equipment, (3) high-efficiency glazing, and (4) geothermal heat pumps.

In 1993, a solicitation seeking participants for projects on these technologies was released. The availability of this solicitation was made known through *Commerce Business Daily*, trade press articles, and direct correspondence with potential interests. Responses were obtained from manufacturers, utilities, trade associations, research institutes, federal sites, and other interested parties.

Because the Program was new, not all technologies could be evaluated. For this reason, the four technology areas noted above were initially targeted. To ensure that no new technology was missed in future projects, a broad technology solicitation was released in late 1993. This solicitation explained the Program and asked for suggestions and certain supporting documentation for any new

technology that should be considered for program participation. The responses by sector and technology grouping are shown in Figures 1 and 2.

[Figure 1 goes here]

[Figure 2 goes here]

These recommended technologies were evaluated in mid-1994 and ranked as to their potential for energy, cost, and environmental benefits to the federal sector. They were also categorized as those that are just coming to market and those for which field data already exist. To secure participation in projects for these new technologies, additional outreach efforts and communications with the public and private sector were initiated in 1994.

H:4.2. Public and Private Participation

When a technology area has been selected and potential parties have expressed an interest in participating, the resources each brings to the project and the ability to assemble the parties into a project team must be considered. An appropriate site for the technology must be found, preferably one with an energy use history for comparative purposes. Because of procurement limitations, creative ways must be found to finance the technology installation. This requires support from the manufacturer and the servicing utility. Communications efforts are aided by the availability of a trade association partner. Without at least a utility, manufacturer, and federal site, a demonstration project is difficult to implement.

There was considerable interest in the first demonstration project--the natural-gas-engine-driven cooling equipment. A manufacturer willing to donate the equipment and/or a utility willing to underwrite its cost had to be identified, as did an appropriate federal site interested in participating. Alternatively, a federal site that already had installed such equipment needed to be identified.

Only one of the manufacturers who responded to the natural-gas-engine-driven cooling equipment solicitation was able to participate. The others were either unable to provide the equipment at no cost or had decided to discontinue developing that technology. After discussions with all the utilities, only three remained able to participate; the others cited financial limitations in their research and development budgets. Because the federal sites that had responded to the solicitation were not located in the service areas of the three remaining utilities, the Program attempted to involve utilities serving those interested federal sites. That effort was unsuccessful. Next, each of the three utilities, all in the East, initiated efforts to find federal sites in their service areas as candidates for installations of the specific technology, a 15-ton natural-gas-engine-driven rooftop air conditioner. Two of the utilities were unsuccessful in finding a suitable and interested federal site. The third found the base exchange building at NASWG, which already had two of the units installed. With the support of an industry trade association, the full complement of participants for the first project was finalized.

Securing participants for other projects has not been so easy. Manufacturers are interested, but their ability to provide the technology as part of the CRADA is limiting. Federal sites appear interested in the Program but do not always want to commit manpower resources or be a demonstration site. Utilities appear interested when the specific technology fits with their organizations' goals and programs. University interest has been good, with most looking to become involved from a research standpoint. Unfortunately, all universities expressing an interest in the Program to date have lacked

the financial resources to participate. Trade association and research institute support has been consistently good for all projects.

H:4.3. Project Design and Support

When potential participants for a project are identified, the project design can be initiated and support for the various tasks secured. The project is governed by the CRADA and a joint statement of work (JSOW). These documents establish the partnership for the project and lay out the tasks and responsibilities. If there is enough continued interest after their review, formal participation can be secured and the project can move forward. If not, additional negotiations must occur, the project needs to be redesigned, or different partners have to be found.

An initial meeting of all the parties occurs at the site, at which time the CRADA, JSOW, and each participant's responsibilities and resource contributions are discussed. In addition, the technical details of the project are discussed and potential sites are examined. If there is a good candidate site and all parties are in general agreement to terms, then the official CRADA and JSOW can be drawn up for signature and implementation. If not, additional discussions and negotiations must occur.

One key aspect of these partnerships is the cooperative nature by which they occur. The Program secures participation in the form of "sweat equity" from all participants, thereby leveraging federal resources with those of the private sector. By forming a project team, the various tasks are assumed by the most appropriate participant while allowing the full value of the project to be shared by all.

H:4.4. Implementation

Implementation of a project encompasses four major activities: (1) planning; (2) execution; (3) documentation; and (4) decommissioning. Depending upon the probability for successful negotiations, some activities can occur before the CRADA is signed.

H.4.4.1 Planning

The planning effort includes project design so the technology can be installed, necessary operating data on the technology and existing "baseline" technologies can be obtained, and the technology can be formally evaluated.

H.4.4.2. Execution

Project execution includes those activities necessary to operate, maintain, monitor, and document the performance of the technology. Specific areas include performance monitoring and acquisition of technology operating data and necessary "baseline" information, operation and maintenance of the technology, and the analysis of the resultant operating data.

H.4.4.3. Documentation

Documentation includes those efforts necessary to record the project activities, evaluate the technology, and present the results.

H.4.4.4. Decommissioning

Decommissioning is the orderly shutdown of the monitoring and evaluation activities and the transition of the site to non-test conditions. Should the technology not meet certain conditions of service specified in the CRADA, decommissioning can also include the technology's removal and replacement.

H:4.5. Outreach

As each project progresses and results become available, those results must be communicated to the federal sector. A technology demonstration project yields more than a formal scientific study. Significant efforts are made within FEMP to communicate throughout the federal sector about the Program and demonstrated technologies. The purpose of these efforts is to facilitate the wider use of the subject technologies by the federal sector.

Based on the results of a Program-sponsored survey, materials and media that would be most effective in communicating with the federal sector were identified. Their identification led to a focused communications plan and specific communications activities. These activities include participation at federal-sector-oriented conferences and trade shows as a speaker and exhibitor, as highlighted in Figure 3.

[Figure 3 goes here]

The communications activities also include distribution of Program-related materials and demonstration results by participating manufacturers at trade shows and exhibits in which they participate.

Direct contact is made through the *FEMP Focus* and a mailing list of federal- sector energy managers and procurement officials. Media relations activities are also stressed, resulting in trade journal, press, and media coverage for significant events associated with the Program and specific project results. These activities all are intended to build an awareness for the Program, secure a greater level of interest, boost participation and Program growth, and spur increased use of new technologies by the federal sector.

H:5. RESULTS TO DATE

Currently, four demonstration projects are officially under way; their status is summarized in Table 1. Numerous other projects are in various stages of planning and negotiation.

[Table 1 goes here]

Additional work must be conducted in measuring the impact of the Program on technology transfer to the federal sector and modifying the Program to have a greater impact on the procurement of new technologies. Through tracking of equipment sales in the federal sector, inclusion of the technology on accepted lists, surveys to federal agency staff on their recognition of the Program, and federal reporting on new technology procurement, it would be possible to determine the impact of this, or other similar programs, on the use of new technologies in the federal sector.

H:5.1. Demonstration Projects

The first demonstration project--the rooftop natural-gas-engine-driven air-conditioning equipment at NASWG--entered its third summer of operation in 1994. Data collected from June 1992 until April 1994 were analyzed. Over the 15-year expected life of the units, they are estimated to provide more than $120,000 net positive cash flow. The second project at NASWG is in its first year, and comparable savings are anticipated. These projects show that the technology performs well and has no major additional maintenance problems or costs. From the first demonstration at NASWG, it was concluded that engine-driven units are generally more cost-effective when (1) the site is characterized by "blended" electric rates higher than $0.15/kWh and gas rates lower than $0.70/therm; and (2) annual cooling loads result in present-value electric energy/operating costs that are at least twice the replacement cost of the electric unit minus any utility rebate (Armstrong and Conover 1993).

The Fort Sam Houston project is in its first year of operation, and data on the new technology installation are not yet available. However, it is significant that the unit installed is one of the first commercial production run. This puts the federal sector on the leading edge of technology transfer. In addition, the federal support for the project is leveraged with an almost equal amount of private-sector support. The Fort Stewart project also is in its first year of operation, and almost half of its resource needs are met by the private-sector participants.

Other technology demonstration projects in various stages of design and negotiation include building automation communications network (BACNet), geothermal heat pumps, and fuel cells.

H:5.2. Program Evolution

The transfer of technologies to any sector, federal or private, is driven by a sales and marketing interest. These interests suggest more technologies being available at a faster rate. This necessitates a focus on how many technologies are demonstrated, how quickly results are available, and how effective the results are communicated to, and embraced by, the federal sector.

The initial efforts of the Program were successful in securing federal partnerships with the private sector, installing and evaluating new technologies, and communicating the results. However, installing and demonstrating four technologies within 2 years and having final results on one technology are not sufficient to hasten the transfer of more technologies. Recognizing that a certain amount of time is required to install and evaluate a new technology, the Program went through a transition in 1994 to improve its ability to address technology transfer needs.

H:5.2.1. Additional Technologies

Through solicitations for technology ideas, candidate technologies will always be available. Experiences with the first such solicitation indicate that some recommended technologies are still in the research and development stage. These technologies need to be monitored so that when they are ready for market, they can be considered for Program participation. Alternatively, federal sites could serve as field test sites during the R&D process. Other recommended technologies are already being used by the federal sector. While it does not seem warranted to instrument another site, the results of existing installations might be compiled and disseminated through technology transfer information digests.

Through more proactive Program communications and outreach activities, the benefits of participation in the Program are expected to become more well known. For example, should the Fort Sam

Houston demonstration yield positive results for the gas heat technology, those results would be directly applied in the design and procurement process for new residential construction on the fort later this decade. If the fort were to use this technology in that construction project, more than 25% of the projected third-year production run of the pump would be directed to one federal site. This kind of response should help build private-sector support for the Program and help better leverage available federal program resources.

H:5.2.2. More Timely Results

In no way can accurate data on a new technology be secured without installation and monitoring for some reasonable performance period. Because operations and maintenance data take years to secure and also are critical to the evaluation of the technology, the probability of getting usable short-term results that can be used in the life-cycle cost analysis and procurement process is remote.

To address this, the Program is evolving to implement projects on technologies just as they come out of the R&D phase and enter the market. At this point, the only available information on the technology is theoretical and based on field-test results. Even though it may take a couple of years to install and evaluate a technology installation under the Program, the results are available while the technology is still relatively new.

Other technologies that have already entered the market and have some experience in the federal sector are candidates for a technology transfer information digest. Working with federal sites, utilities, and manufacturers, the Program identifies federal installations of a subject technology, then gathers and analyzes available data. The experiences to date are summarized; the summaries note any limitations in the available field information. The summaries are communicated to the federal sector in a usable format. These information digests will be less costly and take less time to prepare. While they are only as good as the source of the information, they meet a short-term need that would go unfilled during the few years it would take to implement a field installation and evaluation project.

H:5.2.3. Additional Outreach

Although workshops, seminars, conferences, and print media have been used, it is unclear how information on new technologies is being channeled to those on the "front lines" in the federal system. Through discussions with federal staff involved in activities such as procurement, energy, specifications, and building operation, additional format and media opportunities will be identified. Program communications activities will be modified and implemented to take advantage of those opportunities.

H:6. DISCUSSION

The more difficult aspects of the Program include the time and effort involved in identifying new technologies, determining which to focus on within available resources, and putting together the partnerships for the projects. This suggests a number of areas for enhancement of the Program. Some will address short-term needs. Others will need to occur over longer periods but will ultimately result in a stronger and more effective program.

In the short term, more information on available information from existing federal installations needs to be identified and disseminated. In addition, activities to secure federal reliance on this information must be undertaken. This strategy would eliminate the effort needed to orchestrate partnerships and

develop CRADAs, as well as reduce the amount of up-front effort needed to make results available. It also addresses the impossibility that all relevant personnel in the federal system will seek out and review all available information on a particular technology.

One drawback to using data on existing new technology installations is the unknown accuracy of the information. Such information could be as rigorous as that gathered for a demonstration under the Program; on the other hand, it could be just some anecdotal information obtained in casual conversation with a building operator. Through the Program, some guidelines might be prepared to help federal agencies themselves better monitor installations of new technologies. Through their efforts, which might be provided with the hope of tying them into a larger informational database on new technologies, performance results on new technologies might be gathered and made available to the Program.

Although data from existing installations might be gathered and made available, the accuracy and completeness of the information will always be a source of controversy. This fact supports the rigorous methods the Program has used to evaluate technologies it has installed. In addition, the cooperative nature of the Program allows for samples of the technologies to be made available to the federal sector at no cost. Demonstration projects, as exhibited at NASWG, need to continue: they just need to be completed closer to the market introduction of the technology.

If new technologies are to be effectively demonstrated in a timely fashion, the Program must be much more involved during a technology's R&D phase. Such involvement should focus on identification of relevant technology ideas and follow them through the research process, with the arrangements for the project CRADA being developed at that time. This will save time later and allows the benefits of public/private partnership to be extracted sooner and at a greater rate. When the technology is ready for field testing, at least one field test should occur at a federal site. This affords the federal sector a first-hand look at the technology and allows the technology developer the opportunity to evaluate the product in the federal environment.

When the technology is ready for market, the results of the federal field test should better acquaint the federal sector to the technology, leading to some of the first-production-run installations being in federal facilities. With little effort, numerous federal demonstrations of the technology could occur at market introduction of the technology. The results of those installations could also be made available to both the public and private sectors as soon after market introduction as possible. The federal government could form the foundation of support for new technologies and lead in technology transfer.

H:7. SUMMARY

As the largest consumer of products in the United States, the federal sector can significantly affect the installation and use of any technology or product. It can also have a significant impact on our use of energy and on the environmental and financial costs associated with that use. The ability to transfer new, more energy-efficient technologies to the federal sector and secure their widespread use is dependent on the federal procurement system. That system must be convinced that a new technology will, among others, deliver as promised.

By installing new technologies at federal facilities and monitoring and evaluating their performance, information needed to support their further use is secured. Through partnerships between the public

and private sectors, these new technologies can be provided to the federal site and installed and monitored. Their performance results can then be communicated throughout the federal sector. This provides an objective evaluation of the technology in the field and yields available data upon which life-cycle cost analysis, technology comparisons, and procurement decisions can be based.

The time and resources expended in designing and implementing a new technology project can be significant; the project might also yield results in a less timely fashion than desired. Where the technology is just coming to market, projects to install and evaluate it at federal sites can yield valuable results to support future use of that technology. Where the technology has been in the market, some federal installations should be available upon which to evaluate the technology.

While no data on the impact of the Program on the use of new technologies are available, future efforts will attempt to secure those data. Discussions with federal agency personnel and potential participants in the private sector find considerable support for the Program. Over time, the visibility and growth of the Program should lead to additional interest and support, which, in turn, will allow for additional installations. In addition, future efforts should concentrate on identifying the critical activities in the design, specification, and procurement process, and attempt to improve the system to use the results from projects and technology transfer information digests.

H:8. ACKNOWLEDGMENTS

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Figure 1. Technology Solicitation Respondents by Sector

Figure 2. New Technologies Suggested for Future Program Participation

Figure 3. Representative Outreach Effort

Table 1. Current Technology Demonstrations

Application	Technology	Location	Status
Cooling	Thermo King natural-gas-engine-driven rooftop air-conditioning system	Naval Air Station, Willow Grove, Pennsylvania	First-year interim report published; 1993 cooling season results available soon
Cooling	Thermo King natural gas reciprocating compressor/air-cooled condenser	Naval Air Station, Willow Grove, Pennsylvania	Equipment installed September 1993; startup Spring 1994
Water heating	Seahorse gas hot water conversion system	Fort Stewart, Georgia	Planning baselining; CRADA signed, equipment installed March 1994
Heating and cooling	Triathlon natural-gas-engine-driven heating and cooling system	Fort Sam Houston, San Antonio, Texas	Currently baselining; CRADA signed February 1994; system installed Spring 1994

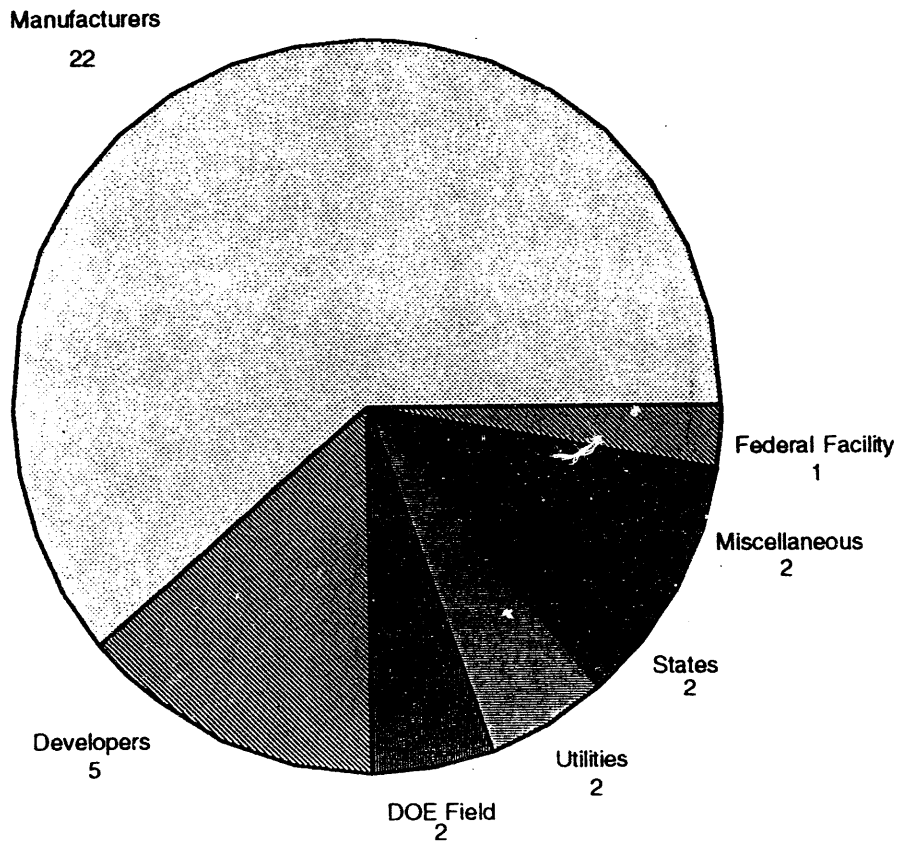

Figure 1. Technology Solicitation Respondents by Sector

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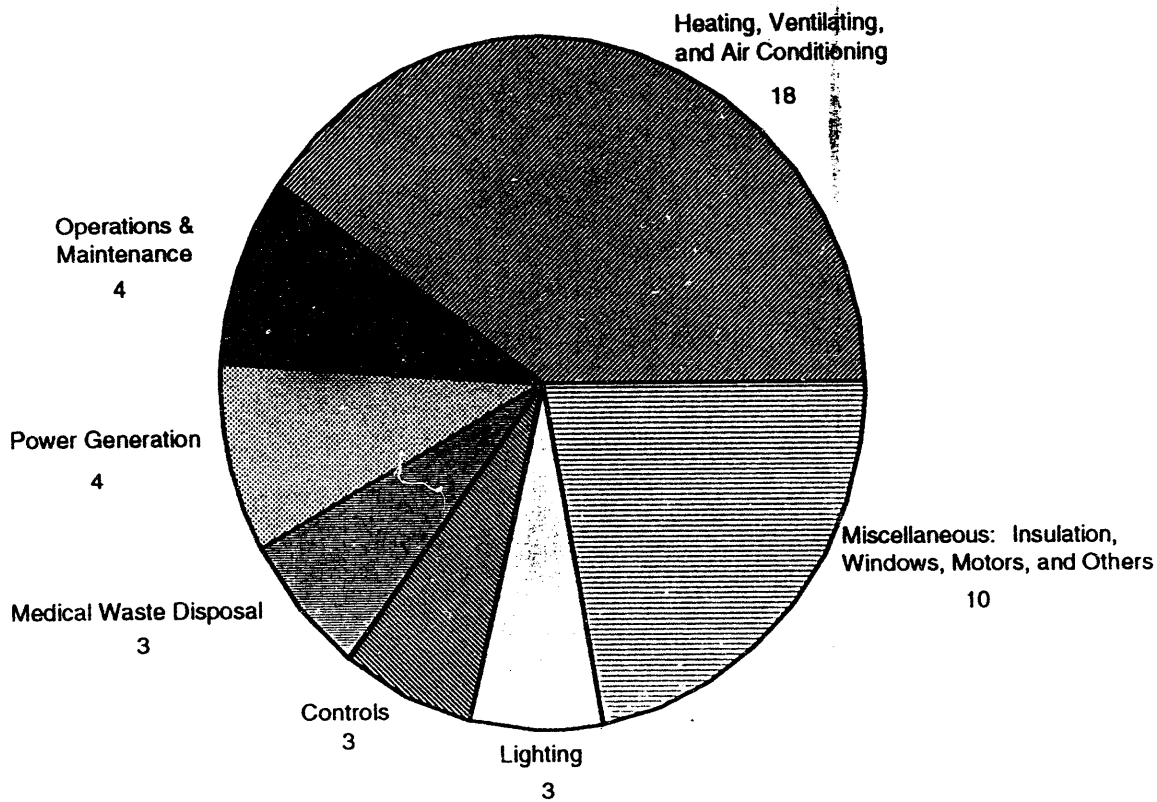

Note: some respondents proposed more than one technology

Figure 2. New Technologies Suggested for Future Program Participation

Nimloc System

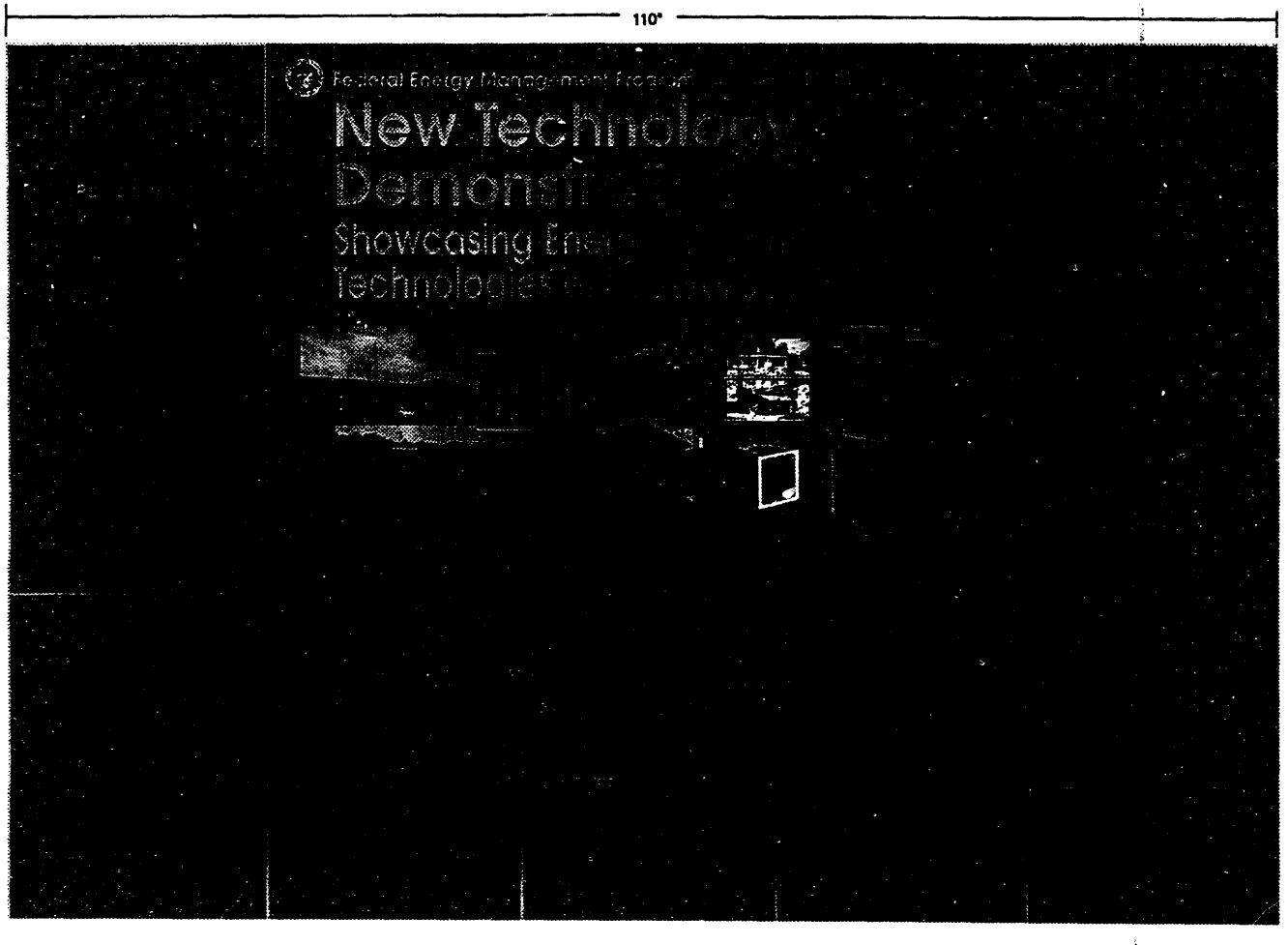

Figure 3. Representative Outreach Effort

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