THE WASTE-MANAGEMENT EDUCATION & RESEARCH CONSORTIUM

ANNUAL PROGRESS REPORT, 1991-1992

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FINAL REPORT FOR 1991-1992

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INTRODUCTION

Efficient and safe management of nuclear, hazardous and solid waste is an increasingly critical national issue. Further, it is a broad multi-disciplinary issue that cannot be addressed by any one entity or organization, but requires a collaborative effort between multiple organizations with diverse expertise and experience.

In February, 1990, The Secretary of Energy, James Watkins, approved a grant for a waste-management education and research consortium program proposed by New Mexico State University (NMSU) to the U.S. Department of Energy (DOE). This program known by the acronym, "WERC" includes as its founding members NMSU, the University of New Mexico (UNM), the New Mexico Institute of Mining and Technology (NMIMT), the Los Alamos National Laboratories, and the Sandia National Laboratories. The Navajo Community College joined the program later in 1991.

The program has the mission of expanding the nation's capability to address the issued related to management of all types of waste. The program is unique and innovative in many aspects. It provides an integrated approach to this national need, and includes:

1) Education in waste management by the three Consortium universities and the affiliate college resulting in graduate, undergraduate, and associate degrees with concentration in environmental management. (The term waste management is used in a broad sense throughout this paper and includes all aspects of environmental management and environmental restoration.)
2) Professional development via teleconference for industry and government.
3) Technology development programs at the leading edge, providing training to students and information feeding into the education programs.
4) Education by technology development at the campuses, as well as from four field sites.
5) Ties with other multidisciplinary university facilities.
6) Ties with two National Laboratories (Los Alamos & Sandia) located in New Mexico and with the Oak Ridge Associated Universities and others.
7) Technology transfer and education via an existing fiber optic network, a satellite link, and an existing state-wide extension program.
8) Outreach programs of special interest to pre-college students, communities and business and government leaders throughout the United States.

Educational Courses

In the first two years, WERC successfully set up the following educational programs:

1) An undergraduate option or concentration in Environmental Management at the three consortium universities with a major in any field that is accredited and provides the necessary prerequisites. This program reaches over 30,000 students, in schools with minority enrollment of about 35%.

2) Master of Science degree options with special emphasis on the Management of Radioactive, Hazardous, and Solid Waste.

3) A two-year Engineering Technology Associate degree program in Hazardous & Radioactive materials handling and a two-year program for Native American students at the Navajo Community College. NCC has about 600 students with a 90% minority enrollment.

4) A series of professional development intensive courses presented through interactive satellite video to laboratories, industry, and federal agencies throughout the country.

5) A capstone design course on environmental process design with competition between universities throughout America.

6) Pre-college education programs interesting thousands of students in science and engineering.

The Consortium's first major task in education was to set up the curriculum and establish undergraduate degrees at the Consortium universities in the fields accredited by ABET. This resulted in options leading to a minor in Environmental Management.

The core programs necessary to satisfy ABET requirements in each of the disciplines are specified in the catalogs of the respective universities. These core requirements are supplemented by 18-30 hours of courses relevant to waste management, covering not just technology, but also other aspects such as legal, public policy, economics and risk evaluation.

The graduate program was also established by Fall 1990. This program requires the students to take core courses in their chosen discipline, but with approximately one half of their credits in the waste management concentration, including a research thesis or research project in waste management.

The Associate Degree program was started in Fall 1991 in radioactive and hazardous materials technology closely patterned after the accredited engineering technology programs offered on the main campus on NMSU at Las Cruces. An important feature of the new curriculum is the high degree of transferability into existing, accredited four-year engineering technology programs. The engineering technology approach to program design and operation

carries implications with respect to faculty credentials as well as course content, level and rigo The technology program uses the WIPP facility in conjunction with the New Mexico St e University Carlsbad Campus as the training facilities. Graduates of this program will be prepared for entry-level employment as technicians in industries, laboratories and government agencies concerned with the generation, mining, disposal, transportation, storage or regulation of hazardous wastes and materials.

In Fall 1991, a two-year program in environmental science was also started at the Shiprock campus of the Navajo Community College, together with a laboratory for hands-on training. Expansion of this program to solid waste management is being planned.

A major emphasis of the consortium is to interchange courses between the Universities and to transmit the courses throughout the U.S. and even internationally. An interactive satellite video system has been set up with the objective of presenting an overview of economic, legal, policy, management, and technical courses in the problems of radioactive, hazardous, and solid waste management and environmental restoration for U.S. research, industry and educational facilities. The satellite system has been installed and is currently in use for course transmission between the three universities as well as to several other sites. Six courses have been transmitted in Spring 1991 and in Fall 1991. Eight courses are started in Spring 1992.

As part of the program, student fellowships have been awarded to both undergraduate and graduate students. These fellowships are awarded on basis of academic merit and desire to pursue a career in the environmental field. In the second year approximately 80 fellowships were awarded to undergraduate students and an equal number of graduate students were awarded research assistantships. Industrial interest has resulted in substantial increase of our fellowship funds, thus leveraging the DOE funds.

The degree programs started in Fall 1990 at all three universities. The undergraduate enrollment in Fall 1991 was over 300 students and the graduate over 50. These students range from freshmen to graduate students. In Fall 1991, the Consortium awarded about 15 degree minors and certificates. Our estimate is that we will be awarding 200-300 degrees with the environmental concentration (or minor) in the first 4 years of the program, leveling off at about 100 each year.

As part of the effort to introduce a design component and at the same time encourage inter-university exchange of information, we have developed and implemented a national university design competition. Universities throughout the United States, Canada and Mexico were invited to compete in the design of a plant for an environmental process and follow this up with a small scale demonstration at a central site. This provided a capstone design course to some universities and at the same time brought university students and faculty from diverse parts of America together to exchange information. In 1991, we had seven universities participating and over 20 universities have registered to participate in 1992. The first year was a fantastic success in achieving the objectives of design education and information exchange based on feedback from the participants and the judges.

Pre-college education projects were also started, including:

1) A summer intensive training course in environmental design for high-school teachers and students,

2) a pilot program on a Los Alamos originated program for student participation called "Students Watching Over Our Planet Earth" (SWOOPE) and

3) a project for international water quality monitoring for high-school students called project Del Rio.

4) presentation to high-schools on WERC.

Education By Technology Development

A very important result of the WERC program is the production of students with advanced degrees in environmental management via hands-on independent technology development projects at the leading edge of technology. This form of education is the focus of our technology development projects.

The scope of the Center is broad-based and is designed to include all areas of radioactive, hazardous and solid waste management and environmental restoration. The second round of projects were selected from proposals submitted by faculty and employees of the consortium members with collaboration from the National Laboratories and industry.

The second round process started with solicitation of proposals. The evaluation of projects to fund was made by a panel of experts based on the following criteria: student education potential, technical merit, collaboration between universities and national laboratories, application to critical issues, industry involvement and investigator's credentials. The final selection was made by a committee of the Consortium Members using the evaluations of the experts as a guideline.

In the second round we received 67 proposals. Thirty-three of these were selected for funding. These projects were scheduled to start in February 1991 but for many the start was delayed to June 1991 due to a delay in budget approval. These covered a range of waste management issues. All but one of these projects have principal investigators from at least two universities and a national laboratory. A third round of 71 proposals were received in August 1991. Following an evaluation as above 45 were chosen for funding in 1992 and the projects are scheduled to start in March 1992, after approval of the third year's budget.

As a means of facilitating the use of the results for education in a timely manner, this past summer we conducted a satellite television series on the programs. The faculty members and students involved in research areas presented their results to a wide audience consisting of industry and university people.

It is too early to predict the impact of the technology development projects. However several of the projects are already showing promise for meaningful applications. It is our objective that in 2 - 3 years, commercial applications will result from this program activity. Equally important is the practical experience that about 150 faculty members and students are getting from the involvement in the research projects and the exchange of technology between the three universities and the two national laboratories.

Educational and Testing Facilities

Four facilities have been set up to assist with the research and education.

1) The Soil-Water-Air Testing Facility (SWAT) at Las Cruces is functional and is currently providing analytical services in the areas of toxic and hazardous waste management to faculty and students from the universities and other organizations. The laboratory is equipped for physical, inorganic, organic and bacterial analysis of soil, water, air plants.

2) The Radioactive Experimental Facility at Carlsbad (CREF) has the role of exploratory development and projects associated with transuranic waste isolation. Furthermore, it provides support for radioactive related technology development and for instrumenting experimental activities planned by other facilities.

3) The Oil-Water Experimental Facility at Hobbs (HOWE) provides for educational, and development programs related to environmental and waste disposal concerns of the petroleum industry in the United States. A field laboratory is also available for use. The field laboratory consists of a watered out petroleum reservoir. The producing formation is approximately 2,000 feet deep and 15 feet thick.

4) The Navajo Drylands Environmental Laboratory (NDEL) at NCC provides for environmental education and monitoring by the Native American students in the Shiprock, area.

It is particularly important to note that each of the facilities has an educational component and a technology transfer component.

Technology Transfer

The technology transfer function of the Consortium is emphasized throughout the program. Specific activities for technology/knowledge transfer noted below are in various stages of implementation:

- An Executive Board, an Executive Committee and an Advisory Board composed of representatives from top management of government, industrial and environmental organizations have been formed and functioning for the purpose of directing the program.

- Continual dialogue has been started with industry and government agencies via an Industrial Liaison Program, via briefings and via newsletters.

- The educational program is continually transferring knowledge from theory and research to the hundreds of students and industrial professionals.

- Technology development results are being transferred via seminars and via formal contacts with participants form industry and government. Results from each funded project are reported each quarter. The fiber optic communication network and the satellite link are used for wide communication of the results; a special ITV series was completed in Summer 1991.

- An eleven part professional development teleconference series has been completed on topics of interest to participants from government and industrial organizations. This series was transmitted via the satellite system throughout the U.S. An eight part waste minimization series will start in 1992.

- Over 60 technical papers have been presented and published on the various aspects of this program. This includes papers on progress in the education program, the laboratory operations, and the technology development results.

- A number of organizations have joined the Consortium's Industrial Affiliation Program and the program is being expanded to others.

Technology transfer is only meaningful if the information is utilized by the outside world. Therefore, the Consortium holds meetings and seminars where industrial and government representatives discuss implementation of project results. These seminars, meetings, and workshops are held at various locations, including the three Consortium University campuses, the National Laboratories and three field laboratory sites.

Outreach

As the program progresses through its first two years, opportunities were identified for reaching out to other groups that could benefit by education and research in the waste management and environmental restoration area. Activities thus started include:

1) A model program has been started for environmental data observation by pre-college (K-12) students on a program originated and initiated by the Los Alamos National Laboratory (SWOOPE).

2) A summer program on environmental engineering design has been conducted for over 100 high-school teachers and their minority students in the last two summers. This program gives a one week intense training to the high school participants in use of math and science for environmental design.

3) Speakers and tours are provided for pre-college students.

4) An environmental design contest has been developed and implemented for competition by university students throughout the U.S. A design demonstration was held on Earth Day 1991 and the next round is planned for April 1992.

5) A laboratory and environmental training program has been started for Native American students at the Navajo Community College at Shiprock, NM. A laboratory has been set up for environmental monitoring around the Shiprock area. Students and faculty will gain hands-on experience. A two-year associate degree program has been started.

6) A major new effort* called the Carlsbad Environmental Monitoring & Research Center (CEMRC) has been started on environmental monitoring of the Carlsbad, New Mexico area. This community is located near the Waste Isolation Pilot Plant (WIPP) facility which is planned as a repository for transuranic (TRU) wastes. This program was started at the request of the Carlsbad community. An independent group has been formed to do complete monitoring of the area (flora, fauna, etc.). This group, which reports to the Director of WERC, will generate the data using state-of-the-art techniques and will also conduct research on advanced monitoring techniques.

7) An Environmental Fellows program is being initiated to train emerging leaders from industry and government in environmental management. An international component of this program will include participants from Mexico and Eastern Europe.

8) Masters of Science in Environmental Engineering programs are being developed at the three universities.

9) A program for training Native Americans in Solid Waste Management is under preparation.

Organization

The organization is shown in Figures 7 & 8. The DOE cooperative agreement is with NMSU. The overall WERC program is led by a Director who reports to the Dean of Engineering at NMSU. The Dean serves as Chairman of an Executive Board that sets the strategic direction of the Center. The Executive Board is made up of top management representatives from DOE, the national laboratories, government, universities, and industry, and provides oversight of Center plans and progress by reviewing overall program plans and strategies, key resource allocations and key hiring decisions as well as evaluating progress against approved plans and budgets. An Executive Committee has been formed to discuss and resolve operational issues.

* The Annual Report of this program will be published separately.

The operations are managed by the Director. An Advisory Board, made up of selected representatives from the three Consortium universities, the two national laboratories, selected environmental organizations, and selected industrial organizations, provides advice, information, and ambassadorship to identify key external linkages and promote relationships. This board advises on agency and industry needs, mechanisms to build relationships, and status of key environmental variables including technology state of the art and practice.

Each of the major functions (Technology Development, Facilities, Interactive TV) are supervised by Technical Heads, who report to the Director. The Carlsbad Environmental Monitoring and Research Center is under the operation of a Director for CEMRC reporting to the WERC Director.

Industrial participation is built into the program as part of the Advisory Board. In addition, industrial participation is included in the Industrial Affiliation Program and the Teleconference Educational Program. Sponsorship is continually sought for specific programs that satisfy the criteria listed previously, i.e., technical excellence and relevance to the Center's purpose.

Student Participation

The undergraduate and graduate student program reaches about 30,000 students. The students participation in the various educational programs is as follows:

Undergraduate Enrollment 91-92

	UNM	NMSU	NCC	NMIMT
Degree	31	184		16
Non-Degree				

Graduate Enrollment

Assistants	19	10		XX
Associate Degree		64	11	

Other Remote Site Enrollment, Undergraduate and Graduate: 135

Design Competition

All Universities 85 in 1991; about 200 in 1992

Teleconference

1000 + professionals

Pre-college

All programs = over 2000

Graphically, the student involvement is shown by the following figures.

Figure 1. University Student Enrollment as Function of Time

Figure 2. ITV Course Enrollment

Figure 3. Geographic Distribution of WERC Students

Figure 4. ITV Receive Sites

Figure 5. Professional Development Teleconference Sites in the United States

Figure 6. New Mexico High Schools in Summer WERC program

The program is only two years old but has been so successful as to receive the following two awards that are usually received only by long-established programs:

1) An award to the overall WERC program by the National Society of Professional Engineers as an outstanding engineering achievement for 1991.

2) The WERC Teleconference series was presented an award for outstanding advanced level training and continuing education at the Telecon II Conference.

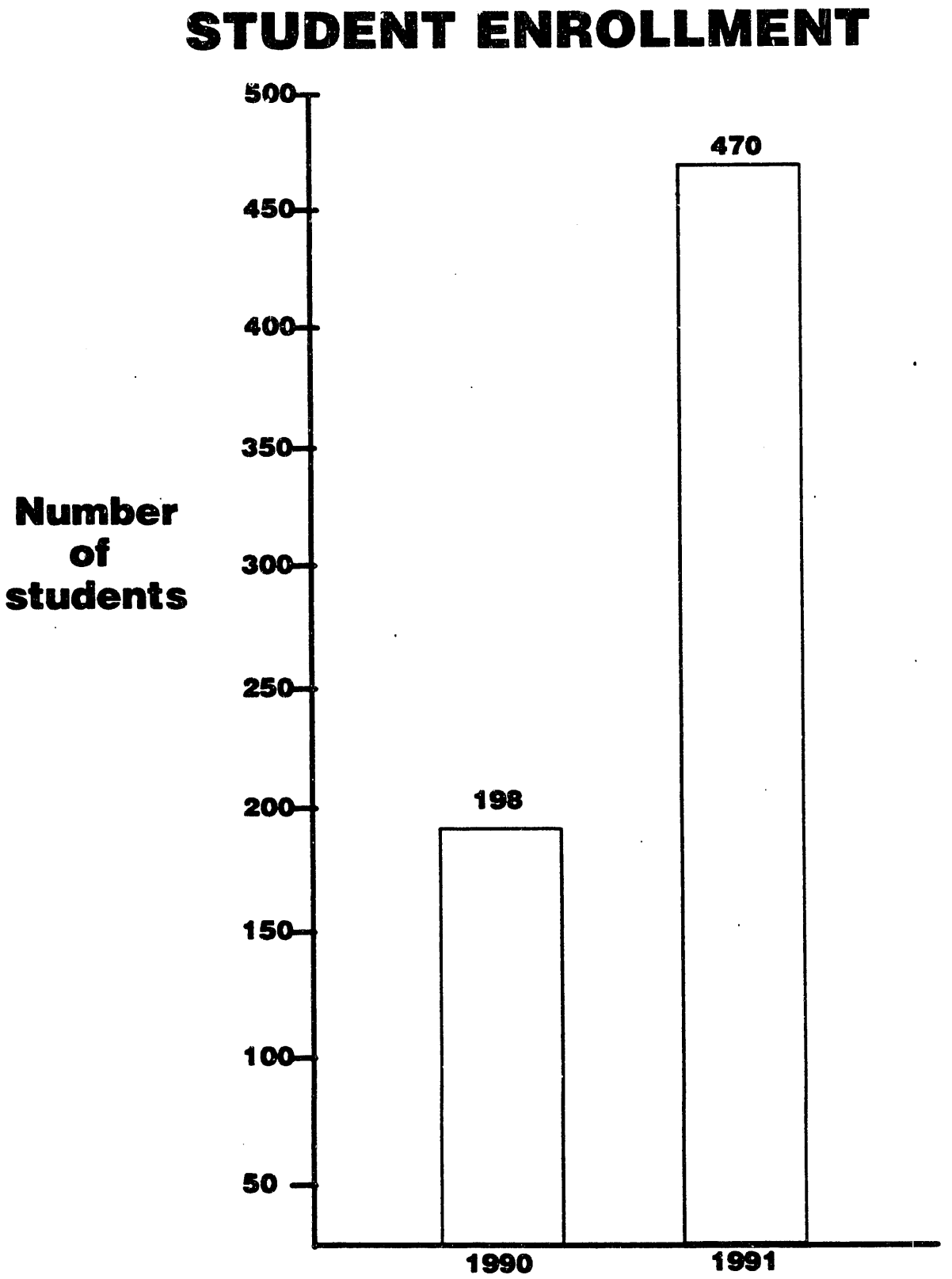

STUDENT ENROLLMENT
Number of students
500
450
400
350
300
250
200
150
100
50
470
198
1990
1991

FIGURE 1

WERC–ITV
TOTAL TELECOURSE ENROLLMENT

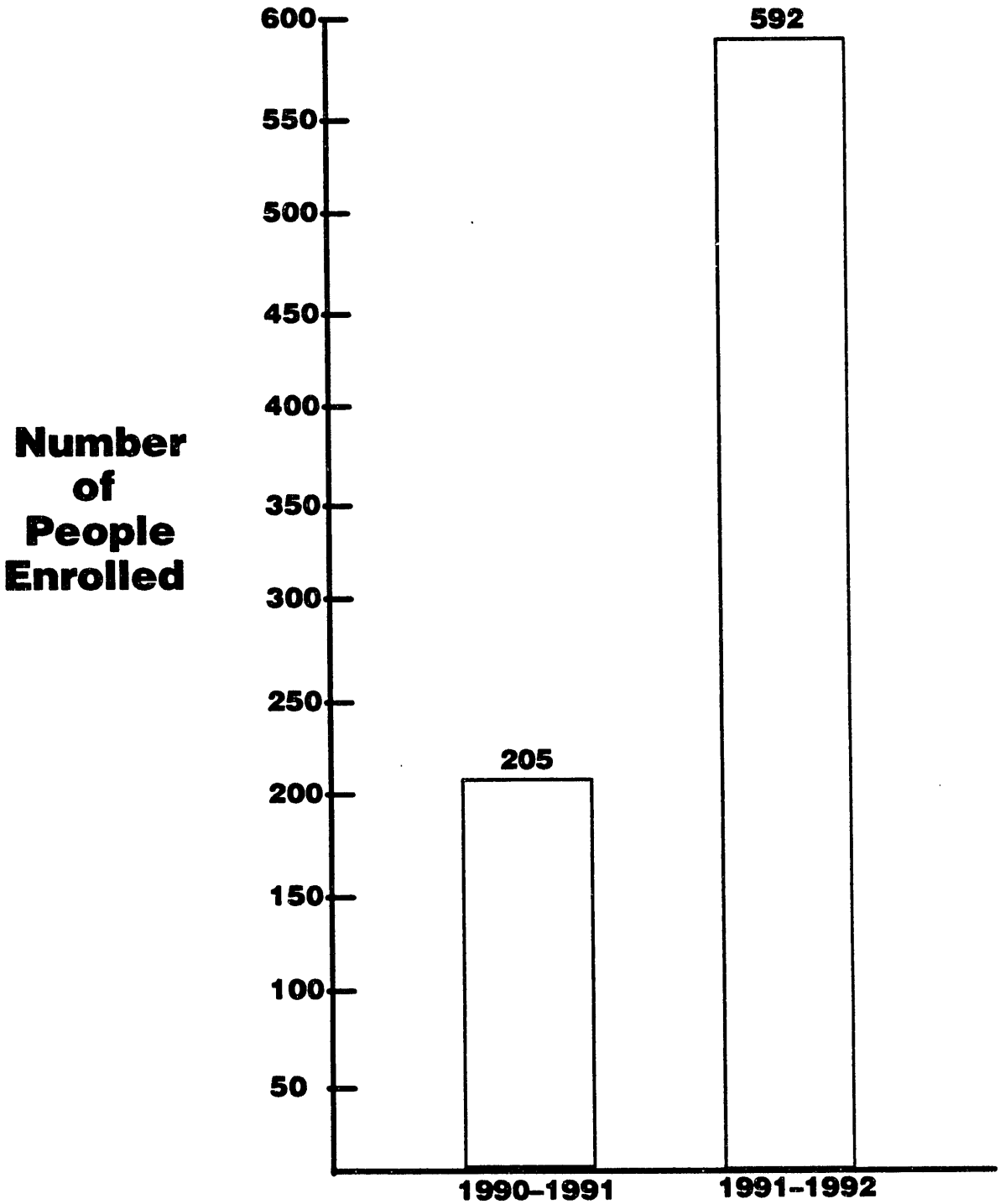


FIGURE 2

GEOGRAPHICAL DISTRIBUTION OF WERC STUDENTS

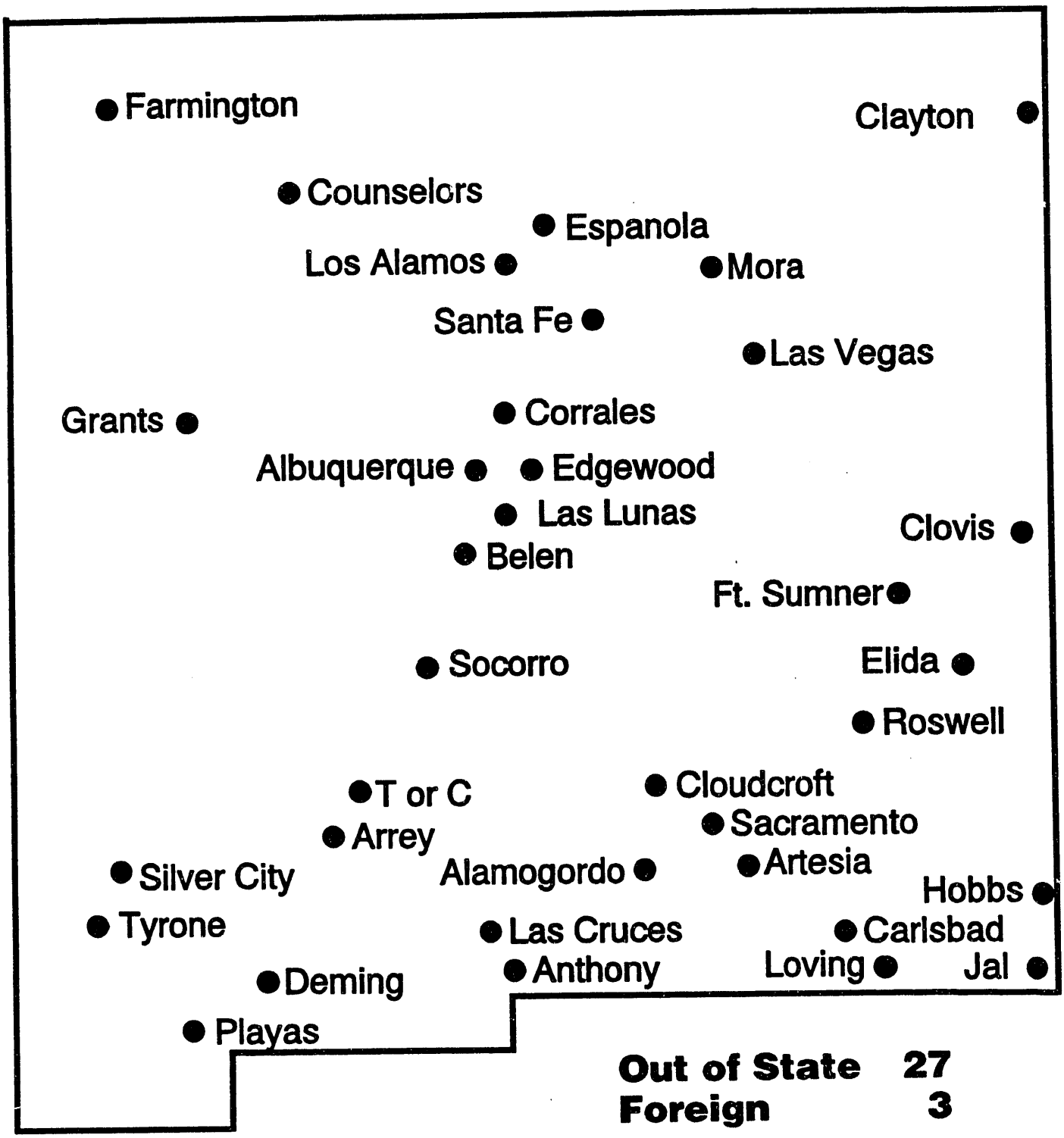


FIGURE 3

WERC–INSTRUCTIONAL TELEVISION RECEIVE SITES

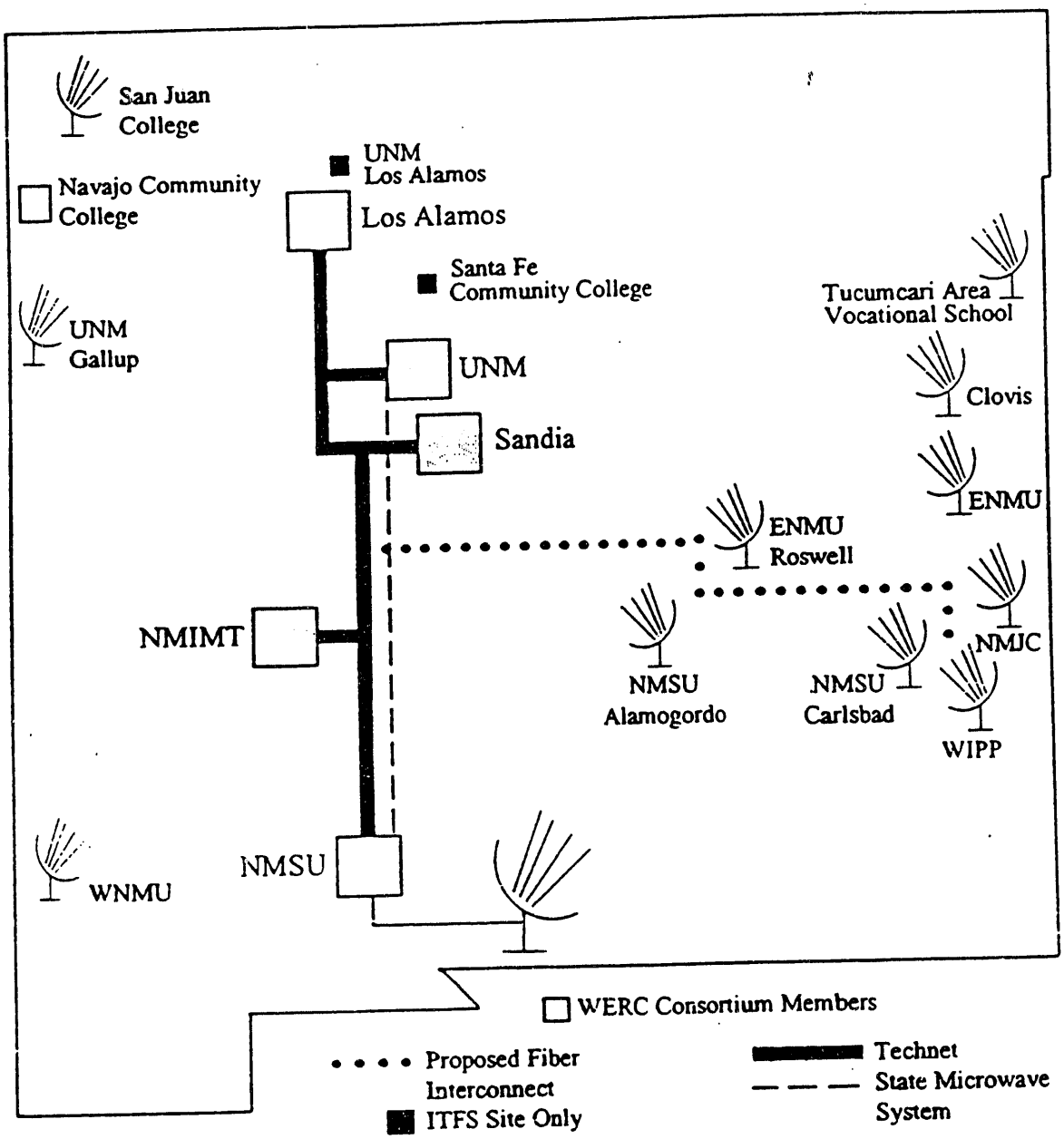


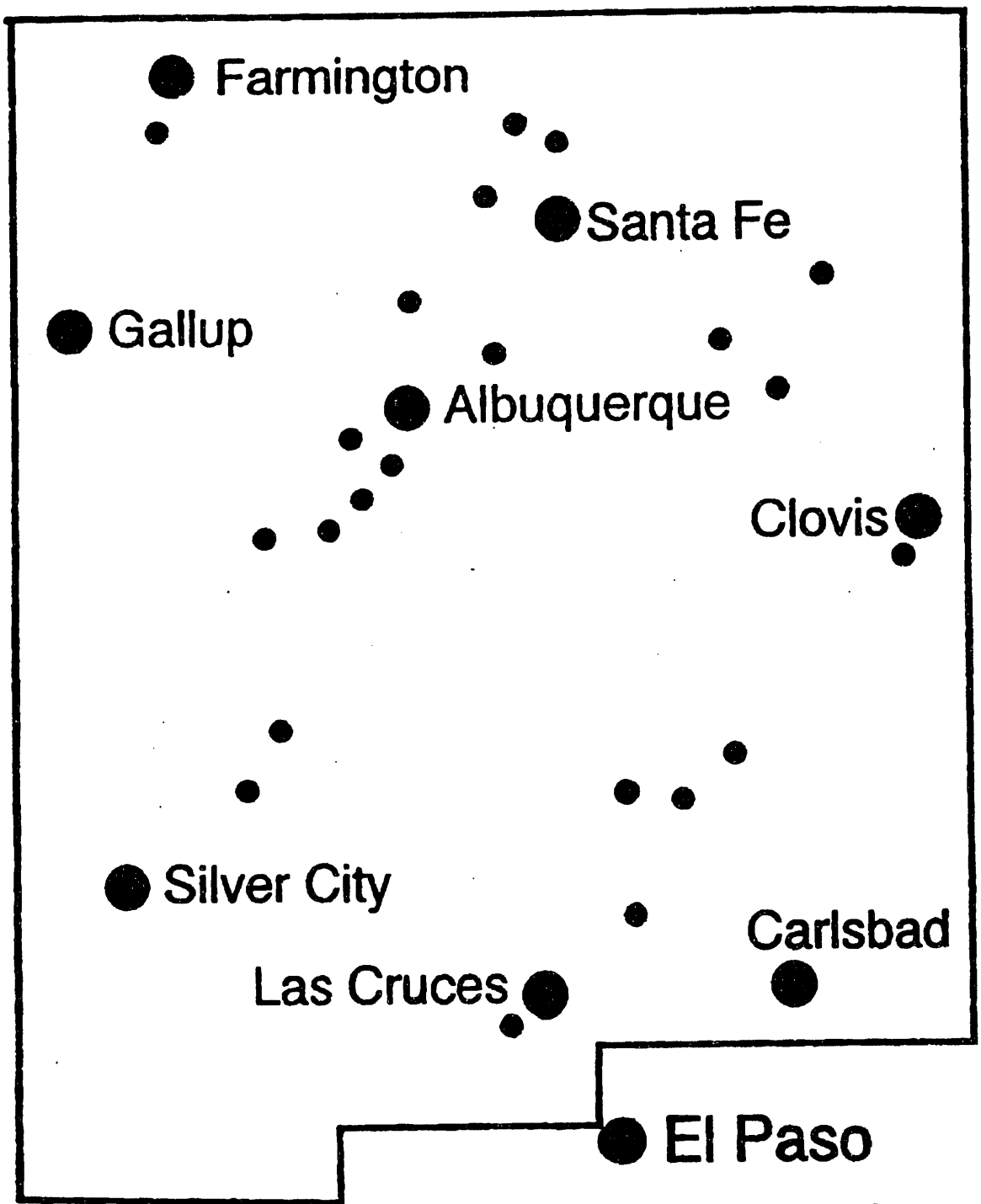
FIGURE 4

PROFESSIONAL DEVELOPMENT SITES IN THE UNITED STATES

WERC–ITV Satellite receive sites for instructional television, special lectures and the Hazardous Radioactive Waste Management Conference Series.

FIGURE 5

NM HIGH SCHOOLS INVOLVED WITH WERC



Out of State

El Paso, TX	**9**
Van Horn, TX	**2**

FIGURE 6

WERC CONTRACTUAL ORGANIZATION

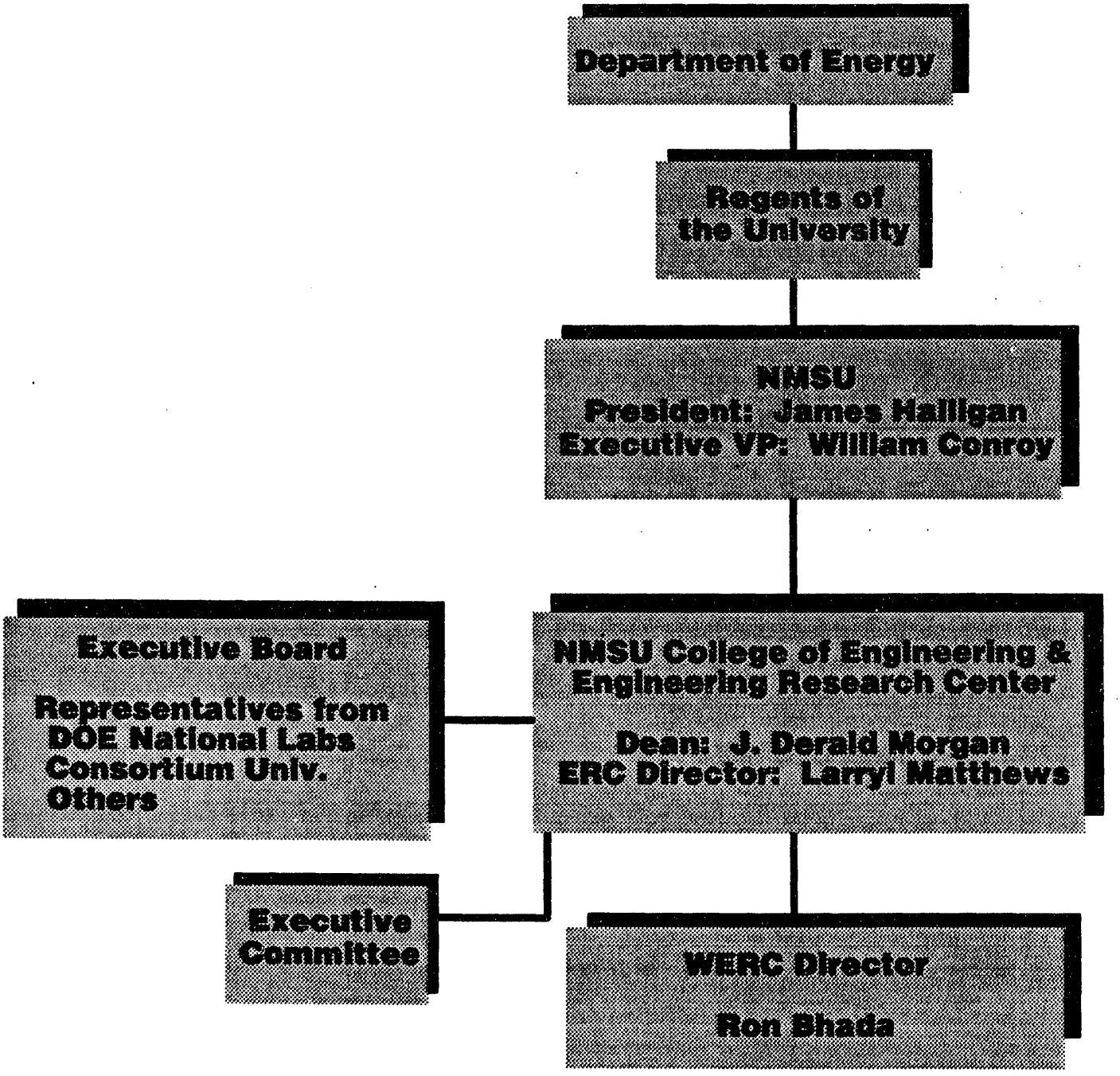


FIGURE 7

WERC OPERATIONAL ORGANIZATION

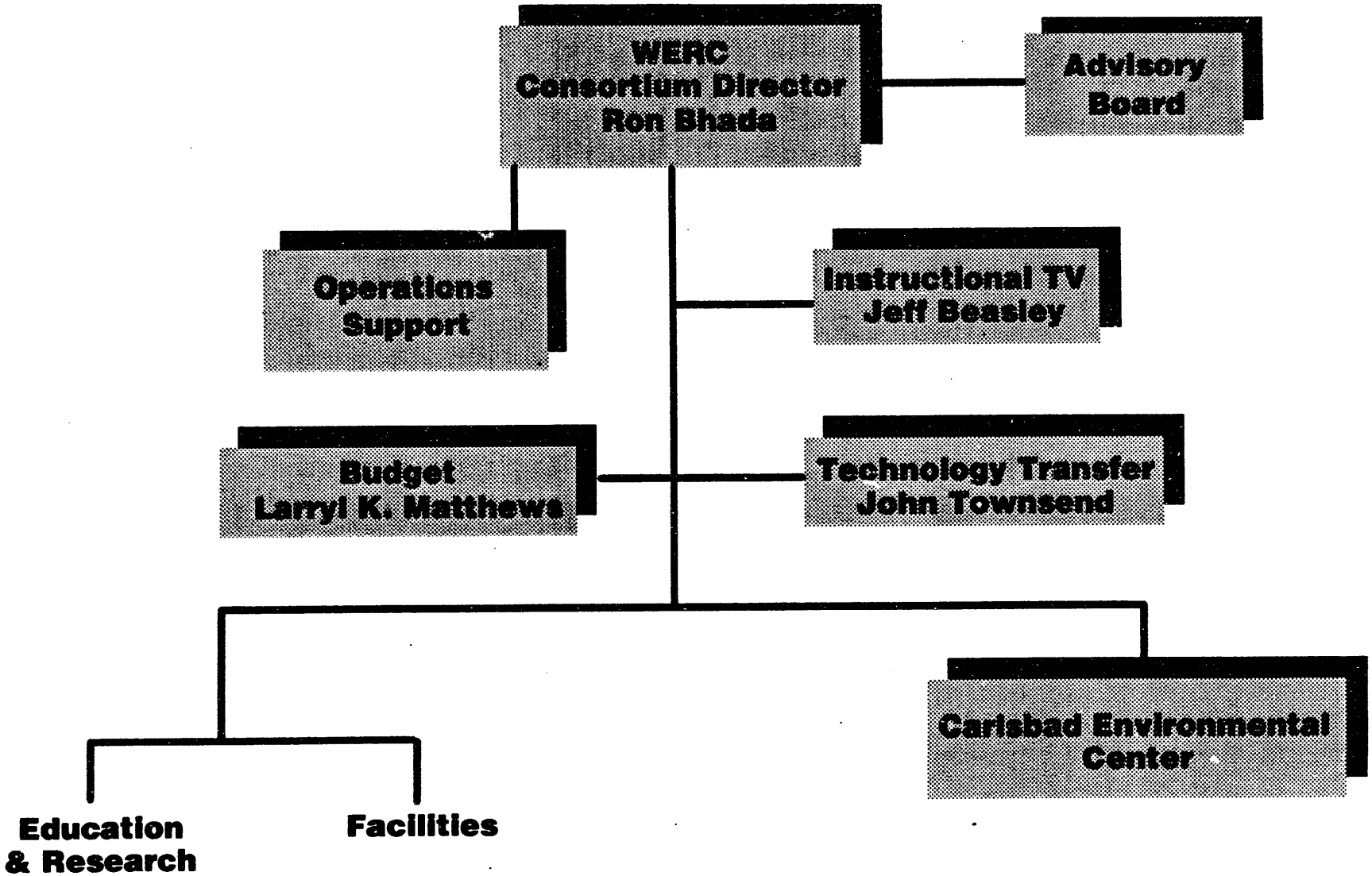


FIGURE 8

INTRODUCTION

Background

Efficient and safe management of nuclear, hazardous, and solid waste is an increasingly critical national issue. Further, it is a broad multi-disciplinary issue that cannot be addressed by any one entity or organization, but requires a collaborative effort between multiple organizations with diverse expertise and experience.

In February, 1990, the Secretary of Energy, James Watkins approved a grant for a waste (management) education and research consortium program by New Mexico State University (NMSU) to the U.S. Department of Energy (DOE). This program known by the acronym, "WERC" includes NMSU, the University of New Mexico (UNM), the New Mexico Institute of Mining and Technology (NMIMT), Navajo Community College, the Los Alamos National Laboratory and the Sandia National Laboratories.

Mission

The mission of the program is to expand the nation's capability to address issues associated with the management of hazardous, radioactive and solid waste, specifically:

- To provide a national resource of education and technology development programs.
- To develop and transfer new technologies and use these to train students.
- To increase human expertise and sensitivity to issues.

Objectives

The program is designed to provide an integrated approach to the national need via the following:

1) Education in waste management to reach thousands of students by the three Consortium universities and the affiliate college resulting in graduate, undergraduate, and associate degrees with concentration in environmental management. (The term waste or environmental management is used in a broad sense throughout this paper and includes all aspects of environmental management and environmental restoration.)

2) Professional development via teleconference for industry and government.

3) Technology development programs at the leading edge, providing training to students and information to faculty feeding into the education programs.

4) Education and technology development at the campuses, as well as from four field sites.

5) Ties with other multidisciplinary university facilities.

6) Ties with two National Laboratories (Los Alamos & Sandia) located in New Mexico, the Oak Ridge Associated Universities and others.

7) Technology transfer and education via an existing fiber optic network, a satellite link, and an existing state-wide extension program.

8) An outreach program of special interest to pre-college students, communities and business and government leaders throughout the United States.

This report summarizes the accomplishments and status at the end of the second year.

Organization

The DOE's cooperative agreement is with the Regents of New Mexico State University. The program is led by a Director who reports to the Dean of Engineering at NMSU. The Dean also serves as Chairman of an Executive Board that sets the strategic direction of the Consortium. The Executive Board is made up of top management representatives from DOE, the National Laboratories, government and industry, and provides oversight of Consortium plans and progress by reviewing overall program plans and strategies, key resource allocations and key hiring decisions as well as evaluating progress against approved plans and budgets. The current members of the Executive Board are shown in Table 1. An Executive Committee, consisting of one voting member from each consortium entity, has been set up to discuss and resolve operational issues.

The operations are managed by the Director. An Advisory Board, made up of selected representatives from the three Consortium universities, the two National Laboratories, selected environmental organizations, and selected industrial organizations, provides advice, information, and liaison to identify key external linkages and promote relationships. This board advises on agency and industry needs, mechanisms to build relationships, and status of key environmental variables including technology state of the art and practice.

Each of the major functions are supervised by Technical Heads, who report to the Director.

Industrial participation is built into the program as part of the Advisory Board. In addition, industrial participation is included in the Industrial Affiliation Program and the

Teleconference Educational Program. Sponsorship is continually sought for Educational Program. Sponsorship is continually sought for specific programs that satisfy the criteria listed previously, i.e., technical excellence and relevance to the Consortium's purpose.

The Carlsbad Environmental Monitoring & Research Center is a separate independent center, reporting administratively to the Director of WERC, but operating as an independent organization for its mission.

TABLE 1

EXECUTIVE BOARD MEMBERS
1991-1992

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WERC Chief Executive Officer
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EDUCATION VIA COURSES

Providing quality education in efficient and safe management of hazardous, radioactive, and solid wastes requires a multi-disciplinary approach. Through the integrated capabilities of its members, the Waste-management Education and Research Consortium (WERC) has established itself as a world-class center for expanding the nation's capabilities to address current and future environmental issues. Relevant background and experience is offered in numerous disciplines including: environmental engineering. environmental science environmental health, environmental law, public policy, economics, risk assessment, hazardous materials handling, etc. The primary goal of the Consortium is to provide educational opportunities to all professional levels serving the environmental field. This section provides a current summary of the environmental education curriculum opportunities established by WERC.

Educational Programs

Undergraduate Degree Program. This program was started in Fall 90 after careful review of industrial and professional needs. Industry wants professionals to have an in-depth education in scientific or engineering field combined with specific but multi-disciplinary environmental training. The courses include not just technical curriculum but each student must also take courses in other areas such as legal, risk analysis and economics. Additionally, each student must take courses from outside the students' home university. The specific details of the minor requirements at NMSU are described in Appendix A. Upon graduation the student has an accredited degree in the field of his choice with a minor in environmental management. Currently, we have over 300 students in the undergraduate program. The geographic distribution of students is shown in Figure 3.

Undergraduate Fellowships. Students registered at the three campuses receive fellowship awards ranging between $500-$5000 per year. The fellowships are awarded on the basis of academic merit and the desire to pursue a career in environmental management. The recipients must complete the requirements for the environmental/waste management minor and must gain work experience on a faculty-directed research team of their choice investigating an environmental management problem. Over $100,000 are awarded from both DOE and industry funds.

Graduate Degree Program. This program was also started in fall 1990 to satisfy the needs of industry and professionals. Students pursuing graduate degrees (M.S. and PhD.) at the member institutions are provided the opportunity to obtain a minor in environmental/waste management. The minor requirements are similar at each campus and are satisfied by completing 8-14 credits of coursework relevant to waste management and environmental restoration. Thus, almost one-half of the students graduate work is in multi-disciplinary

environmental areas including a research project or dissertation. The specific details of the minor requirements are described in Appendix B.

The above program is for the minor in environmental management. This satisfies the need for most of the students. However, there are a small number of students who desire a specific graduate degree in Environmental Engineering. A new program is under development for an interdisciplinary Master's degree in Environmental Engineering. The requirements for this program are shown in Appendix C.

Certificate Programs. This program has been started for individuals who have previously received a bachelor's and/or graduate degree in appropriate technical fields and wish to obtain a professional environmental management certificate at any of the member institutions. The program is designed for students who do not wish to pursue a formal graduate degree but desire an updated background in environmental management. Certificate students enroll at the member institutions in the "non-degree" status and pursue a program similar to the minor program. The specific details of the certificate requirements at NMSU are described in Appendix D.

Associate Degree Program. This is a unique program not available anywhere in the world. After a careful review of 2-year technologist needs, it was identified that an associate degree program is needed for radioactive and hazardous waste management, with emphasis on robotics and safety. An associate degree program in radioactive and hazardous materials technology started in Fall 1991 at the NMSU-Carlsbad branch campus. Graduates of this program are prepared for entry level employment as technologists in industries, laboratories, and government agencies concerned with the generation, mining, disposal, transportation, storage, or regulation of hazardous materials. The program is closely patterned after the accredited engineering technology programs offered on the main campus of NMSU. This feature allows students completing the associate degree requirements to transfer to the engineering technology program. We had projected an initial enrollment of about 30 students and were overwhelmed with over 70 enrolled for Fall 91. The specific details of the associate degree requirements are described in Appendix E.

Navajo Community College (NCC). The program at NCC-Shiprock is intended to address the specific needs for education, training and the environmental problems of the arid Navajo Nation and its Native American population. The program, to be phased in over three academic years, will confer a two-year (Associate of Science) degree in Dryland Environmental Science and Reclamation Technology. The program includes a rigorous curriculum in basic science, environmental courses in hydrogeology, dryland botany, and soil and range sciences, and a summer field or laboratory internship. Graduates of this two-year program will be able to gain employment as environmental technicians, or to transfer to baccalaureate programs in a wide range of science and engineering fields. The specific details of the curriculum program requirements are described in Appendix F.

As part of this effort, NCC-Shiprock has also established an Environmental Geochemistry Laboratory called the Navajo Drylands Environmental Laboratory (NDEL). The educational role of this laboratory will be twofold: (1) to offer professional training in analytical chemistry and environmental science to NCC-Shiprock graduates and (2) to broaden the scope of ground water pollution projects now underway at NCC-Shiprock.

A new broader program for training of Native Americans in Solid Waste Management is under development.

Professional Development Courses. An off-campus training program was conducted throughout 1991 to provide continuing professional education to engineers and scientists involved in environmental management activities in industry and government. The training is provided in a videoconference format. The instructors are selected as highly specialized world-class experts in their fields and are drawn from the three Consortium universities, the New Mexico national laboratories, and other organizations around the country. The first videoconference presents up-to-date material on hazardous and radioactive waste management. The contents of the first videoconference series are presented in Appendix G. This series provided state-of-the-art information in all areas of technology, regulation, etc. to over 1000 professionals throughout the U.S. The second videoconference, scheduled for presentation in 1992, will focus on waste minimization in industrial operations. The preliminary information on the second series is presented in Appendix H.

Educational Aids

Satellite Interactive Television (ITV) System. A major goal of the Consortium is to produce and interchange interactive television courses between the consortium members and to transmit ITV courses across the state, the nation, and international boundaries. This goal is accomplished through a satellite up-link system transmitting under KY band frequency. The Consortium currently transmits six to eight courses and 1-2 special lecture series per semester, a summer research seminar series, and one professional development videoconference course per year. A listing and description of the Fall 1991 and Spring 1992 course offerings is presented in Appendix I. Also, shown in the Appendix is the enrollment trend in the telecourses. The Consortium strives to present a broad range of courses relevant to environmental management including, but not limited to,: engineering, science, economics, law, public policy, and management. Established satellite receive sites in New Mexico include: ENMU-Roswell, New Mexico Junior College-Hobbs, NMSU-Carlsbad, Sandia National Laboratories-Albuquerque, San Juan College-Farmington, Tucumcari Area Vocational School, UNM-Gallup, UNM-Los Alamos, and the WIPP Site-Carlsbad. The receive sites are illustrated in Figure 4. The summer seminar series is one of many components of the technology transfer function built into the Consortium structure. A schedule of the 1991 summer seminar series is presented in Appendix J. The summer seminar was broadcast to numerous sites across the country. The 45 sites (14 in New Mexico) that received the 1991 professional development videoconference course are listed in Appendix K. The distribution of these sites in the U.S. is shown in Figure 5.

Pre-College Assistance. Programs which encourage pre-college students to become environmentally conscious and to pursue professional environmental careers are described below.

Summer Institute: The week long summer institute features high-school level design problems and focuses on enhancing math/science/engineering education within high schools with emphasis on those having a high population of minority students and teachers. The program is directed at schools throughout New Mexico and the El Paso area. Last summer we provided this program to over 50 students and teachers.

Students Watching Over Our Planet Earth (SWOOPE): A pilot program of SWOOPE was established in the Las Cruces public schools. This program is part of a program initiated and started by the Los Alamos National Laboratory. The program is designed to teach K-12 students laboratory, field, and data gathering techniques while monitoring water quality in local lakes, ponds, reservoirs, wells, the wastewater treatment plant, tap water, and public facilities. The program's animation specialists are also developing exciting, colorful, animated, interactive, software which teaches K-12 students environmental consciousness. The school districts involved are illustrated in Figure 6.

Inter-University Design Contests. An environmental design contest for universities across the U.S., as well as Mexico and Canada, is structured to give university student teams an opportunity to compete in a national contest for design and development (technical, economic, public communications, and regulatory aspects) of a bench scale environmental control process. The national competition is held annually at a Consortium university campus on Earth Day. Student teams compete for cash prizes and trophies. The judging team is made up of representatives from industry, academia, and government. The design problem for 1991 focused on management and decontamination of industrial wastewater. Student teams from universities throughout the U.S. competing included the State university of New York at Buffalo, the University of Maryland, and West Virginia University. The 1992 design problem will focus on remediation of contaminated soil. Announcements have been sent to universities throughout America and over 50 universities have expressed serious interest.

Project del Rio. Project del Rio is an international water quality monitoring project along the Rio Grande/Bravo involving high school students in the U.S. and Mexico. The project is designed as a three-week teaching module that can be fit into science and social science classes. Students learn how to conduct a battery of water quality tests, obtain and analyze water quality measurements, and derive a water quality profile for the river. In addition, students are encouraged through classroom discussions to examine the social, political, and cultural dimensions of environmental issues using the Rio Grande/Bravo as an example.

The project provides participating schools with all the equipment and training they need. All of the schools are linked via a computer conference, enabling students at different schools to share data and converse with one another.

An important goal of the project is to foster cross-cultural understanding and provide students with the skills they need to participate effectively in community affairs along the U.S./Mexican border. The project culminates in a day-long bilingual Congress at which students from all of the participating schools meet face-to-face to discuss their findings, share their ideas, and learn action-taking skills at workshops taught by professionals.

WERC supports only a portion of Project Del Rio; outside sources provide majority of funds. It is operated from the College of Education with Lisa La Roque as the Director of the project.

1991 was the pilot year for Project Del Rio. In April, nearly 400 students from 12 schools in Las Cruces, Anthony, El Paso, and Juarez collected water quality data from a 60

mile-stretch of the river. Students also had the chance to pursue their interest in science or the environment after the project. Internships and summer assistantships were established with the Rio Grande Compact Commission, Elephant Butte Irrigation District, and the University of Texas at El Paso.

To assist teachers and students participating in the program, Project Del Rio staff developed a variety of supplementary resources. These included a water quality manual, instructional videos, an introductory video to water issues, a resource list of free and inexpensive materials related to water quality, and a land use map of the Rio Grande. The Spanish versions of these resources constitute a treasury of curriculum materials not previously available to Mexican schools.

A solid network of professionals was established on both sides of the border to support the project by providing technical expertise, advice, internships, volunteer experiences, and tours to participating schools. In addition, university students at New Mexico State University, University of Texas at El Paso, Universidad Autonimo de Juarez, and Tecnologico de Monterrey were trained (and received college credit for assisting teachers and students during the project.

Current Status of Programs

Undergraduate Enrollment

	UNM	NMSU	NCC	NMIMT
Degree	31	184		16
Non-Degree				

Graduate Enrollment

Assistants	19	10		XX
Associate Degree		64	11	

Other Remote Site Enrollment, Undergraduate and Graduate: 135

Design Competition

All Universities 85 in 1991; about 200 in 1992

Teleconference

1000 + professionals

Pre-college

All programs = over 2000

EDUCATION THROUGH TECHNOLOGY DEVELOPMENT

An important result expected of the WERC program is the production of students with advanced degrees who have acquired expertise in waste management and environmental restoration via hands-on independent technology development projects at the leading edge of technology. The technology development projects are intended to provide student and faculty support, laboratory resources, supplies, materials, technical focus, and other ingredients needed to educate the students and assist the faculty in exploring new and innovative techniques that address environmental management problems. Without the support of the technology development program, the quality of the graduate educational experience would be substantially reduced for both students and faculty. Currently, we have over 100 students enrolled in the graduate program and/or involved in the technology development projects.

The scope of technology development is broad-based and is designed to include all areas of radioactive, hazardous, and solid waste management and environmental restoration. The second round of projects for 1991 were selected from proposals submitted by faculty and employees of the consortium members with collaboration from the national laboratories and industry.

The process started with solicitation of proposals. An evaluation of projects was made by a panel of experts on the following criteria:

1) Are graduate and undergraduate education an integral part of the contemplated research? Are students involved in the research? Will the project contribute to student education?

2) Does the proposal have technical merit, a sound approach and the potential to advance the state-of-the-knowledge?

3) Are the facilities and equipment proposed adequate to accomplish the research contemplated?

4) Does the proposal support the consortium's concept of cooperation among members and/or external federal, state and local research organizations?

5) How well does the research address issues of reduction, storage, transport, disposal, economics, risk assessment, legal and public policy related to waste management and environmental restoration?

6) Do the investigators have the credentials to carry out the research?

7) Does the proposed research have cooperative support from outside sources (e.g. industry, other programs, etc.)?

8) Does the research have the potential for results applicable to issues in a reasonable time frame?

9) Is the budget reasonable for the proposed scope?

The evaluation by the experts was used by a team from WERC constituents to make the final selection of projects to be funded.

In the second round we received 67 proposals. Thirty-three of these were selected for funding and the projects were started in February 1991. All but one of these projects have principal investigators from at least two universities and a national laboratory. These covered a range of waste management issues as shown below.

The projects undertaken in 1991 are:

1) Adaptive Control of Manipulators and Telerobots Handling Hazardous Waste: Phase I
2) Application of Biotechnology to Industrial Wastes Containing Toxic Metals
3) Design of Operator Interfaces for Hazardous Waste Removal
4) Assessing Risk Costs for Nuclear Waste Transportation
5) Nuclear Waste Storage Vault Closure Determination
6) Remediation of Hazardous Waste Sites By Heap Leaching
7) Minimization and Remediation of Nuclear Waste Using Actinide Chelators
8) Dynamic Modeling for Designing Transportation Packaging Components
9) Enhancement of Solar Photocatalytic Detoxification
10) Understanding Change in Public Perceptions of Nuclear Waste Policies
11) Recovery of Toxic Heavy Metals from Contaminated Groundwater
12) Nuclear Waste Repository Ventilation System Studies
13) Constrained Motion Control for Teleautonomous Robot Handling of Waste
14) Study of Geochemical Behavior of Uranium Tailings Leachate in the Stubstrate
15) Laboratory Validation of Models of Groundwater Pollution Transport
16) Calibration of Near-Field Stability Instrumentation at the Waste Isolation Pilot Project
17) Conditional Simulation and Contaminant Flow Modeling
18) Treatment of Waters with BTX and Heavy Metals Using Tailored Zeolites
19) Efficient Algorithms for Modeling the WIPP Site
20) Biodegradation of Explosives Wastes
21) Evaluation of Unsaturated Zone Contaminant Transport Models for Waste
22) Development of Sensors for Waste Management Applications
23) Stable Isotope Study of Soil and Ground-Water, WIPP Site New Mexico
24) Deformation Mechanisms in WIPP Backfill

25) Reforming and Gasification Technology for the Destructions of Wastes
26) A New Fast Scanning Environmental SEM for use in Waste Studies
27) Charged Aerosol Scrubber for Air Purification
28) Slurry-Phase Bioremediation of Oilfield Production Pit Sludges
29) Vadose Zone Microbiology for Mixed Hazardous Waste
30) Design of Compact Microsensors for Monitoring Organic Contaminants
31) Mobility of Radioactive Colloidal Particles in Groundwater
32) Performance of Rock Reinforcement Systems at Elevated Temperature
33) Development of Permeable Barriers for Aquifer Restoration

These projects have completed the past year of investigation. A summary of the results are shown in Appendix L.

It is too early to predict the impact of the projects. However, several of the projects are already showing promise for meaningful applications. It is our objective that in 3 - 5 years, commercial technologies will result from this program activity. More important is the practical experience that about 150 faculty members and students are getting from the involvement in the research projects and the exchange of technology between the three universities and the two national laboratories.

Several publications and papers have resulted from the projects. The major ones are listed in Appendix M.

LABORATORY FACILITIES

Four facilities have been established to directly interface with the education programs and support WERC researchers. The facilities are capable of training students in the operation and maintenance of analytical equipment. With supervision, students conduct analysis on water, soil, air, and plants to develop analytical skills and learn monitoring aspects of environmental restoration and waste handling. The facilities include:

1) The Soil-Water-Air Testing Facility (SWAT) on the NMSU campus in Las Cruces is functional and is currently providing analytical services in the areas of toxic and hazardous waste to researchers from the universities and other organizations. The laboratory cooperates with different researchers in the acquisition and operation of specialized testing equipment related to toxic and hazardous waste management and environmental restoration projects. The laboratory is equipped for physical, inorganic, organic, and bacterial analysis of soil, water, air and plants. The demand for services from SWAT is extensive.

2) The Radioactive Experimental Facility at Carlsbad (CREF) has the role of exploratory development and research associated with transuranic waste isolation and mixed waste management. It provides support for monitoring WIPP activities and for instrumenting experimentals planned by other facilities. By combining above ground laboratories in proximity to the underground repository, closely monitored, long-term evaluations of isolation strategies can be carried out along with the required control experiments. This facility provides space to build and instrument experiments, calibrate instruments and monitor results that depend upon exposure to chemical, thermal, and radiation environments only available at the WIPP site. Relationships are being developed with the Carlsbad Environmental Monitoring and Research Center (CEMRC) which may lead to CREF focussing more on laboratory experiments at the licensed facility on the UNM campus. CEMRC would then assume the interface role for WERC research at WIPP.

3) The Oil-Water Experimental Facility at Hobbs (HOWE) provides for educational, research, and development programs related to environmental and waste disposal concerns of the petroleum industry. A field laboratory is available which consists of a watered out petroleum reservoir and supporting equipment. The producing formation is approximately 2,000 feet deep and 15 feet thick. There are several production units (pumps) in place, although only one is operating at present. An injection plant, equipped with one injection pump, is also available. The analytical equipment is based at the New Mexico Junior College campus in Hobbs

and at NMIMT.

4) The Navajo Drylands Environmental Facility (NDEL) provides hands-on training with analytical monitoring equipment to students at the Navajo Community College (NCC). The first phase of the laboratory was dedicated on December 5, 1991. The second phase will be equipped and operational in the 1992-1993 project year.

The major equipment in place at WERC facilities is listed in Appendix N.

TECHNOLOGY TRANSFER & COMMUNICATIONS

The technology transfer function of the Consortium is emphasized throughout the entire regimen of its activities. Specific initiatives designed to implement the transfer of learning as well as technology are in various stages of proposal and implementation and the major ones are summarized as follows:

1) The Executive Board and Advisory Board composed of representatives from top management of governmental, and private sector industrial and environmental organizations are now operating and are holding their meetings at the appropriate times.

   The Advisory Board held its second meeting in Carlsbad concurrently with the meeting of the Executive Board. At this second meeting Mr. Samuel Small of the Amerada Hess Corporation was elected Chairman. The charter of the Advisory Board was revised and adopted as revised. It is now being printed prior to distribution to the membership.

2) Dialogue with industry and the National Laboratories continues to grow through briefings, and collaboration among researchers of the various member institutions of the consortium and these national resources.

   To improve the dialogue with the private sector entities, the Consortium has been fortunate in obtaining the services of Mr. Jim Walls on a "loan" basis from Westinghouse-WIPP. Mr. Walls has begun an aggressive program to recruit support community both within the state of New Mexico and throughout the nation.

3) The educational arm of the consortium has been broadened and strengthened by the advent of the Navajo Dryland Environments Laboratory (NDEL) which was formally dedicated in December of 1991.

   The associate degree program at NMSU-Carlsbad is in operation and major proposal for a robotics option to this curriculum before the Department of Energy and preliminary indications are that the chances for funding are very good.

A proposal for a Native American Associate Degree Program on Solid Waste Management intended to be located at Navajo Community College is currently in preparation.

An aggressive student recruitment program focused on secondary school students in New Mexico and surrounding states is underway and will be expanded as resources permit.

Increased involvement with high school programs is being implemented through a newly proposed design contest which will be part of the Summer Design Institute previously held at NMSU.

4) Technology development results are being transferred by means of seminars and through formal contacts with participants both from government and the private sector. Two major conferences have been held and these have attracted about two hundred participants. Results from each funded project are reported each quarter. Wide area dissemination of these results is accomplished by means of the fiber optic communication network and the satellite uplink system.

5) The development and presentation of an eleven part professional development teleconference series entitled Hazardous/Radioactive Waste Management has been completed and the program has been distributed to over fifty paid subscription sites throughout the Northern Hemisphere. The success of this first initiative has prompted the producers to begin work on a second series to be presented in 1992 and entitled Pollution Prevention and Waste Minimization and a number of receive sites have already been pre-enrolled for this series.

At the TeleCon 11 conference in Santa Fe, California the WERC teleconference series was presented an award for "Advanced Level Training and Continuing Education." The winning of this award by a comparatively new and unknown group working with a budget of under a million dollars in competition with established producers spending several million dollars on a single effort should serve as prima facie evidence of the dedication to quality present within this group and to the technological expertise present within the Consortium.

6) Highlights of operation for each consortium facility are presented in the 794 page Annual Research Progress Reports which has been in great demand by researchers and collaborators throughout the country.

7) Over sixty technical papers have been presented and published by WERC investigators and staff personnel covering all of the varied aspects of the program. These presentations have included reports on the progress of the educational initiative, the operations of the Consortium laboratories and the results and progress of research projects.

8) The WERCforce Newsletter is sent out bi-monthly covering the various activities and updates on the WERC. Emphasized in the newsletter are the three major areas of the consortium including: Education by Courses; Education by Technology Development; and Technology Transfer. Also included is a letter from the consortium director, Ron Bhada. Announcements and future activities are highlighted throughout each issue. There are approximately 4,000 documented readers of the WERCforce. Per issue there are approximately 7,000 issues distributed through a mailing list or various ways of distribution such as conferences, inserts in the WERC information packet and presentations to the public and private organizations. An average of about 25 readers are added to the mailing list per issue.

9) WERC made a number appearances throughout the year by displaying a booth and giving presentations at various conferences and exhibit shows. Along with the display literature was also available to promote the WERC including: a brochure, the WERCforce newsletter, an information guide on the Interactive Television Program, a request for information card and a number of fact sheets for each of the areas of the consortium. For one on one contact there is always at least one WERC staff member manning the booth for any specified questions and verbal information. A WERC videotape is also shown with the exhibit giving the general overview of the consortium.

10) WERC produced a promotional videotape giving the general overview of the consortium. It is used with the WERC exhibiting display and for presentations given on WERC to officials in government, academia, industry and the general public. Also produced was a videotape on WERC's First Environmental Design Contest. The tape describes all activities of the design contest and is also used in various presentations of promotion. It has been very successful in getting more universities and sponsors involved in the 2nd Annual Environmental Design Contest to be held April 1992.

11) Planning is currently a way to expedite technology transfer throughout the State of New Mexico. At the present time it is intended that "hands-on" courses which meet the current OSHA, EPA and DOT training requirements will be presented. Among the governmental agencies with whom discussions are currently being held at the U.S. Department of the Interior, the Bureau of Land Management, the New Mexico Department of Environment and the State Corporation Commission, Mr. Samuel Small, WERC Advisory Board Chairman, is concurrently attempting to initiate support for this program among potential clients within the private sector.

WERC Recognition

The accomplishments of the WERC have been recognized throughout the year as to numerous groups. In the past year WERC has been recognized at the following events:

KBIM-TV/"Horizons"-Roswell, NM	June 91
KDBC-TV/"Foresight"-El Paso, TX	June 91
HBCU/MI Curriculum Planning Meeting-Jackson, MS	June 91
Rotary Club-Roswell, NM	July 91
KTSM-TV/"Inside 9 Country"-El Paso, TX	July 91
Kiwanis Club-Albuquerque, NM	July 91
Energy, Natural Resources and Environment Interim Committee of the New Mexico Legislature	Aug. 91
Economic Development Committee of New Mexico Legislature	Aug. 91
Border Development Committee of New Mexico Legislature	Aug. 91
Economic Forum-Albuquerque, NM	Aug. 91
AIChE National Meeting, Pittsburgh, PA	Aug. 91
Environmental Conscious Manufacturing, Albuquerque, NM	Sept. 91
1991 Eastern New Mexico State Fair-Las Cruces, NM	
Second Year Signing Ceremony	April 91
DOE News Conference-Albuquerque,NM	March 91
WERC National Environmental Design Contest-Las Cruces, NM	April 91
WERC Environmental Design Institute for High School Students and Teachers	Aug. 91
WERC News Conference-Albuquerque, NM	Nov. 91
First graduates of the WERC Environmental Minor	Dec. 91
Hazardous Waste Management Seminar-Carlsbad, NM	Oct. 91

WERC and DOE have been covered in numerous newspapers throughout New Mexico and the United States including Associated Press coverage. Through the New Mexico Clipping Bureau in Albuquerque WERC has received copies of over 200 articles printed in newspapers throughout the state, including:

New Mexico Business Journal
HazTech Transfer Newsletter
Page One Newsletter
Round Table Newsletter
New Mexico Technology Enterprise Forum
Engineering Magazine
Engineering News
DOE News
New Mexico Research & Development Forum
National Sources Directory

NEW PROGRAMS STARTED BY WERC

Three major innovations have recently been initiated and activated by the Consortium. These are included as additions to the WERC program. They are:

1) The Carlsbad Environmental Monitoring and Research Center (CEMRC)

2) The Environmental Fellows Program

3) The Navajo Dryland Environments Laboratory

The Carlsbad Environmental Monitoring and Research Center

The Carlsbad Environmental Monitoring and Research Center (CEMRC) provides a source for an independent assessment of the environment of the Carlsbad area in order to provide monitoring for the operation of the Waste Isolation Pilot Plant (WIPP). Services available include the capability to perform complete bioassays of WIPP employees and a representative sampling of residents from the Carlsbad area, the laboratory evaluation of air samples collected during the monitoring near the WIPP site and the establishment and maintenance of an environmental database. Contract services will be available to both public and private entities that have environmental monitoring requirements and/or a need for bioassay and laboratory analysis capabilities.

A part of the CEMRC mission is the development of student and independent world leadership for the development of methodology, protocols, and sensory apparatus for obtaining, processing, and disseminating environmental data. To attain and maintain the requisite level of intellectual and scientific independence as well as technical competence the program's:

* Long range objectives and policies will be guided by an independent board of directors composed of distinguished faculty from institutions within the Consortium, prominent residents of the State of New Mexico, and nationally recognized experts as needed to balance the representation.

* Daily operations and capabilities will be guided by periodic reviews by a Technical Advisory Committee, composed of the nation's experts in health and environmental monitoring.

* Research to advance monitoring techniques, protocols, and methodologies will be identified by the program and the requisite research and development projects will be proposed and funded from a portion of the program's operating budget.

The CEMRC will also provide a unique and invaluable resource for the training of students as well as university faculty members.

* Relationships with public and private entities will be developed which will effect transfers of technology which will result in industrial development based on the results of sound research.

The bioassay facilities at the CEMRC will include a whole body counter, other radiation detection and sampling instrumentation as well as standard medical diagnostic equipment. In particular, the actual rate of exposure and accumulated radiation dosage of WIPP employees and local Carlsbad area residents will be evaluated on a regular basis to corroborate that the WIPP procedures are and have been effective. These measurements are currently being obtained by the Los Alamos National Laboratory at considerable expense to the U.S. Department of Energy (DOE) and do not presently include samples from the local population. In the highly unlikely event of an incident involving radioactivity, the dose and exposure added to the community can be determined by the CEMRC once an adequate primary baseline has been established.

The CEMRC will have sufficient instrumentation on board to provide all of the laboratory tests required for the on-going monitoring of the WIPP site and its surrounding environment.

The CEMRC data center will have sufficient computer capacity to collect, organize, and disseminate test results and information to entities of the public and private sectors upon request. Confidential information on specific individuals will not, however, be revealed to the public.

The Environmental Fellows Program

The Environmental Fellows Program has the mission of expanding the world's capability to address those issues associated with the management of hazardous, radioactive, and solid wastes. This task will be accomplished by:

1) An educational program at the graduate and/or post-doctoral level for selected emerging leaders from around the world.

2) Seminars and conferences featuring the foremost technical experts from the international environmental arena.

3) A technology application component which will allow the participants of the program to utilize their expertise in the search for solutions to the environmental problems which currently beset our world.

4) An optional work experience residency program which will give to the international fellows an opportunity to gain up-to-date practical experience by working with the staff in the National Laboratories for a short time following the completion of their educational program.

The Navajo Dryland Environments Laboratory

The Navajo Dryland Environments Laboratory (NDEL) is developing resources and addressing issues associated with environmental restoration and management of the semi-arid to arid Navajo Nation and the surrounding region in the Four Corners area. The laboratory is accomplishing this task through the following educational and research initiatives:

1) NDEL supports field and laboratory research in environmental geology, hydrology, and resource management in addition to serving as an environmental monitoring facility for the eastern Navajo Nation.

2) NDEL is utilized as a training facility for Navajo undergraduate students studying quantitative environmental science.

3) With WERC support, NDEL is participating in the development of a new associate degree program in Earth and Environmental Sciences (EES) at Navajo Community College in Shiprock. This program includes a rigorous curriculum in basic sciences as well as specialized courses in environmental geology, analytical chemistry, dryland botany, and soil and range sciences in addition to a summer field or laboratory internship.

   Graduates of the EES program, which is designed in accordance with Navajo educational philosophy, will be able to gain employment as environmental technicians or managers within the Navajo Nation. In addition, these students will be able to transfer to baccalaureate degree programs in a wide range of science and engineering fields at four-year institutions in New Mexico and elsewhere.

PERFORMANCE CRITERIA

We have set up criteria to measure the performance of our program. These have been set up for several different forms of measurement as follows:

1) Event-related measurements, comparing target dates of events with actual dates of completion.

2) Quantitative data measurement comparing initially project achievement (e.g. student enrollment with actual achievement.

3) Survey type of measurements relying on feedback from customers and users of WERC, e.g., feedback from industry on graduates from WERC.

The following pages show the customer base of WERC and the measurement criteria set up to serve the needs of our customers.

MILESTONE RELATED PERFORMANCE
KEY MEASUREMENTS

	Date Target	Date Actual
Set Up a Unified Administrative System and Qualified Team	4/90	3/90
UG & G Degree Program		
- Approved	7/90	7/90
- Started With Students	8/90	8/90
Fellowships		
- Established	5/90	5/90
- Awarded	8/90	8/90
Interactive Televised Courses (ITV)		
- System in Place	7/90	8/90
- Courses Transmitted	8/90	8/90
Professional Training		
- Program Developed	1/91	1/91
- Series Transmitted	2/91	3/91
Inter-University Design Contest		
- Organized	10/90	11/90
- Held	4/91	4/91
K-12 Summer Institute	8/91	8/91
Associate Degree		
- Approved	5/91	3/91
- Started With Students	8/91	8/91
Student Recruitment		
- In State especially minorities	6/90	6/90
- Out-of-State	12/91	2/92
Technology Development		
- Selection Process	2/90	12/89
- Start First Projects	4/90	5/90
Technology Reports - First	2/91	2/91

MILESTONE RELATED PERFORMANCE
KEY MEASUREMENTS

	Date Target	Date Actual
Technical Results Teleconference	7/91	7/91
Teaching/Technology Laboratories		
- Initiated	9/90	9/90
Industrial Affiliate Program		
- Initiated	9/90	9/90
- Operational	2/91	4/91
Newsletter Initiated	9/90	9/90
Seminars/Briefings Initiated	8/90	9/90
Extension System Initiated	2/90	Postponed
Data Base Operational	2/92	(by 6/92)
Placement with National Labs	8/91	8/91
New Outreach Programs	2/92	10/91

KEY QUANTITATIVE MEASUREMENTS

Measurement	Projection	Actual
Number of Undergraduates Enrolled		
Fall 1990	30	200+
Fall 1991	250	250+
Number of Graduates Enrolled		
Fall 1990	10	15
Fall 1991	30	50+
Number in Associate Program		
Fall 1991	30	63
Faculty Members Teaching		
Fall 1990	100	100+
Fall 1991	140	140+
ITV Courses		
Number in Fall 1990	3	3
Number in Fall 1991	6	8
Enrollment in Fall 1990	50	150+
Enrollment in Fall 1991	250	300+
Percent Underrepresented		
Minorities	25%	25%
ITV to Communities		
In New Mexico by 1992	10	15
In US in 1994	15	
Teleconference Series		
Institutions Enrolled	40	48
Professionals Enrolled	500	1000+
Measurement Laboratories		
Number Operational		
1990-91	3	3
1991-92	3	4
EPA Certification		
1992-93	1	

KEY QUANTITATIVE MEASUREMENTS

Measurement	Projection	Actual
Inter-University Design Contest		
University Teams - 1991	5+	7
University Teams - 1992	12	19
Summer Institute		
Students & Teachers	54	54
Underrepresented Minorities	40%	50%
Undergraduate Scholarships		
1990-92	40	50+
1992-93	50	(Not selected yet)
SWOOPE		
Students Participating in Las Cruces	500	750+
Pre-college Information Sent/Presented to	200	400+
Out-of-State Recruiting		
1992-93	10	20+
1993-94	20	
Professional/Technical Presentations		
1990-91	30	30+
1991-92	60	60+
1992-93	90	
Newsletters		
1990-91	2	4
1991-92	3	4
1992-93	4	
Technology Development Projects		
Number of Projects:		
1990-91	25	27
1991-92	30	33
1992-93	35	42

KEY QUANTITATIVE MEASUREMENTS

Measurement	Projection	Actual
Technology Development		
Number of Students Educated:		
1990-91	25	75+
1991-92	50	75+
1992-93	50	100+
Number of Faculty Trained:		
1990-91	40	60+
1991-92	50	70+
1992-93	50	85+
Number of Collaborators:		
1990-91	25	26
1991-92	30	33
1992-93	35	44
Technology Realized to Large Scale Use		
1993-94	1	(Not due yet)
1994-95	2	(Not due yet)
Technology Development Conferences		
Number in:		
1990-91	1	1
1991-92	2	2
1992-93	2	2
Number of Students Graduated		
1990-91	0	1
1991-92	20	12*
1992-93	30	
1993-94	40	
1994-95	50	

*To Date

KEY QUANTITATIVE MEASUREMENTS

Measurement	Projection	Actual
Number of Graduates Employed in Environmental Area		
1990-91	0	1
1991-92	15	10*
1992-93	20	
1993-94	30	
1994-95	40	
Number of Summer Jobs for WERC Students		
1990-91	5	5+
1991-92	10	
1992-93	20	
1993-94	40	
1994-95	60	
High School Participants Enrolling In University Environment Programs		
1991-92	2	2+
1992-93	10	
1993-94	20	
1994-95	20	
Industrial Employers Satisfied		
1992-93	15	
1993-94	20	
1994-95	30	
New Major Programs Started		
1991-92	1	1*
1992-93	1	1**
1993-94	1	
1994-95	1	

*To Date

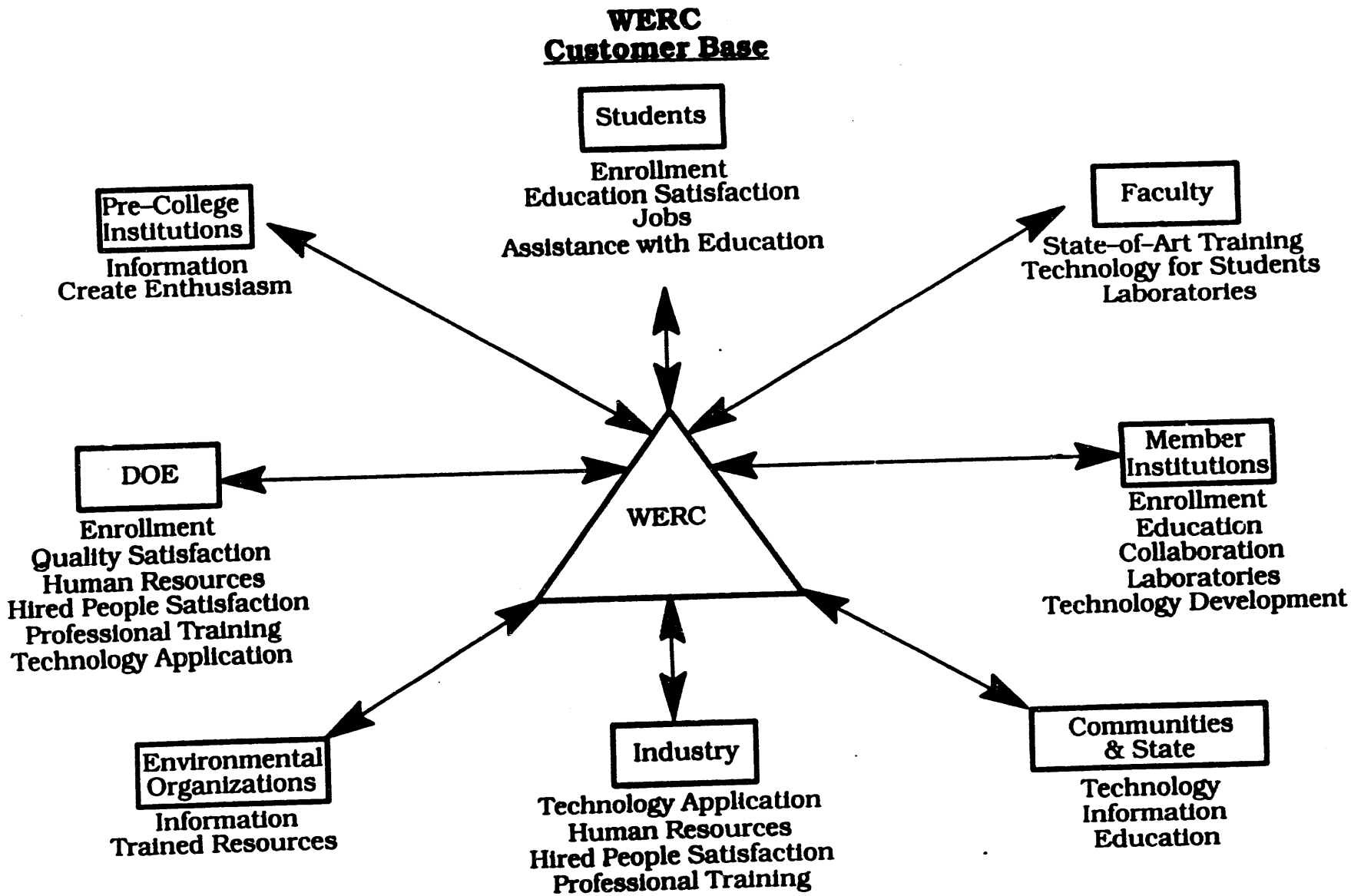
KEY QUANTITATIVE MEASUREMENTS

Measurement	Projection	Actual
Information to Communities/State		
Number of Inquiries Satisfied:		
1991-92	2	3
1992-93	4	
1993-94	6	
1994-95	8	

*Carlsbad Environmental Monitoring & Research Center
**Environmental Fellows Program

PERFORMANCE SURVEYS

	Target Date	Actual Date
Students in Program		
Survey Completed	12/92	
Actions Completed	6/93	
Students Graduated		
Survey Completed	6/93	
Actions Completed	12/93	
Industry with Graduates		
Survey Completed	6/93	
Actions Completed	12/93	
Professional Development Customers		
Survey Completed	1/92	1/92
Actions Completed	3/92	3/92
Other Universities		
Survey Completed	8/92	
Actions Completed	2/93	
Pre-college Institutions		
Survey Completed	9/92	
Actions Completed	2/93	
Advisory Board		
Feedback	4/92	
Actions	7/92	
Faculty		
Survey Completed	12/92	
Actions Completed	6/93	
Laboratory Customers		
Survey Completed	12/92	
Actions Completed	6/93	


WERC
Customer Base
Students
Enrollment
Education Satisfaction
Jobs
Assistance with Education
Pre-College Institutions
Information
Create Enthusiasm
Faculty
State-of-Art Training
Technology for Students
Laboratories
DOE
Enrollment
Quality Satisfaction
Human Resources
Hired People Satisfaction
Professional Training
Technology Application
WERC
Member Institutions
Enrollment
Education
Collaboration
Laboratories
Technology Development
Environmental Organizations
Information
Trained Resources
Industry
Technology Application
Human Resources
Hired People Satisfaction
Professional Training
Communities & State
Technology
Information
Education

DATE
FILMED
6/9/93