

A CONSORTIUM TO ADDRESS MULTIDISCIPLINARY ISSUES OF WASTE MANAGEMENT

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Efficient and safe management of nuclear, hazardous, and solid waste is an increasingly critical national issue [1-5]. Further, it is a broad multidisciplinary issue that cannot be effectively addressed by any one entity or organization. It requires a collaborative effort between multiple organizations with diverse expertise and experience.

New Mexico has an infrastructure that will support and provide benefits to the nation from education and research activities related to nuclear, hazardous, and solid waste management. This infrastructure includes the three major research universities, the WIPP site, the Sandia National Laboratory, and the Los Alamos National Laboratory. A designated "Center of Excellence" to educate and research issues in managing nuclear, hazardous, and solid waste is a natural extension of the programs and facilities that already exist in the State.

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The research scope of the Center of Excellence is broad-based and is designed to include all areas of radioactive, hazardous, and solid waste management.

THE WERC PROGRAM

In July of 1989, the Secretary of Energy, James Watkins, approved a waste (management) education and research consortium program [6-8] which had been proposed by New Mexico State University (NMSU) to the U.S. Department of Energy (DOE). The program would be known by the acronym "WERC."

The program is unique and innovative in many aspects. It is the only program in the nation that provides an integrated approach to this national need, and it includes

- Education in waste management by the three Consortium universities which results in graduate, undergraduate, and associate degrees.
- Research programs on the leading edge, feeding into the education programs.
- Education and research at campuses, as well as from three field sites:
 - at the WIPP site (for nuclear and mixed waste),
 - at Hobbs, near the WIPP site (for waste management associated with oil and gas recovery), and
 - at a Soil-Water-Air Laboratory on the NMSU campus (for hazardous and solid waste).
- Ties with other multidisciplinary university facilities.
- Ties with two national labs located in New Mexico.

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

EDUCATION ACTIVITIES

The Center of Excellence offers several education programs:

- Master of Science degrees in chemical, civil, geological, mechanical, mining, petroleum, or nuclear engineering, with special emphasis on the management of radioactive, hazardous, and solid waste.
- A two-year Technology Associate degree program in fields relevant to nuclear and hazardous waste handling.
- Short courses presented through interactive satellite video to laboratories, industry, and federal agencies throughout the country.
- An undergraduate option in Waste Management Engineering, with a major in one of the engineering fields noted in Table 1.

Undergraduate degrees accredited by ABET are offered at the Consortium universities (New Mexico State University [NMSU], University of New Mexico [UNM], and New Mexico Institute of Mining and Technology [NMIMT]) in the engineering fields listed in Table 1. Each department offers options specific to its discipline, leading to a minor in Waste 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 also 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 in waste management.

An associate degree program in radioactive and hazardous materials technology is offered at the Carlsbad Branch of New Mexico State University. Graduates of this program are 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.

The associate degree in hazardous materials technology is closely patterned after the accredited engineering technology programs offered on the main campus of NMSU at Las Cruces. Thus, 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 rigor. The technology program uses the WIPP facility in conjunction with the NMSU Carlsbad Campus as the training facilities.

The interactive satellite video component has the objective of presenting overview economic, legal, policy, management, and technical courses in the problems of radioactive, hazardous, and solid waste management to U.S. research, industry, and educational facilities.

TABLE 1
Undergraduate Degree Options
in Waste Management Engineering

	NMSU	UNM	NMIMT
Agricultural Engineering	✓		
Chemical Engineering	✓	✓	
Civil Engineering	✓	✓	
Electrical Engineering	✓	✓	
Geological Engineering	✓		✓
Mechanical Engineering	✓	✓	
Nuclear Engineering		✓	
Petroleum Engineering		✓	✓
Mining and Metallurg. Eng.			✓

RESEARCH ACTIVITIES

The research scope of the Center of Excellence is broad-based and is designed to include all areas of radioactive, hazardous, and solid waste management. Research under this scope can cover a multitude of subjects. A critical analysis of the research areas shows that research is vitally need in the following subjects:

- Novel Waste Disposal Systems
- Waste Constituent Identification and Migration
- Waste Storage Systems
- Development of Instruments
- Waste Reduction and Minimization

- Risk / Economics / Management
- Public Policy / Community Negotiations
- Petroleum Contamination
- Topics Related Specifically to WIPP
- Toxicology
- Materials
- Meteorological Systems and Methods
- Transportation
- Air, Soil, and Water Monitoring

Individual research projects are funded in the foregoing areas based on the following criteria:

- **Excellence of the proposed work in terms of scientific, engineering, economic, social, legal, or institutional factors**
- **Relevance to Center of Excellence thrust areas and subjects of emphasis**
- **Importance of research to solution of problems in areas of greatest need**
- **Extent of cross-disciplinary interaction and collaboration with industry and national laboratories**
- **Technical expertise of the investigators.**

RESEARCH TESTING FACILITIES

Three facilities are utilized by the program to assist with research and education. They are

1. The soil-water-air testing and research facility on the NMSU campus at Las Cruces, which has the role of providing analytical services in the areas of toxic and hazardous waste management to researchers from the universities and other organizations. The laboratory cooperates with different researchers in acquisition and operation of specialized testing equipment related to toxic and hazardous waste management projects.

2. The Radioactive Experimental Facility at Carlsbad, which has the role of exploratory development and research associated with transuranic waste isolation. Furthermore, it provides support for monitoring WIPP activities and for instrumenting experimental activities 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 the place to build experiments, instrument experiments, calibrate instruments, and monitor results from experiments that depend upon exposure to chemical, thermal, and radiation envi-

ronments only available at the WIPP site.

3. The experimental facility at Hobbs, which provides for educational, research, and development programs related to environmental and waste disposal concerns of the petroleum industry in the United States.

It is particularly important to note that each of the facilities has an educational component and a technology transfer component. Each of the facilities will provide short courses and instructional television courses as part of their mission. Another educational mission of the facilities is to train people in all aspects of handling, monitoring, and management of all types of waste.

The facilities participate in technology transfer via biannual conferences. Invitations will be extended to industry personnel, academic experts, State officials, the federal government (legislators, Department of Energy, Environmental Protection Agency, Department of the Interior), and private environmental groups. The purpose of the seminars will be to provide a forum for opposing points of view, with the goal of conflict resolution so that a mutually acceptable environmental program can be developed.

TECHNOLOGY TRANSFER

The technology transfer function of the consortium is emphasized throughout the program. Specific activities for technology/knowledge transfer include:

- **Use of NMSU's existing extension system to transfer information to communities and individuals.**
- **Continuous dialogue with industry and the National Laboratories via an Industrial Liaison Program.**
- **An Advisory Board composed of representatives from top management of governmental, industrial, and environmental organizations.**
- **The entire educational program is designed to transfer knowledge from theory and research to the hundreds of students in this program.**
- **Research results transferred via seminars with participants from industry and government. Results from each funded project will be reported at least once each year. The fiber optic communication network and the satellite link are used for wide communication of the results.**
- **Research results will also be transferred via technical reports. Every research project will issue accomplishment reports at least once each year.**

- Short courses will be presented on topics of interest with participants from government and industrial organizations.
- Highlights of operation for each laboratory facility will be reported in an annual report. These reports will be published and widely distributed.
- Technical papers will be presented and published on the various aspects of the program. They will include progress in the education program, the laboratory operations, and the research results.

The technology transfer is only meaningful if the information is utilized by the outside world. Therefore, the Consortium plans to hold meetings and seminars where industrial and governmental representatives will discuss implementation of research results. These seminars, meetings, and workshops will be held at various locations, including the three Consortium university campuses and the three laboratory sites. The meetings will also provide opportunities to conduct tours to further transfer technology.

ORGANIZATION

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 Center. The executive board is made up of top management representatives from DOE, the national laboratories, 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.

The operations are managed by a 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) works with the director to provide advice, information, and ambassadorship to identify key external linkages and to promote relationships. This board advises on agency and industry needs, on mechanisms to build relationships, and on the status of key environmental variables including technology state-of-the-art and practice.

Each of the major functions (research, education, facilities, interactive TV) 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." Sponsorship is sought for specific programs that satisfy the criteria listed previously, *i.e.*, technical excellence and relevance to the Center's purpose.

PROJECTED RESULTS OF THE PROGRAM

Beneficial results from the program will include:

- Professionals with degrees in engineering and with expertise in economics, law, and science for the management of nuclear, hazardous, and solid waste.
- Technicians who have been educated in the safe handling of radioactive and hazardous waste, long-term storage principles, robotics, health procedures, environmental monitoring, materials accounting, and public education.
- Dissemination of research results that will advance the state of waste management technology throughout the United States.
- Educational programs that will utilize research results and thus maintain state-of-the-art technology for all the students. Upon completion of their education, these students will enter the workforce with knowledge and experience at the leading edge of the technology.
- Interactive satellite video courses that present overview economic, legal, policy, management, and technical courses in the problems of radioactive, hazardous, and solid waste management to research, industry, and educational facilities throughout the United States.

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