PREPARING FOR THE FUTURE: HIGHER EDUCATION MEETING ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT HUMAN RESOURCE NEEDS

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ABSTRACT

The Office of Environmental Restoration and Waste Management (ER/WM) of the U.S. Department of Energy (DOE) has as its goal the elimination of risks from hazardous waste to human health and safety and the environment or the reduction of these risks to prescribed safe levels. The achievement of this goal requires the availability of sufficient and appropriately educated scientists, engineers, and technicians. A preliminary workforce needs assessment conducted for the Office of Environmental Restoration and Waste Management in 1990 indicated that the technical workforce involved in ER/WM activities would grow by 50 to 70 percent by 1995. A more exhaustive assessment is currently underway. To ensure the availability of the necessary human resources, the Office has initiated a series of education programs.

The programs designed for the college/university levels are expected to increase the number of students pursuing associate, baccalaureate, and advanced degrees in ER/WM relevant science and engineering disciplines and to initiate research and training in technical areas supportive of the ER/WM mission. The ER/WM Scholarship program provides scholarships to undergraduate students pursuing science and engineering degrees at designated two- and four-year academic institutions. Fifty-four four-year and six two-year institutions are involved. The ER/WM Fellowship program supports graduate study and research at designated academic institutions in specified science and engineering disciplines or in interdisciplinary programs. Thirty graduate students are pursuing advanced degrees in disciplines supportive of the ER/WM mission at 14 different academic institutions. Scholars and fellows are required to spend one summer at a DOE facility participating in ongoing ER/WM projects. The fellowship and scholarship programs are expected to create a pool of appropriately educated professionals ready to enter the workforce and contribute to the DOE mission. To ensure the full participation of the academic community in education and associated research in areas supportive of the ER/WM mission, the Office supports a Distinguished Young Faculty Award Program. Under this program, non-tenured faculty are supported to initiate education programs or related research in support of ER/WM programs. In FY91, 12 faculty awards were made. The speaker will describe program operation, expected outcomes, and achievements to date.

INTRODUCTION

Within the past five years, the U.S. Department of Energy (DOE) has significantly expanded its commitment to environmental restoration and waste management. A milestone in this movement toward a cleaner and safer environment was the creation of the Office of Environmental Restoration and Waste Management. The Office has as its goal the elimination of risks from hazardous waste to human health and safety and to the environment or the reduction of these risks to prescribed safe levels. The achievement of these goals requires the availability in sufficient numbers of an appropriately educated technical workforce of scientists, engineers, and technicians.

A preliminary workforce needs assessment conducted for the Office of Environmental Restoration and Waste Management in 1990 indicated that the technical workforce involved in ER/WM activities would grow by 50 to 70 percent by 1995, from an estimated 10,000 to 12,000 full-time equivalent scientists, engineers, and technicians to an estimated 15,000 to 20,000. A more exhaustive assessment is currently underway. Preliminary data from this study also indicate employment requirements of approximately the same magnitude as the preliminary estimates. Significant growth is expected in some small specialties that are extensively used in the ER/WM work (for example, hydrology, health physics, industrial hygiene) but in absolute terms the largest employment impact is expected to be for technicians and for chemical, mechanical, and environmental enginees.

The Office of Technology Integration and Environmental Education was established within the Office of Environmental Restoration and Waste Management to ensure--among other objectives--the availability of the necessary technical workforce to implement and carry out DOE's environmental and waste management mission. Its education goals, objectives, and programs were established through a reiterative process by a group of educators from DOE laboratories and from a variety of educational institutions. These goals complement the national education goals and contribute to the implementation of the Department of Energy's education objectives. The Office's education programs encompass the entire "education pipeline" from precollege through postgraduate, as well as focusing on groups currently underrepresented in technical employment. They ensure the involvement of the national academic community in the education of the technicians, scientists, and engineers who will implement and carry out DOE's environmental and waste management mission. At the precollege level, the primary emphasis is on infusing environmental awareness into the classroom while at the same time strengthening general science and mathematics education. The expected outcomes are a more technically literate society and an increase in the number of students who pursue careers in waste management and environmental remediation, especially of currently underrepresented groups in technical careers. The programs directed at the college/university levels are specifically designed to increase the number of students pursuing associate, baccalaureate, and advanced degrees in ER/WM-related science and engineering disciplines

and to initiate and support relevant academic research and education programs. This paper discusses the ER/WM Scholarship, Graduate Fellowship, and Distinguished Young Faculty Award programs. These programs are administered by the Oak Ridge Institute of Science and Education, which is operated for the Department of Energy by Oak Ridge Associated Universities.

PROGRAM DESCRIPTION

The programs supported by the Office are designed to head-off potential shortfalls of appropriately educated scientists, engineers, and technicians. There are several points along the education "pipeline", from elementary through post-graduate education, where intervention strategies can be applied. The cost and effectiveness of such strategies depends on the specific point of intervention or target audience. In the early stages of education, the target audience is very large and diffuse and strategies must be general rather than specific. As one moves along the education pipeline, the number of students in a target population decrease and interventions can be more specific. The Office has adopted a series of programs that address audiences along the whole education pipeline.

This paper focuses on programs directed at students pursuing associate, baccalaureate, or graduate degrees in technical disciplines supportive of the Office's mission and at faculty who teach or conduct research in disciplines relevant to DOE's ER/WM mission.

The ER/WM Scholarship program will ensure that the U.S. Department of Energy has access to a pool of talented and appropriately educated technicians, scientists, and engineers with associate or baccalaureate degrees in relevant scientific and engineering disciplines. The objectives of the scholarship program are to: increase the number of technicians, scientists, and engineers educated in technical areas supportive of the ER/WM mission; assure that an adequate number of these educated individuals consider employment with DOE and DOE contractors; increase the number of academic institutions involved in ER/WM education, training, and research; strengthen collaborative training and research between the national academic community and DOE laboratories and facilities; improve student and faculty awareness of and participation in DOE and DOE contractor ER/WM research and education; and make available to students supported under this program and to the national academic community relevant education and training opportunities at DOE laboratories and research facilities.

The scholarship program provides financial support through stipends and payment of tuition and fees for undergraduate science and engineering students majoring in specific disciplines at qualified academic institutions nationwide. Students are selected for scholarship awards in a national competition based on the merit of their applications. Selection criteria include previous course work, grades, a statement on career goals and objectives, national test scores, and faculty references.

Participating academic institutions must provide associate or baccalaureate degrees in relevant technical disciplines with an adequate concentration in environmental restoration and waste management. Criteria used in selecting participating institutions include the number and type of courses offered and their ER/WM emphasis, facilities and equipment, expertise of the faculty and staff, and a statement of the institutional commitment to the program. Typical engineering disciplines include: nuclear, civil, environmental, sanitary, mechanical, chemical, metallurgical, agricultural, industrial, materials, ceramics, electrical, or petroleum. Science disciplines include: applied mathematics, environmental sciences, health physics, biotechnology, ecology, industrial hygiene, chemistry, radiochemistry, geology, hydrology, toxicology, epidemiology, radioecology, applied physics or related science. The academic program should include some additional course work in: regulatory processes, chemical wastes, mixed wastes, low/high-level radioactive wastes, environmental systems, risk assessment, communications of technical issues, and robotics.

At present, six two-year and fifty-four four-year academic institutions participate in the program and serve as host institutions for the thirty-four current scholars. In most cases, the participants major in one of the disciplines described above with additional course work in relevant related areas.

An important aspect of the scholarship program is the practicum assignment in which each scholar is required to spend a three-month training period at a DOE facility engaged in ER/WM research or development activities. The purpose of the practicum is threefold: to give students hands-on practical experience in ER/WM technologies; to allow the students to apply the principles learned in the classroom to real world problems; and, to familiarize students with DOE facilities and the exciting ongoing ER/WM activities and career opportunities. At the present time, seven DOE facilities and laboratories serve as host sites for practicum assignments. In 1991, twenty-four scholarship holders participated in a practicum. Assignments were held at seven different DOE laboratories or facilities.

The ER/WM Graduate Fellowship program was initiated in 1989 with the objective of developing a pool of highly educated technical professionals with expertise in environmental protection and restoration and in hazardous mixed and radioactive waste management. These professionals are expected to make significant contributions to improving the environment, safety, and health at DOE facilities. The fellowship program is also designed to strengthen academic teaching and research in disciplines supportive of DOE's ER/WM mission, enhance collaborative linkages between the academic community and DOE facilities, and make environmental restoration and waste management career opportunities more visible and attractive.

Fellowships are awarded in a national competition based on the merit of each application, including such factors as grades, GRE scores, recommendations, career statements, previous experience, and general academic background. Fellows must pursue a course of study and research in a specific discipline supportive of and relevant to DOE's mission in environmental restoration and waste management. In addition, course work in public policy the regulatory process, technical and public-media communications, and risk assessment are strongly encouraged.

Academic institutions participating in the fellowship program must have ongoing graduate programs and research in appropriate engineering and science disciplines with emphasis in environmental restoration and waste management. Additional technical areas of emphasis include: regulatory processes, chemical/mixed waste management, low/high-level radioactive waste management, environmental systems, risk assessment, and robotics. At present, thirty-five academic

institutions are designated as fellowship universities. These institutions hosted thirty fellows in FY1991; their majors are as follows: environmental engineering; nuclear engineering; environmental sciences; hydrology; civil engineering; geology; chemical engineering; chemistry; mineralogy; health physics; mechanical engineering; and statistics.

A major element of the fellowship program is the three-month practicum assignment at a DOE facility to gain hands-on, practical experience in state-of-the-art practices and procedures. These assignments allow students to apply the principles learned in the classroom to real world problems and familiarize students with DOE contractors and career opportunities. Currently, nine DOE facilities and laboratories serve as practicum sites for fellows. In FY 1991, ten fellows held practicum assignments at six different sites.

Over the life of the program, 217 applications have been received and 35 fellowship awards have been made. To date, 5 fellows have graduate with an advanced degree. Three fellows received the M.S. degree and 2 the Ph.D. degree. Of these, 3 are employed with DOE or a DOE contractor in the field of environmental restoration and waste management and 2 are furthering their education. Of the 3 fellows who graduated in FY 1991, 2 are employed with DOE or a DOE contractor. Examples of dissertation titles of the fellows are: Separation of Solids in a Supercritical Water Oxidation Process; Bioremediation of High Explosives; Deposition Modeling of Atmospheric Pollutants; and Plasma Decomposition of Mixed Wastes.

In addition to producing more graduate students in relevant technical fields, the fellowship program impacts the overall education infrastructure be strengthening academic teaching and research in areas relevant to environmental restoration and waste management, highlighting career options, and enhancing collaborative linkages between academic institutions and DOE facilities. The support of graduate study and research and the assignment of students at DOE facilities contribute to the achievement of these broader objectives. By "sharing" graduate students with DOE and contractor scientists during the practicum, institutional collaborative linkages are established. For example, as a result of the practicum, fellows may conduct their dissertation research at a DOE facility or the fellow's academic research advisor may be awarded a research contract to conduct research on campus. Participation of faculty in fellowship conferences or advisory and review panels make faculty aware of technical advances and directions and may impact the faculty's teaching and research.

The primary objectives of the ER/WM Distinguished Young Faculty Award Program are to increase the number of faculty members and students who conduct basic and applied research and technology development in environmental restoration and waste management and to enhance related education and training. It is aimed at non-tenured faculty members with the goal of helping them become the next generation of leading academic researchers and educators. Faculty are required to work with DOE facilities in developing mission-related proposals in technical areas that complement ongoing education and research and respond to identified education and research needs. Annual awards are up to $50,000 per year, renewable for a second year. The program is expected to create a pool of creative academic researchers and educators with a variety of advanced technical skills directly applicable to environmental restoration and waste management; link the national academic community with DOE facilities through collaborative research in technical areas supportive of the facilities' needs; and strengthen academic research, education, and training in support of DOE's ER/WM research and education. The Office of Environmental Restoration and Waste Management will benefit by the creation of a pool of professionals dedicated to contributing to the successful completion of DOE's ER/WM goals and objectives and the infusion of creative new ideas and approaches to existing technical problems.

The ER/WM Distinguished Young Faculty Award Program was initiated in 1990. To date, twelve awards have been made to faculty members at the following institutions: University of Maine; Howard University; Northern Arizona University; East Caroline University; University of California (2 awards); University of Wisconsin; University of Cincinnati; Kent State University; University of Colorado; University of Virginia; and Rutgers University. Examples of titles of proposals selected for support include: Liquid Membranes for Metal Recovery; Isolation and Analysis of Unique Bacterial Strains for the Degradation of Xenobiotic Compounds; and, Enzymic Degradation of Halogenated Aromatic Molecules: Development of Enzyme-Based Waste Treatment Technology.

SUMMARY

The Office of Environmental Restoration and Waste Management has taken far-reaching steps on both the regional and national levels to incorporate the nation's academic institutions in its research and development efforts and in ensuring that these institutions contribute effectively in education and training. These commitments to the national academic community are expected to ensure the availability and viability of relevant education and training programs, which in turn will result in a cadre of appropriately educated scientists, engineers, and technicians and the infusion of creative solutions to challenging and vexing research problems. These programs enable the Office to carry out its mission successfully and in a timely manner.