University Currents

A Newsletter For and About the University Nuclear Engineering and Science Community

U. S. Department of Energy *Spring 2000*

Congressman Knollenberg Delivers a Lecture at the University of Michigan

Congressman Knollenberg (right) visits the Ford Nuclear Reactor with John Lee, chair of the NERS department.

Congressman Joseph Knollenberg, United States Representative from Michigan's 11th Congressional District, visited the Department of Nuclear Engineering and Radiological Sciences (NERS) at the University of Michigan on April 20. Congressman Knollenberg toured the Stress Corrosion Laboratory and Nuclear Measurement Laboratory in the department as well as the Ford Nuclear Reactor (FNR), and met with the departmental faculty. He indicated considerable interest in the relevance of the Heavy Section Steel Irradiation (HSSI) program underway at the FNR to the relicensing effort of a large number of nuclear power plants. The HSSI program is sponsored by the U.S. Nuclear Regulatory Commission and involves Oak Ridge National Laboratory, the University of California at Santa Barbara and the University of Michigan to study the material integrity of pressure vessel samples from light water reactor (LWR) plants. Congressman Knollenberg acknowledged the importance of the $250K control room upgrade project underway at the FNR, which includes $180K from the DOE Reactor Instrumentation Program.

The highlight of Representative Knollenberg's visit was his lecture to a large audience of students, faculty, and staff from various University departments and outside visitors. His lecture entitled "The Energy Supply for the United States and the Role of Nuclear Energy," discussed the importance of nuclear power and the significance of DOE efforts on the Generation IV nuclear power plants. He reiterated the importance of continued DOE funding for university programs to ensure the vitality of the nuclear community and continued supply of bright, young engineers trained in nuclear science and technology.

As a key member of the Energy and Water Development Appropriations Subcommittee, Congressman Knollenberg is an acknowledged expert on energy policy. He has supported continued research in nuclear technologies and has provided the crucial leadership in funding nuclear R&D programs for the past several years. On behalf of the NERS department, John Lee thanked Congressman Knollenberg for his support, leadership, and foresight for nuclear energy development. ■

U. S. DOE Announces Nuclear Engineering Education Research Grants

RESEARCH & Development

The Department of Energy's Office of Nuclear Energy (DOE-NE) has awarded the FY-00 awards to 13 universities under the Nuclear Engineering Education Research (NEER) Program. The NEER Program awards special research grants that support nuclear engineering research. Research on the projects will begin this Spring. The total first-year funding for the 13 projects is $1.04 million. A total of 117 proposals were received in response to the solicitation. During the past two fiscal years, 39 awards were granted under this program, and the multi-year proposals are now entering their second year or third years.

Eligibility for awards under this program is restricted to colleges and universities with nuclear engineering degree programs and/or university research reactors. The purpose of the NEER program is to (1) support basic research in nuclear engineering; (2) assist in developing nuclear engineering students, and (3) contribute to strengthening the academic community's nuclear engineering infrastructure.

NEER grants are directed to state-of-the-art research that contributes to the following eight areas: reactor physics, reactor engineering, reactor materials, radiological engineering, radioactive waste management, applied radiation science, nuclear safety and risk analysis, and innovative technologies for next generation reactors, space power and propulsion, or radiation sources.

DOE-NE plans to solicit applications for another group of NEER grants in September 2000, contingent on available FY-01 funding. Research on the next group of projects would commence in the Spring of 2001.

The universities receiving grants this year are: University of Michigan, University of Wisconsin-Madison, North Carolina State University, University of Illinois, Washington State University, University of Florida, Purdue University, University of Missouri-Columbia, Cornell University, Oregon State University, and Georgia Tech (some received more than one grant).

Examples of some of the research projects are: Direct Conversion of Radioisotope Energy to Electricity, Development and Applications of Time of Flight Neutron Depth Profiling, and Hybrid Monte Carlo-Deterministic Methods for Nuclear Reactor-Related Criticality Calculations.

For more information on the NEER program, please contact Mr. John Gutteridge, DOE-Headquarters at (301) 903-1632 or john.gutteridge@hq.doe.gov or Ms. Nancy Elizondo, DOE-Idaho at (208) 526-4169 or elizonna@id.doe.gov. ■

OSU-UC Live Video Seminar Program Starts Fourth Season

The University of Cincinnati Nuclear and Radiological Engineering Program and The Ohio State University Nuclear Engineering Program launched the fourth year of a unique, two-way video seminar program on April 4th. Dr. Richard Denning of Battelle spoke on the progress that has been made on improving the safety of nuclear power plants in the former Soviet Union. Denning's presentation was made in an "electronic classroom" in Columbus and instantly transmitted to a similarly equipped classroom in Cincinnati. Both classrooms are equipped with full-coverage real-time video and audio equipment. Dr. Denning's presentation was followed by a question and answer session with questions originating from both sites. Other speakers this quarter were from small businesses such as Rad Physics, Inc., in Cincinnati and Key Technologies, Inc., in Pittsburgh, from other universities including Yale, the Universities of Michigan, and Texas, and from national laboratories such as ORNL.

The presentation graphics of the seminars are available on the UCNRE Web site: "*http://www.min.uc.edu/nuclear/nuclear.html*".

Other organizations represented included the National Institute of Occupational Safety & Health, Westinghouse, small business such as Rad Physics and Key Technologies, and other universities and laboratories including Yale, Michigan, and Oak Ridge National Labortory.

The seminars have become a regular weekly occurrence in the autumn and spring quarters. Over the past four years the two programs have sponsored more than 60 joint seminars. Past speakers have included ANS presidents, members of the ACRS, the President of the NCRP, national laboratory staff members, nuclear engineers from both the utilities and commercial firms as well as faculty members from many U.S. nuclear engineering programs. A complete set of recent seminar announcements and many of the seminar presentation graphics is maintained on the UC Web site.

Use of the video classroom and the resultant sharing of speakers has enabled the two universities to implement a higher quality seminar program than would be possible if each university was working independently.

The seminar program is partially supported by the DOE Matching Grants program. ■

University Grant Programs

In the Department's continuing effort to support students and universities involved in nuclear engineering education, the Office of Nuclear Energy, Science and Technology is awarding new grants to four programs totaling $3.5 million (not including private contributions) benefitting universities. These are: Matching Grants, Reactor Sharing, Nuclear Engineering Education Research (NEER) and University Reactor Instrumentation (URI).

The Matching Grant awards will go to 22 universities throughout the U.S. totaling $2,000,000; $1,000,000 of DOE funds and $1,000,000 from private companies (primarily utilities). Under the DOE/ Industry Matching Grants program, the Department and private companies provide up to $60,000 each to universities for use in funding scholarships, improving nuclear engineering and science curricula and improving experimental and instructional facilities. To be eligible for this award, a university must grant a Bachelor, Masters, and/or PhD degree in nuclear engineering.

The Reactor Sharing program enables universities with research reactors to "share" them with students and faculty at other institutions who lack such a facility. The reactors are made available for use in research, experiments, training and for facility tours and other educational activities. For fiscal year 2000, $600,000 is being made available to 25 university reactors; the largest number of reactors during the past five years.

The NEER program awards special research grants that support nuclear engineering research. While $5.0 million was made available for fiscal year 2000, most of the funds were necessary to support the 2nd and 3rd years of prior year awards (grants range from one to three years). Therefore, the total amount of funding for new projects is over $1.0 million which will enable the start of 13 projects. A total of 117 proposals were received in response to the solicitation.

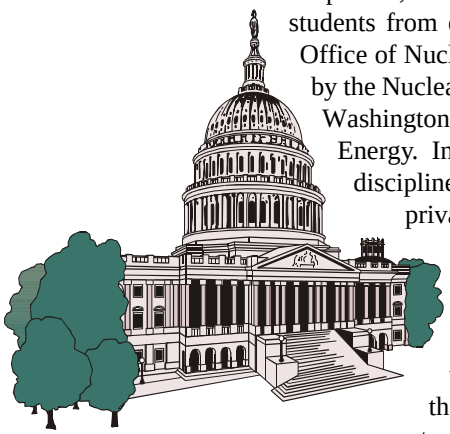
The University Reactor Instrumentation program provides assistance to university research reactors to improve their operational and experimental capabilities. The grants allow the universities to purchase equipment and services necessary to upgrade reactor facilities such as instrumentation and controls, data recording devices and radiation monitoring equipment. Twenty-one universities received funding totaling almost $800,000.

For more information on the any of the four grant programs, please contact Mr. John Gutteridge, DOE-Headquarters at (301) 903-1632 or *john.gutteridge@hq.doe.gov*. ■

Idaho National Engineering and Environmental Laboratory
Summer Intern Program

This summer, the Office of Nuclear Energy, Science and Technology will sponsor four undergraduate students from Howard University and five from other schools to work at the Idaho National Engineering and Environmental Laboratory (INEEL) in Idaho Falls for eight weeks, beginning the first week of June through mid-August. These students are, typically, rising juniors or seniors for which NE provides a monthly stipend and living expenses. The summer internship allows the students to put their education to work on research projects at INEEL. Each of the students will work with a mentor at one of the INEEL sites and is required to give a formal presentation on his or her summer experience. This year all but two of the students are new to the program. ■

Nuclear Energy Students Visit Washington



On April 12, 2000 William D. Magwood, IV, and his staff met with nuclear engineering students from eight universities to discuss issues of importance to the students and the Office of Nuclear Energy, Science and Technology. These students, sponsored each year by the Nuclear Energy Institute (NEI) and the American Nuclear Society (ANS), travel to Washington, D.C. to visit congressional members, OMB staff and the Department of Energy. In each instance, they discuss current issues affecting the nuclear engineering discipline and present their ideas for improvements the government, universities, and private entities can implement to better assist the education of students in their field of study. They attended congressional hearings germane to their area of study to gain insight into the political process and the proposals and/or changes being advocated from the executive and legislative branches of government. They also met with representatives of NEI and ANS to understand how public interest groups develop their programs and advocate their positions. The students spend three to four days in Washington and return to their universities where they share their experience with other students, their professors and member of the local student ANS Chapters. ■

Nuclear Energy Research Advisory Committee

"Blue Ribbon" Panel

Over the last decade, the U.S. educational infrastructure in nuclear technology has been in virtual free fall. The number of independent nuclear engineering programs and operating research reactors at U.S. universities have fallen by about half since the mid 1980s.

While the trends are negative, the reality of stagnant plant construction in the U.S. and the still uncertain outlook for nuclear research means that we do not know what infrastructure is really required. How many nuclear engineers does the Nation needs? How many university research reactors?

To attempt to answer these questions, the Office of Nuclear Energy, Science and Technology (NE) concluded that the Nuclear Energy Research Advisory Committee (NERAC) was an appropriate mechanism to analyze these issues.

The NERAC "Blue Ribbon" Panel to Analyze the Future of University Engineering and Research Reactors held its first of several meeting on December 20, 1999 in Chicago. The panel members are:

- Chairman Michael Corradini, the University of Wisconsin
- Pete Miller, Los Alamos National Laboratory
- Marvin Adams, Texas A & M
- Glenn Knoll, University of Michigan
- Thomas Isaacs, Lawrence Livermore National Laboratory
- Kenneth Rogers, Former Commissioner, NRC
- Donald Dei, Office of Naval Reactors

The panel presented its findings at the May 23-24, 2000 NEARC meeting in Arlington, Virginia. The full report is available on the NE home page. ■

Reactor Sharing Funds Help Sponsor Medford High School (Massachusetts) Science Fair 2000

One of the uses to which MIT applies the DOE reactor sharing money is the support of high school student science fairs. Approximately 60 students from grades 9-12 participated in the latest fair and all received participation certificates. The winners received trophies and certificates and the opportunity to participate in the regional and National Science Fair.

Talking top honors were Davin Mack, Amanda Leetch, Jessica Nackel, Ashley Griffin and David Ryan. Honorable mention went to Chris Harrington, Allyson White, Jessica Kearn, Mary Jirmanus, Natalie Paine, Jeanine Feeley, Franky Agueci, Megan Van der Kloot, Sean Westaway and Brenda Morelus. Group honors Ly Tran, Jessica St. Fleur.

Davin Mack's projected involved irradiating topaz crystals and then explaining the origin of the color centers. Although the MIT Research Reactor does not participate in the commercial alteration of gemstones, it was done for the students benefit. Davin was one of five who received top honors at the Medford High School Science Fair 2000. He qualified for the Massachusetts State Science Fair. Credit is due to the University of Lowell Research Reactor which provided technical assistance and gamma irradiation of topaz crystals. One aspect of Davin's project was to compare the affect of different types of radiation and different energy radiations on the creation of the color centers. ■

MIT and TEPCO Agreement for Nuclear Energy Technology Development

The Massachusetts Institute of Technology (MIT) and Tokyo Electric Power Company (TEPCO) have agreed to a 5 year, $2.15 million dollar collaboration in the development of enhanced technological options for nuclear power and its fuel cycle. The agreement was signed on October 22, 1999 by the Provost of MIT Robert Brown and Managing Director of TEPCO Toshiaki Enomoto. The collaborative program started on November 1, 1999 and will end on August 31, 2004. This agreement may be the most significant "hand shake" that MIT and Japan have had in the last few years. The idea stems from the belief that nuclear power provides a clean renewable energy source for a world increasingly concerned with global warming and air pollution.

TEPCO will fund two activities under the agreement : (1) an endowed chair in nuclear engineering; and (2) educational activities for its employees at MIT. In addition, collaborative research will be conducted under separate funding. A visit by a TEPCO team, headed by Mr. Katsuya Tomono former executive vice president of TEPCO, to MIT took place on April 8. During the visit, Prof. Jeff Freidberg, head of the MIT Nuclear Department, announced that Prof. Mujid Kazimi will become the first holder of the TEPCO chair. It was also announced that a joint MIT-TEPCO steering committee will oversee the activities of this agreement and will be comprised of six members, three from TEPCO and three from MIT. The co-chairs of the committee will be Prof. Kazimi from MIT and Dr. Enomoto from TEPCO. The April 8 meeting also resulted in approval of four projects to start in the year 2000. The projects will investigate: (1) Nuclear power strategy in the era of utility business deregulation; (2) Methods to improve seismic risk assessment for power plants; (3) Risk-informed management of plant operations; and (4) Thermal striping effects on piping. ■

Concrete for Holding Nuclear Waste

is Focus of MIT Study

Small cylinders of cement rolling to and fro in a gently rocking bath are key to MIT work that could aid efforts to safely contain nuclear waste.

Temporary measures for storing such waste already employ cement, a key material that binds together the small particles in concrete. Concrete, in turn, is used to encase steel containers holding the waste. For permanent storage, however, researchers would like to be able to predict how the concrete-specifically, the cement that makes it strong--will weather over hundreds of years.

Enter the MIT engineers, led by Franz-Josef Ulm, who have created a laboratory test that allows them to observe in one day what Nature takes 300 to wrought. This accelerates concrete aging three times over what other researchers have achieved.

Many Pressures

For the first time, the team also subjected the weathered materials to pressures from all sides, a situation closer to what could be expected when concrete containers are buried underground. Other teams have just considered uniaxial, or one-dimensional, loading conditions.

The triaxial tests resulted in new insights on what happens to concrete when it is weakened and put under stress. They "show the importance of Thinking 3D' when monitoring the durability performance of concrete in nuclear waste containment," according to Professor Ulm and colleagues.

His coauthors are Franz H. Heukamp, a graduate student in the Department of Civil and Environmental Engineering (CEE), and Dr. John T. Germaine, a CEE principal research associate. Two other key members of the team are Dr. Marc Mainguy, a CEE postdoctoral associate, and Jennifer Burtz, a CEE junior working on the project through the Undergraduate Research Opportunities Program.

The team is currently merging the experimental results with a theoretical model of concrete leaching being developed by Dr. Mainguy. "Our goal is to go back to real-life structures, monitor the environment around them, and predict by model-based simulation what the concrete will do over extended periods of time," Professor Ulm said. And if a parameter changes-say groundwater begins to seep around the structure-"we'll be able to predict its eventual effect, and intervene in time to slow down or reverse the aging," Professor Ulm said.

The current lab test can comfortably predict aging up to about 300 years. Professor Ulm is confident that the work can be extrapolated to over 1,000 years. "When, and if, spent nuclear fuel from the US is buried in the Department of Energy proposed repository at Yucca Mountain, it will be placed in concrete casks that are supposed to maintain integrity at least 300 to 1,000 years," said Mujid Kazimi, an MIT professor of nuclear engineering who Professor Ulm has consulted about the work.

Like Osteoporosis

In a process akin to osteoporosis, concrete can weaken over time when water leaches calcium from the material. Just as in bones, the calcium is what gives concrete its strength.

"The challenge in studying this is that concrete aging is a very slow process," Mr. Heukamp said. "It could take a couple of hundred years to really dissolve a concrete structure." However, this is the time scale over which the structural integrity of concrete applied in nuclear waste containment must be ensured.

To accelerate the process, the MIT researchers replaced the water with a highly concentrated solution of ammonium nitrate. The beauty of that solution: "The chemical process of calcium leaching is still the same, but it occurs at a much higher rate," Mr. Heukamp said. Coupled with an oscillating table developed by Dr. Germaine, which ensures an even concentration of solution around each sample, the MIT researchers had their setup for accelerated material agin by calcium leaching.

The next step: expose the weathered material to stress. To do so, the team placed sample into a triaxial high-pressure cell that applie pressure from all sides. When they applied shear, or slightly larger stress from one side slivers of the material slipped apart, much lik what happens to a high pile of books if yo drop something on it from slightly off cente

This was the first time a team has studied th behavior of weathered concrete under triaxia stress. A key insight: the researchers found significant loss of frictional performance in th artificially aged cement paste. The leache calcium left large pores that collapsed unde the pressure, allowing the material to slip apar

Professor Ulm noted that the microstructur of the leached cement paste, as visualized wit an environmental scanning electro microscope, "showed a strong similarity to tha of osteoporotic trabecular bones." "So material that is originally very strong ultimatel ages to one that behaves like a wea low-friction soil, such as clay," he concluded

The research was sponsored by the Nuclea Energy Research Initiative Program of th Department of Energy. Professor Ulm als notes a significant collaboration with th Commissariat l'Énergie Atomique in Franc through Dr. Jerome Sercombe.

For more details about the concrete studie contact Elizabeth Thomson a *thomson@mit.edu*.■

Fellowship/Scholarship Review Panel

The Office of Nuclear Energy, Science and Technology provides fellowships and scholarships through our Nuclear Energy/Health Physics grant program. These awards are extremely competitive, particularly the fellowships. The merit review evaluation of the candidates for the upcoming academic year occurred April 3, 2000 in Charleston, S.C. The panel, which performs this review without remuneration, was comprised of individuals from three national laboratories, and three universities. All hold degrees in nuclear engineering. There were 42 fellowships and 52 scholarship candidates to evaluate. The fellowship talent pool is truly a "best of the brightest" group of students while the scholarship applicants are students with the outstanding academic standing at their respective universities. The selected fellows will receive full tuition a monthly stipend and a paid summer practicum. Scholarship winners will be awarded $2,000 per year. Selections should occur by June 2000.■

Minority/Majority University Partnerships

The Office of Nuclear Energy, Science and Technology's initiative to increase the number of minorities pursuing nuclear engineering education came to fruition on May 8, 2000, when a merit review panel met at South Carolina State University to select the schools with their associated students, to participate in the first year of the Minority/Majority Partnership program. This program requires that a minority institution pair up with an institution offering a degree in nuclear engineering so that the minority institute students can earn both a bachelor degree from their own institution in a scientific or engineering discipline and a nuclear engineering bachelor or masters degree from the majority school. This usually requires a five-year program in lieu of the traditional four years with some of that time spent at the majority institute and a period of time (practicum) at a national laboratory. Eight pair of schools applied for the right to enroll their students in the first year of the program. A pilot program has already been in place for several months pairing South Carolina State University (one of the administrators of the overall program) and the University of Wisconsin. The additional two or three pair of schools selected (the actual number depends on the amount of funding available and the cost of tuition at the selected schools) will be announced in June 2000. ■

Nuclear Fundamentals Workshop

The University of Tennessee Nuclear Engineering Dept., TVA, and the Oak Ridge/Knoxville Local Section of ANS will present a free one-day workshop on Nuclear Fundamentals for middle and high school science teachers on Monday, July 10, 2000. The workshop will be held at TVA's Watts Bar Nuclear Plant near Spring City, Tennessee and will include a tour of the plant. Attendees will also receive a free Geiger Counter and instructions on how to use the counter. The Registration Form is available online at www.engr.utk.edu/nuclear, or the Form can be obtained by phone request at 865-974-5048. Enrollment is limited and is based on a first come—first serve basis. ■

Tour of French Nuclear Facilities

The French nuclear power industry will sponsor a tour of french nuclear facilities for several U.S. nuclear engineering professors during the week of July 16-21, 2000. Attendees will include the following professors and their spouses who will participate in a special guest program: Barry Ganapol (Arizona), Larry Miller (Tennessee), Gary Was (Michigan), Doug Henderson (Wisconsin), Bill Martin (Michigan), Brian Hajek (Ohio State), John Christenson (Cincinnati), Henry Spitz (Cincinnati), Yassin Hassan (Texas A&M), Jim Stubbins (Illinois), John Valentine (Georgia Tech), and Lee Dodds (Tennessee; U.S. Coordinator). Jean-Louis Nigon of Cogema is the primary host representing the French nuclear industry. ■

Manpower Supply and Demand in the Nuclear Industry

Concerned by declining enrollments in nuclear engineering throughout the '90s and a strong surge in demand for nuclear engineering graduates beginning in 1998, the Nuclear Engineering Department Heads Organization (NEDHO) initiated a study of the balance in supply and demand for nuclear engineers in the coming years. The published report was edited by Gary Was and William Martin, with support from the Manpower Subcommittee of NEDHO (G. Brown, H. Dodds, A. Klein. W. Martin, J. Sherrard, J. Tulenko. J. Valentine, G. Was and C. Williamson and with assistance from the American Nuclear Society (ANS) and the American Society for Engineering Education (ASEE), and with financial support from the Office of Nuclear Energy, Science and Technology of the U. S. Department of Energy. The wealth of information in this document is intended to provide educators, policymakers and industry leaders with a view of the manpower situation in nuclear engineering as seen from the perspectives of industry, academia, and government as of the year 2000.

The report contains the outcomes of two workshops and a survey addressing the supply of nuclear engineers by the Nation's universities and the demand of these individuals by industry and the government. The first workshop on the manpower crisis, held in Washington D.C., in November, 1998 identified some 40 issues regarding the supply and demand of nuclear engineers. The second workshop on "Crisis in the Workplace II: Addressing the Growing Supply/Demand Gap in the Nuclear Industry" was held in Long Beach, California in November, and identified six major issues that needed to be addressed to solve the supply/demand problem. The Manpower Survey resulted in a quantitative assessment of both the supply and the demand for nuclear engineers out to the year 2003. The results show that the demand—supply gap increases monotonically from a shortfall of 363 nuclear engineering graduates in 1998-1999 to a shortfall of 468 in 2002-2003.

The survey concludes that demand for nuclear engineers substantially outstrips the supply and this gap is expected to increase through the year 2003. The challenge is how to use this information to provide a sufficient supply of nuclear engineering graduates in the coming years to assure a viable and stable nuclear energy future for the United States. The study was funded by the U.S. Department of Energy, Office of Nuclear Energy, Science and Technology. ■

FOR ADDITIONAL INFORMATION OR SUBMISSION OF ARTICLES FOR PUBLICATION, PLEASE CONTACT:

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