# UNIVERSITY CURRENTS

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

*U. S. Department of Energy* *Spring 2002*


# A Major New Initiative in 2002: "INIE"

All the hard work of the Nuclear Energy Research Advisory Committee, Nuclear Engineering Department Heads Organization, the Test Reactor, Training Reactor Organization, the Office of Nuclear Energy, Science and Technology (NE) and of course, the United States Congress has resulted in a program that holds the promise of reinvigorating university nuclear engineering education and research. The impetus in this and other on-going nuclear engineering education programs was the dramatic decline in nuclear, university research reactors and nuclear engineering undergraduate students over the past two decades and especially the enrollment decline since 1992 (see figure 1).

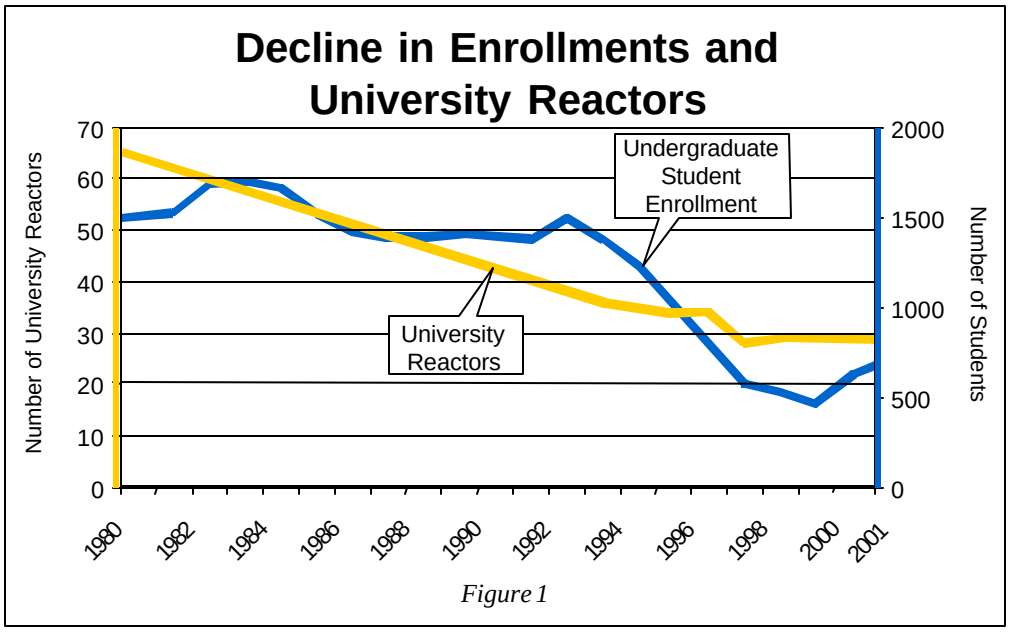



*Figure 1*

The Innovations in Nuclear Infrastructure and Education (INIE) Program was initiated in FY 2002 by the Office of Nuclear Energy, Science and Technology (NE) with the issuance of a December 21, 2001 solicitation and the receipt of 13 proposals by mid-March 2002. Each peer-review panel member will evaluate and numerically rate the proposals. Then the peer-review panel scores will establish an overall rating for each proposal. Subsequently, an assessment will be made by NE of the projects that can be funded within the available FY 2002 funding of $5.5 million. It is anticipated that selected proposals will be announced by June with funding provided in July 2002. Those projects not receiving funding from this initial allocation will be supported in priority order if and when additional funding is made available to support ongoing and new projects in FY 2003.

INIE is an outgrowth of a Nuclear Energy Research Advisory Council (NERAC) Task Force study on University Research Reactors chaired by Robert Long, Senior Vice President GPU (retired), and including the participation of Jose Luiz Cortez, consultant and Allen Sessoms, Professor, Kennedy School of Government-Harvard. This Task Force was asked to examine how to preserve and utilize the research and training reactor infrastructure at U.S. universities. The Task Force reported back to the full NERAC on April 30, 2001. This was followed by an implementation conference held in Chicago in July 2001 and attended by university reactor managers and University Deans of Engineering.

The NERAC Task Force recommended several activities in pursuit of strengthening university nuclear engineering education and university research reactors. One was that the DOE's Office of Nuclear Energy, Science and Technology's University Support Programs be continued and enhanced as recommended in other NERAC reports. These programs include reactor fuel assistance, reactor sharing, reactor upgrades, Nuclear Engineering Education Research (NEER) grants, nuclear engineering/health physics fellowships and scholarships, radiochemistry, and nuclear engineering and science education.

# Expanding Educator Workshops

The American Nuclear Society (ANS) continues to expand its sponsorship and support of educator workshops across the U.S. working in cooperation and with funding provided by the Office of Nuclear Energy, Science and Technology.

In the second half of 2001, faculty and nuclear engineering students at a number of universities conducted workshops, serving more than 200 teachers. These included: University of Tennessee, Penn State University, University of Missouri-Rolla, University of Wisconsin, Texas A&M, and North Carolina State University.

*Kim Luebbert, physics and math teacher at Fatima H.S., Westphalia, MO, takes a seat in the reactor control room during a University of Missouri-Rolla teacher workshop.*

*Teacher Workshop participants pause at the reactor pool during a facility tour as part of a teacher workshop at University of Missouri-Rolla.*

During the same time period, non-university groups (ANS local sections, ANS organizational members, and the ANS headquarters) organized and conducted workshops which served more than 475 teachers.

Each of the 675+ teachers served through ANS supported workshops has the potential to impact many students (estimates are 60-125 students per year).

In addition to teacher workshops, DOE/ANS supports outreach activities which provide information about career opportunities in nuclear science and technology. This is accomplished through secondary classroom visits and career fairs, as well as events which provide university freshmen with information about nuclear engineering. ANS student groups or faculty at Massachusetts Institute of Technology, University of Texas-Austin, and University of Cincinnati participated in special career events during the last half of 2001, with assistance from ANS.

*Teacher workshop participants at Penn State University get pointers on a lab activity from Candace Davison.*

ANS continues to distribute copies of the special career brochure and poster which were released last fall. The poster, designed for use in secondary school classrooms and in vocational guidance offices, highlights opportunities in nuclear science and technology and refers students to the ANS web site for additional career information. The career brochure, for distribution to students, teachers, counselors, and the general public, provides more information than the poster. It, too, refers students to the ANS web site for additional information. To preview the poster or brochure, go to http://www.ans.org/pi/students/careers/. For more information about the poster and brochure, contact the Outreach Department at ANS at outreach@ans.org.

*Becoming familiar with the operation of a radiation survey meter is one activity at a teacher workshsop at Penn State University.*

ANS continues to produce ReActions, a newsletter for teachers interested in nuclear science and technology. ReActions serves as a resource for teachers, providing information and ideas for their classrooms. The newsletter is mailed to more than 18,000 teachers twice each year; two additional issues are posted on the web each year. Copies of all issues can be reviewed at http://www.ans.org/pi/teachers/reactions/.

The DOE/ANS teacher workshop and career information program is expanding in 2002. In mid-February, the combined list of teacher workshops and career events scheduled for 2002 was already at 35 and continuing to grow.

DOE/ANS is eager to provide materials and assistance to Nuclear Engineering departments as they develop plans for 2002 teacher workshops and activities which promote knowledge of nuclear career opportunities. For information or assistance, contact the Outreach Department at outreach@ans.org.❖

America's Energy Challenge
## The Nuclear Answer

A major nuclear energy symposium, entitled "America's Energy Challenge: The Nuclear Answer," was held at the George Bush Presidential Conference Center on the campus of Texas A&M University on November 19, 2001. More than 230 people attended the event, which featured U.S. Congressman Joe Barton, Dr. Pete Lyons (science & technology advisor for U.S. Senator Pete Domenici), Mr. William Magwood IV, Director of the Office of Nuclear Energy, Science and Technology for the Department of Energy, Dr. Nils Diaz, Commissioner of the U.S. Nuclear Regulatory Commission, Mr. Joe Colvin, President of the Nuclear Energy Institute, Mr. Jerry Yelverton, President and CEO of Entergy, and Dr. Alan Waltar, Professor and Head of the Department of Nuclear Engineering at Texas A&M University. Mr. Erle Nye, Chairman and CEO of TXU and Chairman of the Texas A&M University System Board of Regents, moderated the symposium. Mr. Nye is also the past Chairman of the Board of the Nuclear Energy Institute.

As pointed out by Dr. Diaz, the September 11 terrorist attacks should not stop the United States from using nuclear power as an energy source. "America's nuclear facilities…have the best physical security of any industrial infrastructure in the country" said Dr. Diaz. "Nuclear power plants are specifically designed and operated to protect against a terrorist attack and acts of sabotage." Dr. Lyons added that in evaluating the safety of all infrastructures, including chemical plants and pipelines, nuclear plants are the hardest structures in the world.

William Magwood pointed out that as the country grows, the shortfall between energy use and supply will increase. He noted that nuclear energy is reliable, cost-effective and does not produce greenhouse gases. He called it a "1000-year resource" if spent fuel is recycled. Mr. Magwood also spent considerable time introducing the new concepts reflected in the Generation IV program, where the Depart-ment of Energy is taking the lead to encourage the development of the types of advanced nuclear power plants that will be needed in the next several decades to meet burgeoning global energy needs. He also offered to support a dialogue with anti-veteran groups.

*Willam D. Magwood, IV, Director, Office of Nuclear Energy, Science and Technology, U. S. Departmetn of Energy*

Professor Waltar observed that "In 50 years, the world's average citizen will be using at least 50% more energy than he or she is using today. We simply can't squeeze this much power out of fossil fuels, hydropower, or solar. They all have limits in term of scaling up. Nuclear is the answer."

Whereas great interest was sparked within the nuclear community by the May 2001 announcement of the new National Energy Policy by Vice President Dick Cheney, in which nuclear energy was given a key role, world events have prevented that policy from being implemented. Hence, the nuclear symposium at A&M was viewed as a substantive step in helping to maintain the upbeat momentum generated by the renewed national interest in nuclear energy. The text and graphics made available by the speakers can be found at the following web site: http://nuclear.tamu.edu. *Simply click on "The Nuclear Answer."*❖

## 2002 ANS Student Design Competition

Each year the American Nuclear society offers a design competition that permits a university to define its own design project. Student design reports are evaluated and ranked by judges from government and industry based on submission of a single design report authored by the participants. There are separate competitions for graduate and undergraduate students. Two undergraduate and two graduate entries are selected as finalists to make oral presentations to judges in a special session at the Winter ANS Meeting. Winner and runner-up awards are announced in each category at the conclusion of the session.

In addition to the final design report, each entry must also submit electronically a 900-word summary to ANS for possible publication in the Transactions of the Winter Meeting. These summaries must be submitted to ANS by June 21, 2002 according to instructions for electronic submission which is available on the ANS website, www.ans.org. The four finalists who are invited to make presentations at the Winter Meeting will have their summaries published in the Transactions of the meeting. The final design reports must be submitted to H. L. Dodds, at the University of Tennessee, Nuclear Engineering Department by July 31, 2002.

A capstone design course, which most ABET accredited programs have, can be the basis for undergraduate students to enter the competition. Similarly, many programs also have a graduate design course, which can be the basis for graduate students to enter the competition. The Intent to Participate and Guidelines Form, and the Judges' Evaluation Form are available at the ANS Website, www.ans.org. Please encourage your design-oriented faculty and students, both graduate and undergraduate, to participate in the competition.❖

# Distance Education Programs in Nuclear Engineering at The University of Tennessee

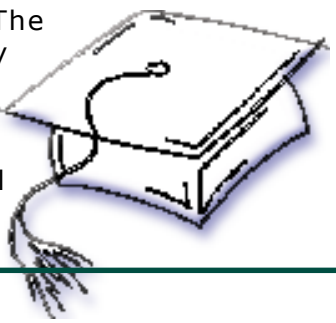
*by H. L. Dodds, Head, UT Nuclear Engineering Department*

The Nuclear Engineering Department at the University of Tennessee offers three graduate programs that are available to distance students: the MS degree in nuclear engineering and two new Certificate Programs, one in Nuclear Criticality Safety and the other in Maintenance and Reliability Engineering. Most of the courses in the three graduate programs are delivered synchronously (i.e., live and interactive) to the student's desktop computer via the Internet using CENTRA (see http://www.centra.com ). The CENTRA software permits oral communication between instructor and students as well as oral communication between students. This interactive oral communication is accompanied by video streaming of visual aids such as PowerPoint slides and HTML documents. The synchronous classes are also available asynchronously (i.e., saved on a server) for a few days after synchronous delivery to accommodate students who must occasionally miss class.

The MS program for distance students is the same as our traditional MS program for local students, but with fewer courses offered. The MS program requires eight 3-hour graduate courses: four Nuclear Engineering (NE) courses, two courses in a related technical discipline (or two more NE courses), and two courses in mathematics, statistics or computer science. In addition, at least six hours of research or engineering practice are required for a total MS requirement of at least 30 hours. The courses that are currently available to NE distance students are *Fundamentals of Nuclear and Radiological Engineering, Reactor Theory I, Radiation Protection I, Reactor Theory and Design, Advanced Radiation Protection, Reactor Shielding, Monte Carlo Analysis, Radiological Assessment and Dosimetry, Introduction to Nuclear Criticality Safety, Nuclear System Design, Selected Topics in Nuclear Criticality Safety, Advanced Monitoring and Diagnostics, Introduction to Maintenance Engineering, Introduction to Reliability Engineering, Statistical Methods, and Applied Linear Models in Statistics.* Up to one-third of the credit hours for the MS degree can be transfer credit from another accredited institution.

MS students must also register for at least three hours of research or engineering practice during any semester in which research or engineering practice is conducted to satisfy degree requirements. Proposed projects, either thesis research or engineering practice projects, may (or may not) be related to the student's current job, but must be approved *a priori* by the student's major professor and graduate committee. To obtain approval, a brief proposal written by the student must be submitted to and approved by the student's major professor and graduate committee at the beginning of the proposed project. The student must also write brief monthly progress reports, which are submitted to and approved by the student's major professor. The student may also have an on-site advisor or mentor to help direct the student's work along with the overall supervision provided by the major professor. However, acceptance of the student's work in satisfying degree requirements is solely the responsibility of the student's major professor and graduate committee. Good research and engineering practice projects frequently lead to external publications that are co-authored by the student, the on-site advisor, and the major professor. At the conclusion of the MS program, students come to the UT main campus to defend their work, both coursework and thesis or engineering practice project report(s), in a comprehensive oral exam in front of their major professor and graduate committee.

Each Certificate Program consists of four 3-hour graduate courses and does not include a requirement for research or engineering practice. The four courses required for the Nuclear Criticality Safety Certificate are *Introduction to Nuclear Criticality Safety, Selected Topics in Nuclear Criticality Safety, Monte Carlo Analysis*, and one of the following three elective courses: *Reactor Theory I, Reactor Theory and Design,* or *Reactor Shielding*. This certificate program is intended to complement practical on-the-job training that is required of most criticality safety specialists. The four courses required for the Certificate in Maintenance and Reliability Engineering are *Introduction to Maintenance Engineering, Introduction to Reliability Engineering*, and two elective courses selected from the following list: *Advanced Monitoring and Diagnostics, Process System Reliability and Safety, Mechanical Vibrations, Reliability Centered Maintenance,* and *Statistical Methods in Industrial Engineering*. The Maintenance and Reliability Certificate program is actually a college-wide program, which currently includes elective courses in mechanical



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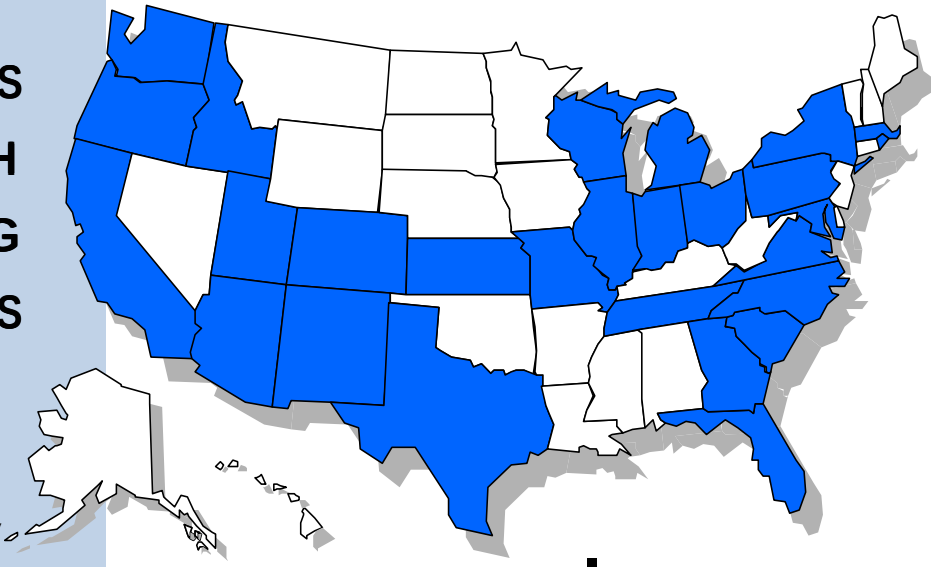
# States With Participating Universities



Clemson University
Colorado State University
Cornell University
Georgia Institute of Technology
Howard University*
Idaho State University
Kansas State University
Massachusetts Institute of Technology
Morgan State University*
New Mexico State University**
North Carolina State University
North Carolina A&T University*
Ohio State University
Oregon State University
Pennsylvania State University
Purdue University
Reed College
Rensselaer Polytechnic Institute
Rhode Island Nuclear Science Center
South Carolina State University*
Tennessee State University*
Texas A&M University
Tuskegee Institute*
University of Arizona
University of California-Berkeley
University of Cincinnati
University of Florida
University of Illinois
University of Maryland
University of Massachusetts-Lowell
University of Michigan
University of Missouri-Columbia
University of Missouri-Rolla
University of New Mexico**
University of Tennessee
University of Texas
University of Utah
University of Virginia
University of Wisconsin
Washington State University
Worcester Polytechnic Institute

* *U.S. Historically Black Colleges and Universities;*
** *Hispanic Serving Institution*

# www.nuclear.gov

The Office of Nuclear Energy, Sciene and Technogoy would like to extend to each of our participating universities an opportunity to be included on the NE Web site, www.nuclear.gov. A new page is under development which will be dedicated to our University Program. If you would like to have your university's home page and/or a department home page added to this page, please e-mail the following information to the ne.webmaster@hq.doe.gov:

- University Name
- University Webmaster E-Mail Address
- URL(s) Address and a Short Description of Link(s)

We would also like to request that you add a link to your home page linking to the NE Web site. That address is www.nuclear.gov. If you have any questions, please e-mail the NE Webmaster at ne.webmaster@hq.doe.gov or Wendy Brumley at 301-903-2789.

## Visit other Office of Nuclear Energy, Science and Technology Program Websites

Nuclear Engineering Education Research: **neer.ne.doe.gov**
University Research Implementation: **uri.ne.doe.gov**
Generation-IV Nuclear Energy Systems: **gen-iv.ne.doe.gov**
Nuclear Energy Research Initiative: **neri.ne.doe.gov**
International Nuclear Energy Research Initiative: **www.pnl.gov/ineri**
Nuclear Energy Plant Optimization: **nepo.ne.doe.gov**

# NEER Project Appears in the New York Times

Jake Blanchard and Doug Henderson both of the University of Wisconsin, were featured in a *New York Times* article entitled "A World of Wee Devices Seeks Some Batteries to Match" on January 10, 2002. The article follows:

## A World of Wee Devices Seeks Some Batteries to Match

ENGINEERS have yet to create a tiny submarine like the one in the 1966 movie ''Fantastic Voyage,'' which traveled through a patient's bloodstream to battle a deadly blood clot.

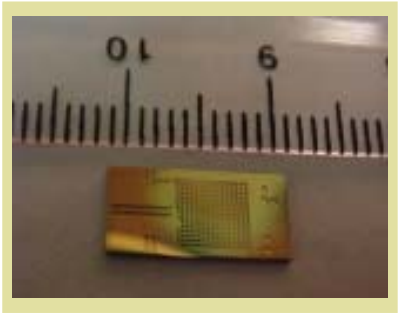
But researchers are steadily shrinking once-massive machines, fabricating blades, hinges and other parts out of silicon at an ever tinier scale to create systems the size of a grain of sand or a red blood cell.

Millions of these miniature machines, known as microelectromechanical systems, or MEMS, may surround us one day, embedded in the concrete foundations of roads and bridges to monitor their conditions, aloft to check for biological warfare agents in the atmosphere, or attached to automobile tires to gauge pressure.

To do their job far from a wall outlet, MEMS devices need power to sense, calculate and transmit the data they collect. But so far the batteries needed to accomplish that have not duplicated the amazing shrinking act of the silicon machines. The power of a battery depends on its volume, and scaling down the size while maintaining the power has proved to be a tremendous challenge.

To address the problem, a handful of researchers have turned from traditional fossil fuels or electrochemical cells to a new source to create micro and nano- size batteries: nuclear power. The hope is that the high-energy particles emitted by radioactive materials as they decay will one day drive a generation of MEMS devices.

Dr. James P. Blanchard, an associate professor of nuclear engineering at the University of Wisconsin in Madison, has spent the last three years and about $450,000 awarded by the Department of Energy to develop prototypes of nuclear microbatteries for MEMS use.



*Latest Battery Design*

Dr. Blanchard is not splitting atoms to get his nanonukes, which is the first thing he has learned to explain patiently when describing his work. ''People hear 'nuclear' and 'power' and they think 'fission' '' and explosions, he said. ''That's not what we are doing — we are not splitting uranium.''

Instead, Dr. Blanchard and an assistant professor and MEMS expert, Dr. Amit Lal, are using minute amounts of a radioactive version of nickel, Nickel-63, in one of the prototypes they have developed. As this substance decays, it produces beta particles, high-energy electrons that now yield nanowatts (one nanowatt is one-billionth of a watt) and may soon, the inventors hope, yield microwatts.

This kind of technology — harnessing radioactive isotopes to create a power source — was used to create the far larger nuclear batteries of NASA's Cassini probe, launched in 1997, to help it travel through the far reaches of space. Shrinking such technology became Dr. Blanchard's goal. ''We wanted to show it could be done,'' he said.

Resigned to alarmed reactions at the mention of the word ''nuclear,'' Dr. Blanchard is quick to explain how little nuclear material is involved. ''Batteries headed for another planet make a few hundred watts using an isotope of plutonium and are the size of a dishwasher,'' he said. ''Ours is about as dangerous as a smoke detector'' that falls off the wall and breaks. Smoke detectors contain small amounts of radioactive materials.

In one of Dr. Blanchard's prototypes, Nickel-63 dissolved in a solution is poured into micromachined channels; in another, it travels in pyramid-shape indentations in the silicon. The relatively low energy emitted by beta particles does not damage the semiconductor device where the particles collect. The half-life of the isotope — 102 years, meaning that in that time half of the substance will have decayed — makes it attractive for long-term applications.

Dr. Blanchard's group has also worked with alpha-emitting radioisotopes and plans to use them for future experiments. His work on microbatteries was reported last April at the ninth International Conference on Nuclear Engineering in Nice, France.

Dr. Jean-Pierre Fleurial, a physicist at the Jet Propulsion Laboratory in Pasadena, Calif., oversees several projects that tap the power of alpha particles, including an effort at the University of Illinois. Alpha particles give off far more energy than beta particles and are therefore a promising source, he said, but in some prototypes they eventually damage the semiconductor diode where they are collected and converted to electricity.

''The work ahead is to find innovative designs that last a long time and are reasonably efficient,'' Dr. Fleurial said. Because the research has already yielded several prototypes, he said, he is confident that alpha particles will eventually yield powerful batteries. ''Most of the power source technologies don't scale down easily,'' he explained. ''These do.'' The work of Dr. Fleurial and his colleagues was reported last June at the 20th International Conference on Thermoelectrics in Beijing.

Dr. Kris Pister, a professor at the University of California at Berkeley, is among the scientists who aim to give microbatteries a trial run with a wireless network based on MEMS technology. Dr. Pister is the inventor of smart dust, or networked airborne motes of silicon that are designed to sense, measure and transmit data like temperature, humidity and light intensity.

''Everything is getting smaller in MEMS but the batteries,'' he said. ''The batteries remain the single

*(continued on page 8)*

# The University of Texas at Austin

# Celebrates 10 Years of Reactor Operations

At 12:10 on March 12, 2002 the Nuclear Engineering Teaching Laboratory (NETL) TRIGA Mark II Research Reactor had been officially operating for ten years. The staff, faculty and students noted the ten-year anniversary with a celebration at the NETL. A commemorative copy of the original reactor startup strip chart (and a fair amount of birthday cake) was given to the attendees. The NETL is the newest University Research Reactor (URR) and the second TRIGA for the University of Texas at Austin.

*Nuclear Engineering Teaching Laboratory Building*

The NETL supports the Nuclear and Radiation Engineering (NRE) program within the Department of Mechanical Engineering. Rapid growth of the NRE program and higher experimenter use over the past four years has resulted in a doubling of the number of licensed reactor operators to accommodate extended daily operations. The total hours of reactor operation in 2001 were nearly twice the previous highest year (1999). Currently, the NETL and Cornell have the only operating cold neutron sources at any United States URR. The NETL cold source was used much of the past year performing prompt gamma activation analysis. The number of traditional samples irradiated at the facility is often limited by the available counting equipment time. Future facility plans include additional counting areas to use the available reactor time more efficiently.

*View of TRIGA Mark II Reactor Area from Control Room.*

The failure and flooding of the TRIGA Reflector in 2000 has limited beam port development (two of the five beam ports were flooded) until this item is repaired or replaced. However, the DOE has provided partial replacement funding through the University Reactor Instrumentation Program and the NETL is planning a temporary facility shutdown following the manufacture of a replacement reflector.❖

*Beam Port Area showing Neutron Beam Port #1. Positron Source (foreground), #2 Neutron Depth Profiling, #3 Texas Cold Neutron Source*

## NEER Project *(continued from page 6)*

heaviest and most expensive part.''
Dr. Pister said he was considering making smart dust that draws its power from the radioactive isotope tritium and that he had been approached by Trace Photonics, a company in Charleston, Ill., that is interested in shrinking nuclear batteries to smart-dust size.
''Nuclear batteries can potentially give off a staggering amount of energy,'' he said.
Their longevity also makes them attractive. ''Many applications of wireless networks are for places you never want to go back to,'' Dr. Pister said, like the foundations of tall buildings or the walls of houses. ''You don't want to have to dig beneath the sheetrock to change the batteries.''
What risks might the batteries pose if, for instance, they were scattered through the walls of a large building to monitor air quality or temperature? ''They aren't likely to be very dangerous,'' said Stephen I. Schwartz, publisher of the Bulletin of the Atomic Scientists, ''unless you ate them, or threw them in the fire and inhaled the smoke.''
Most people are still unaware that their smoke detectors contain radioactive materials, Mr. Schwartz said. Still, he added, if people did become aware that MEMS devices might be powered by nuclear batteries, some of them might be alarmed. ''The odds of getting hurt by these devices would be very small,'' but research on them should not be kept secret, he said.
''Let people know about the work,'' he said. ''Let all the facts be put on the table and then let people decide.''❖

## INIE *(continued from cover)*

The key recommendation of the Task Force was that, beginning in fiscal year 2002, DOE should provide funding to initiate establishment of (five) geographically distributed regional university research reactor (URR) user facilities selected from peer-reviewed proposals submitted by universities meeting stated criteria. Each selected proposal should be provided with a five year commitment of support and the host university must be committed to operation of their research reactor through the five year support period and demonstrate that substantial institutional support comes from the university and will continue through the program support period. In addition, (four) geographically distributed regional university training and education reactor user facilities should be established with similar guidelines regarding university commitments and support. Both the research and education and training facilities should actively seek linkups with universities, national laboratories and professional societies.

These recommendations were slightly modified at the Chicago meeting (with the NERAC Task Force in a attendance) to accommodate suggestions by the reactor/university community. While the $5.5 million provided will enable a substantial start toward developing regional facilities with various partnerships among universities, national laboratories, utilities and private companies, it is generally believed that approximately $12 million/year is necessary to adequately support regional reactor partnerships.❖

## Distance Education Programs *(continued from page 4)*

engineering and industrial engineering as well as nuclear engineering. Any of the courses in the two Certificate programs may also be used toward satisfying MS degree requirements in the respective disciplines.

Admission requirements are the same for all three graduate programs; namely, a BS in any engineering discipline, physics, chemistry, or mathematics from an accredited institution with at least a 3.0/4.0 GPA. In addition, all entering nuclear engineering students must have, as a minimum, competency in mathematics through ordinary differential equations and competency consistent with an introductory course in nuclear engineering.

If these competencies do not exist, the student must take appropriate courses to develop the competencies prior to beginning the graduate program. The recommended course of study for each individual student is determined by an advising conference with the student and depends on the student's professional interests, academic background, and work experience. The cost for either of the three programs is the standard fee schedule for the Graduate School at the University of Tennessee and is described in detail in the current Graduate Catalog, which is available online at http://web.utk.edu/~gsinfo/. More detailed information about the courses and the Web delivery technology is available at http://www.anywhere.tennessee.edu/ne/default.htm.

Finally, students who successfully complete any of the three programs will gain state-of-the-art knowledge in their chosen field, be better qualified to work as professionals, and increase their value to their current employer and to perspective new employers. More importantly, students will have the personal satisfaction and enjoyment of learning new concepts and developing new skills in exciting fields of national and international importance.❖

# New Mexico Opportunities in Nuclear Engineering (NMONE)

New Mexico nuclear engineering students are excelling thanks to a grant funded by the Department of Energy. A three-year award that began in the fall of 2000 is offering a unique opportunity for minority students in Nuclear Engineering (NE) to gain the skills they will need to do outstanding work in positions with the DOE and National Laboratories once they graduate.

The New Mexico Opportunities in Nuclear Engineering (NMONE) fellowship program offers tuition remission, stipends for research training and travel to national academic conferences, as well as mentoring and tutoring opportunities for qualified students at The University of New Mexico (UNM) and New Mexico State University (NMSU).

UNM currently has four undergraduate students involved in the program and are expecting to increase that number to 15 within the next nine months. Of those 15 students, there will be eight undergraduates pursuing a degree in NE, five undergraduates pursuing a minor in NE, and two graduate students pursuing their MS degrees in NE. NMSU is offering new courses related to NE to encourage their engineering students from a variety of disciplines to pursue a minor in NE. They plan to award a number of fellowships within the next six months.

Students currently involved in the program are working with faculty on projects encompassing the research areas of Nucleate Boiling, Thermionic Energy Conversion, AMTEC Systems, and Semiconductor Cooling Systems. Many new projects are slated for Fall 2002.

NMONE fellows say that the program has benefited them in many ways including helping them to gain needed research skills, allowing them to make professional contacts, giving them better knowledge about nuclear power technology, and increasing their self confidence. Three of the four fellows are now considering advanced degrees in Nuclear Engineering.

If you would like to receive additional information on the program please feel free to contact Reyna Sandoval at reyn@unm.edu. You may also view details about the program at the following web address http://www-chne.unm.edu/NMONE/NMONE.asp.❖

***New Mexico Opportunities in Nuclear Engineering Fellows:*** *(Clockwise from top left): Lark Lacey, Dan Torres, Rochelle Times, and Loan Libby*

# *University of Cincinnati Engineers Forge New Relationship with Tuskegee University*

The University of Cincinnati's College of Engineering has joined forces with engineering faculty at Alabama's Tuskegee University in an effort to attract students in nuclear engineering and health physics professions after both schools were granted a DOE Majority/Minority University Program (MMUP) award in October 2001. This meets the fourth award in the MMUP since the program began in January 2006.

The collaboration was formalized recently when representatives of Tuskegee's engineering programs visited UC. They were welcomed by Mitchel Livingston, vice president for Student Affairs and Human Resources; Ed Prather, assistant engineering dean; and several faculty members in Nuclear and Radiological Engineering (UCNRE).

The collaboration will be known as the UCNRE-TU Bridge Building Project and will focus on re-cruiting top Tuskegee students in engi-neering, physics, chemistry and mathematics.

An important component of the program will be identifying six Tuskegee seniors each year who will be designated "Bridge Scholars." Those students will have the opportunity to visit UC and work on undergraduate research projects with advisers at both UC and Tuskegee University.

The principal investigators on the project are Professor John Christenson (UC) and Professor Pradosh Ray (Tuskegee). The co-PIs are Syed Ali (Tuskegee) and Shoaib Usman (UC).

For more in-formation about UC Nuclear and Radiological En-gineering, visit the program's website.❖

# Missouri University Research Reactor Archeometry Laboratory

*Archeological Samples*
*Photo courtesy of*
*Leonardo Lopez-Lujan.*

Since achieving criticality in October 1966, archeologists from all over the world have used the University of Missouri-Columbia's Research Reactor (MURR) neutron activation analysis facilities to study archaeological artifacts. This work is internationally recognized, which led to the formation of the MURR Archeometry Laboratory. Since 1988 the Lab has been continuously funded by the National Science Foundation to support international collaborations. More than 200 research groups from over 100 universities, museums and institutes in 45 states and 15 foreign countries regularly use MURR Archeometry Lab services and expertise.

Over the past 12 years, the Lab has analyzed over 50,000 archeological samples including pottery, obsidian, chert, metals, glass beads, and other artifacts. The scientific contributions to determine culturally significant aspects of our history is an excellent example of how nuclear analytic methods available through university research reactors contributes to a wide variety of scientific endeavors.

Archeometric analysis at MURR supports faculty and students from several University of Missouri-Columbia (MU) departments, including Anthropology, Art History and Archaeology, Geography and Geological Sciences. As an example, scientists at MU and other universities are analyzing obsidian materials *(a dark glass-like material produced by volcanic eruptions that holds a fine, sharp edge for knife blades and points for weapons)* from volcanic sources all over the world. This analysis is used to create a comprehensive database for successfully identifying the origin *(i.e., source)* of obsidian artifacts. Although all obsidian is formed from the same basic material—magma, the molten rock beneath the earth's surface—the slight variations in the trace elements for each volcanic eruption *(identifiable via NAA)* help differentiate the chemical fingerprints. The Lab's materials database now has more than 300 obsidian sources from the Western Hemisphere that have been fully characterized, which allows archaeologists to trace an obsidian artifact to the precise outcrop from which the original material was mined with nearly 100% confidence.

To analyze samples, the MURR measures the concentrations of about 30 elements, generally at a sensitivity level of parts per million by weight. By comparing elements found in these samples, clusters of data points are found which are typically unique for a particular obsidian mine or pottery recipe. Through these techniques, scientists have begun to answer questions such as:

- Did the ancient Hopewell peoples of Ohio import volcanic obsidian glass from source areas near Yellowstone National Park or from the Jemez Mountains of New Mexico?
- Did Aztec veneration of their predecessors in central Mexico lead them to excavate the shrines of earlier civilizations?
- Where did the kings of ancient Kushan obtain the metal ores for making their coins?

These answers, and more, can be determined from application of nuclear science to archaelogy.

## Important Dates to Remember

**June 2002**

- American Nuclear Society Meeting, Hollywood, Florida, June 9-13
- American Society for Engineering Education Meeting, Montreal, Quebec, June 16-19

For Additional Information Please Contact

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