THE *NUCLEAR NEWS* INTERVIEW

Gutteridge: On the DOE's assistance to university nuclear engineering programs

Job opportunities, government sponsorship, university outreach, and excellent salaries add up to student enrollment increases in university nuclear engineering programs.

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Gutteridge talked with Rick Michal, *NN* senior associate editor, about what the DOE is doing to help colleges and universities develop their nuclear engineering programs.

Gutteridge: "Undergraduate enrollments have at least doubled over the last four or five years."

What are the DOE's university programs?

The DOE, through its Office of Nuclear Energy, Science and Technology (NE) has a variety of initiatives that assist universities to develop nuclear engineering programs. We want to help breathe life into those programs that were suffering during the last two decades because of financial reasons and low student interest. University assistance began its renaissance in 1996 when Bill Magwood became director of the Office of Nuclear Energy, Science and Technology. Prior to Bill's arrival, the programs in existence were underfunded and underenrolled, presenting problems of retention of nuclear engineering programs by universities. In fact, some programs had been terminated by various universities, and many university research reactors closed.

One of the programs that was strengthened is called Reactor Instrumentation, which includes grants to university research and training reactors to help them improve their instrumentation and controls and most anything else reactor-related that needs modernizing.

Another program that was improved was Reactor Sharing, which allows universities to conduct outreach to schools that don't have reactors. The DOE provides funding to the universities to conduct this outreach, which enables students from local high schools, community colleges, and universities to become more familiar with the operation of a reactor and teaches them nuclear concepts.

We also continued the industry/university Matching Grant program, which began in 1992 with Commonwealth Edison, now Exelon, as the first utility participant. This program allows schools to enlist an industry sponsor and then have the DOE provide a matching amount of funding. The funding can be used for any aspect of university nuclear engineering, including facilities, equipment, and even faculty and student support. It's a wide-open program, and probably the best one from the university's standpoint since it is not restricted to any particular nuclear activity. It allows the university to spend the funding where it is needed the most in the nuclear engineering program.

The Matching Grant program now has about 35 private sponsors at 25 universities, and it attracts from 20 to 25 schools each year. Some utilities, such as Exelon, sponsor four or five schools, but there also can be one school having four or five different sponsors. The DOE's participation caps at $60 000 per school. So, for example, if a school gets $60 000 from a utility, the DOE will try to give that school $60 000 as well, if the appropriated funds are available.

Some of these programs existed under the DOE's Office of Science but now have been expanded under the university programs area in NE.

Could you talk about programs that were started up under Bill Magwood?

One of them is INIE—or Innovations in Nuclear Infrastructure and Education—which was instituted in 2002 as an outgrowth of an effort to support university research and training reactors. NE was attempting to find a way to get the universities into some type of consortium where they would have support from government, private utilities, national laboratories, other universities, and vendors. In that way, the universities and other entities in the consortiums could share research and facilities.

Initially, in September 2002, awards were made to four consortiums, each representing a different section of the country. The geographical balance was a desired outcome but not one that could be dictated since the selection of the consortiums was governed by a rigorous peer review. The four consortiums selected encompass 14 different schools, several utilities and private companies, and national laboratories. Each consortium has taken a different approach for what they chose to do in the first year.

Recently an assembly of the four consortiums was held in San Diego [during the

American Nuclear Society Annual Meeting, June 1–5] so that each consortium could report on the direction they were headed and their progress to date. Up to the time of that meeting, the consortiums had been working for about eight months on their activities.

Could you name the consortiums, and give an overview of what kind of research each is conducting with INIE funds?

Yes. They are, in no particular order, MIT, the Western Nuclear Science Alliance, the Big 10 Consortium, and the Southwest Consortium.

MIT is working in a partnership with the Rhode Island Nuclear Science Center. That consortium wants to develop and operate a national user facility for neutron capture radiation therapy (NCT). The INIE funding is being used primarily to purchase instrumentation and to upgrade equipment for control and monitoring of thermal and epithermal beams for the prompt neutron activation analysis facility and to facilitate use by visiting scholars. Proposals for NCT user projects were received from 16 researchers, 14 of whom are based outside MIT. One proposal was for a collaborative project with the University of Rhode Island. Other areas of work under the INIE include the development of an in-core, high-temperature irradiation facility for testing materials for advanced reactors and equipment upgrades that will improve the ability of researchers to conduct neutron science research at the MIT reactor.

The Western Nuclear Science Alliance, which consists of Oregon State University, University of California–Davis, Washington State University, University of California–Berkeley, and Idaho State University is taking a different approach. They are using the INIE funds in a partnership to try to develop many aspects of their nuclear programs. They are promoting innovations in research in specific areas of research including neutron-computed technology (at UC–Davis) and neutron radiography (at Oregon State). They are intent on providing academic, governmental, and industrial communities with highly skilled scientists through their educational programs. They're also awarding quite a few scholarships through their INIE funds.

Regarding specifics of the Western Nuclear Science Alliance, Washington State is developing a pre-college program in radiochemistry education; the University of California–Berkeley no longer has a reactor, so they have taken their students on field trips to the University of California–Davis reactor to do experiments in nuclear fuel assembly corrosion using neutrons; Idaho State is doing the same thing, taking field trips to Davis for neutron radiography demonstration; and Oregon State is setting up an Extended Campus program for off-campus graduate courses in Nuclear Engineering and Radiation Health Physics.

The Big 10 Consortium consists of Penn State, Purdue, Illinois, and Wisconsin universities. Although they're doing many things independently in research and education, Penn State, Purdue, and Illinois are working together to design a virtual university research and training reactor that they hope will lead to a new university training reactor's being built.

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Another area for the Big 10 is their "mini-grants" program, where they've provided some of their funding to develop a multidisciplinary and multi-university research grant program. This enables the universities in the consortium, other colleges and schools, and their consortium industrial partners to collaborate on research. Some of these mini-grants are being awarded to high schools, too, so that those students can come and use the reactor. The mini-grants run from $1000 to $25 000. It may be the first time in university programs where we actually have grants going to non-universities and other entities. Private labs and industry also can be awarded a mini-grant to use the reactor. So far, 13 mini-grants have been awarded for a total of approximately $175 000.

The fourth consortium is the Southwest Consortium of Research Reactors, which includes Texas A&M, Texas, and New Mexico universities. The schools are enhancing their laboratory courses and improving laboratories while developing distance learning modules where a prototype module is almost complete. Other areas of interest include research on a heavily filtered neutron irradiation system for use by biological experimenters, upgrading prompt gamma-ray activation analysis and cold neutron source, and the sharing of lectures, laboratories, experimental facilities, and personnel in projects such as neutron tomography. This latter collaboration remains one of the primary objectives of the INIE program.

Did the four consortiums have to compete with other groups for funding?

When proposals for INIE funding were submitted, we gathered a panel of seven experts from around the country who performed the peer review. The panel evaluated 13 proposals during a two-day meeting. Seven of the 13 proposals were judged meritorious, and of those seven, four consortiums—the four I just noted—were awarded. The other three proposals were promised funding if and when it became available.

The University of Michigan was one of the schools that submitted a proposal, but Michigan has since shut down its reactor [*NN*, Aug. 2003, p. 132] and is no longer eligible for a stand-alone INIE; it is, however, eligible to join an existing consortium.

The other two meritorious proposals were from the North Carolina State University Consortium, consisting of NC State and five other schools, and the Midwest Nuclear Science and Engineering Consortium, consisting of University of Missouri–Rolla, University of Missouri–Columbia, and several other schools. The latest news is that some additional funding has become available, and those consortiums will receive partial INIE awards before the end of the year. So, we will have six INIEs by the close of fiscal year 2003.

How much funding does each INIE receive?

Most consortiums receive from $1 million to $2 million each year for five years. Some requested more, but their requested amounts were not a factor in the panel's decision to award a consortium. In actuality, the DOE needed about $8.5 million to fund the first year of INIE, but there was only about $5.5 million available. So, the consortiums took about a 30 percent reduction across the board.

All of the consortiums will receive money for five years without having to reapply for funding each year. However, we have two reviews each year to track the progress of the consortiums to ensure the funding is being used properly. Theoretically, the INIE funds could be withdrawn, but I don't see any of these consortiums suffering that fate, given the track record of the universities involved.

What about consortiums that submitted proposals that weren't accepted, or even those that haven't yet submitted proposals—do they have to wait five years until current funding ends before they can jump into the game?

At this point, the DOE has determined that we will not go out with a second solicitation for INIE funding, since we have so many schools that are currently in the pro-

gram and not fully funded.

However, to answer your question, schools that did apply and were not awarded, or schools that were never part of an INIE proposal, are eligible to become members of existing consortiums. For example, the University of Massachusetts–Lowell submitted a proposal but did not receive an award. They would like to become part of the MIT consortium. Another example, from the Big 10 consortium, involves Ohio State's becoming a member this year. Even though that consortium won't receive additional funding, each school may reduce its own share of INIE funding to bring in Ohio State. The same thing could occur in the Western Alliance, where it is possible that Reed College, the University of Utah, or the University of California–Irvine could become a partner. Also, the Southwestern Consortium could consider bringing in Kansas State University or another university. However, most of the consortiums are, understandably, a bit "gun shy" about accepting new partners until they know exactly what amount of funding they will receive.

How does your office view events such as the University of Michigan's recent closing of its Ford research reactor? Also, is MIT considering closing its reactor?

We were as supportive as possible in attempting to sustain the Ford reactor because of its importance to the university nuclear engineering community and the Michigan nuclear engineering program. The Ford reactor was very important because it was a symbol, much like the MIT reactor. We thought there might be a domino effect if a reactor at a large school like Michigan closed down. Other universities might be influenced and decide that it's time for them to do the same. But I don't think that's going to materialize.

Regarding Michigan, DOE alone could not have saved that reactor because the amount of funds the university required to support it exceeded the amount available to us, and Michigan had other issues that they alone needed to resolve. One was that the reactor was in need of millions of dollars in upgrades. Michigan also desired to recover a portion of the operating cost of the reactor, which is something not typically assumed by the DOE. Despite several meetings between DOE and university officials, an agreement that satisfied both parties could not be reached and Michigan decided it could not wait any longer. When DOE could not provide a larger part of the resources required by the university, the reactor was shut down on July 3.

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While it's a loss to the nuclear community, I don't think it's a fatal one with regard to the other university reactors. Each university must assess the value of the university research reactor to their needs.

As to the MIT reactor, I think the people at MIT are very dedicated to the fact that a reactor should be used for research and should benefit students and not be used, primarily, as a source to generate revenues from commercial work. MIT is fulfilling the need of the university, but, unfortunately, it costs a considerable amount of money to operate the reactor. The university assumes much of these costs, but, like most universities, it has budget concerns. DOE hopes that the MIT reactor will continue to operate.

If they were to close the MIT reactor, what would happen to INIE funding for the MIT consortium?

The INIE probably would cease to exist for that consortium if the MIT reactor closed. The larger point is that the closure of the MIT reactor, which is viewed internationally as the most important nuclear engineering program and research reactor in the world, would send a negative signal to the nuclear engineering community.

Do U.S. university nuclear energy programs have more use of research reactors than European or Asian nuclear energy programs?

I'm a little hard pressed to know that answer. I think the answer is yes, but at the same time, since we have more research reactors compared with other countries, our research reactors are probably more thinly used than those of our European or Asian counterparts.

New nuclear engineering programs were established last year at South Carolina State University and the University of South Carolina. How are these programs progressing?

They are both in the infancy stage. The University of South Carolina program has begun, but it will really get going once they hire a professor to chair the nuclear engineering program. That search started earlier this year and is still ongoing. I think they will make a decision in another few months. The program there is going to be focusing mostly in the area of nuclear energy and hydrogen. They'll have their first true class of nuclear engineering students arriving in the fall of this year, so it's too early to comment on how the program is progressing. However, some DOE representatives did visit the campus and saw a very strong commitment by the university to the program. By the way, the program will be a graduate program, within the university's Mechanical Engineering Department.

As for South Carolina State University, that is an undergraduate program. They are partnering with the University of Wisconsin so that students will be able to get core courses at Wisconsin that aren't offered yet at SC State. Several students from SC State enrolled at Wisconsin last summer, and I think the last count had seven or eight students in the program. SC State fully expects to have 20 or 30 students in the pipeline eventually. They also have hired two professors of nuclear engineering. One of those professors has a Ph.D. in nuclear engineering from the University of Florida and is a former DOE fellow. What is happening at SC State is a nice success story.

Regarding the Nuclear Engineering and Science Education Recruitment Program, which the DOE defines as "designed to increase the number of university students entering a nuclear engineering course," has there been success in attracting more students since the industry learned a handful of years ago that the nuclear engineering pipeline was drying up?

Yes, very much so. DOE produces a chart that displays nuclear engineering undergraduate enrollments. Undergraduate enrollments in 1980 were at 1800, and they dropped to 480 in 1997/1998. The good news is that the trend has since been reversed. DOE initiatives have had an impact because we started offering research grants, fellowships, reactor support, and an outreach program to inform potential students that there is a life and career in nuclear. At last count, which was the 2002 fall term, there were 1060 undergraduate students in nuclear engineering programs, and that represented just 18 universities. We typically receive reports from about 28 universities. We figure that undergraduate enrollments have at least doubled over the last four or five years.

We'll do another count soon to get the 2003 fall term number. But, so far, we've

had some amazing stories. We have Purdue going from nine students to well over 100 over a four-year period. We have Texas A&M going from 55 to almost 200 over that same period. Every school, almost without exception, has seen immense increases. Even if they go from 30 to 55 students, that's a huge increase.

Is the increase due to the industry's marketing of programs?

We've tried to pinpoint a couple of reasons for the increase. One is the DOE's investment. DOE's investments in undergraduate and infrastructure education closely track enrollments. As investment went up, enrollments went up. So I think it's the DOE's investment in university programs, and it's the DOE's leadership. I think that government leadership was not there for the longest time, and now it is there.

I think there also are some demographics going on here. There are a lot of retirements in the nuclear community, and so a lot of job openings are occurring. And, because we have a lot of jobs chasing very few students, there are impressive salaries for those coming right out of college. There was such a dearth of nuclear engineering graduates during the 1990s and the early 2000s that competition drove up salaries, and now nuclear is one of the highest paid, if not the highest, engineering discipline. Texas A&M officials state that their graduates are the highest paid of any undergraduate discipline in the university. So, the increase in student enrollment is due to a combination of job opportunities, personnel needs, image improvement, government sponsorship, university outreach, and excellent salaries.

How is the Nuclear Engineering and Science Education Recruitment program coming along?

That is, of course, a small recruitment program that we conduct through the American Nuclear Society. It basically consists of teacher workshops. It's a program where ANS uses its volunteers and DOE funding to establish workshops throughout the country. ANS conducts a two to three-day instruction for middle-school and high-school science teachers to educate them in nuclear energy and engineering concepts. This enables the teachers to introduce nuclear materials to their students, so that the students don't automatically associate nuclear with Three Mile Island or Chernobyl.

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How successful is the International Student Exchange Program (ISEP)?

ISEP used to have about 10 to 15 nuclear engineering students per year from the U.S. studying in Europe and Japan. In return, we received 10 to 15 foreign students. The students worked at national labs during the summer and into the fall, so they did about three or four months of research. I think it

was a good program from a diplomatic standpoint. The French, Germans, and Japanese seemed to love it. When DOE was thinking of dropping ISEP about three or four years ago due to lack of funding, those countries sent us letters and asked us to continue the program. So, we found the funds to support six students instead of the 10 to 15 we had been sending.

ISEP has been successful in that it promotes good international relations. The students selected for the program are very intelligent. We'd like to expand the program to include Argentina, the Russian Federation, Brazil, and others, but funds have not been available to do that. We do need additional funds to make the program stronger, and it probably needs a little more attention to refocus it, too, since it hasn't been updated in about 20 years. An example of an update would be to extend the students' stays a bit, maybe to a year, and expect more from them. I think a year would be better, if the students could spare it out of their classroom education. But perhaps, too, we could have them receive credit for courses taken overseas.

ISEP is something we want to keep, but unfortunately with all the other initiatives we have, it has suffered a bit. We definitely would like to expand it.

To what extent is foreign student enrollment helping to hold up the nuclear engineering programs at U.S. universities?

The large majority of students in undergraduate programs are American citizens. For graduate programs, it's difficult to tell because it varies from school to school. But overall, it's about 50 percent foreign students. They like studying in the United States because our universities offer the best nuclear engineering education. Also, some of our U.S. students really want to get out in the job market, so many do not continue on for an advanced degree because utilities typically don't require it. Of course, if students want to teach or do research, they need a master's or Ph.D. But many of them are not willing to wait that long because the high salaries for a B.S. in nuclear engineering are a real lure. That's one of the reasons why a larger percentage of foreign students populate the graduate programs.

Did the events of 9/11 have any effect on foreign students entering the United States because of security reasons related to their visas?

I would say that 9/11 has had little effect on the numbers. The universities might be able to answer that better, but in my discussions with them, 9/11 doesn't seem to have had much effect. The universities are required by the INS (Immigration and Naturalization Service) to do more checking into a foreign student's background, at least a three-year background check. That is sometimes difficult to do because, depending on the country of origin, the records may not exist. But the schools are complying as well as they can. There is more paperwork, but I don't think the foreign student population in nuclear engineering has declined since 9/11.

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Are you seeing a significant shift from reactor-focused nuclear engineering programs to those of wider scope, such as nuclear engineering/health physics?

A little bit. I think what has happened since the late 1990s and recently is that because the programs had so few students, a lot of schools decided to merge their programs into other departments in order to survive. Obviously, if schools are cutting budgets and they have three professors and only eight or 10 undergraduates, it may be advisable to attach the nuclear engineering program to a larger program such as mechanical or radiological sciences. Some people used to view this merging as unhealthy because we were losing the pure nuclear engineering focus. But generally we don't see it like that any longer because we really wanted the programs to survive, and they have survived. Overall, I don't think the mergers dilute the programs.

Besides the Matching Grant program, is industry participating to help universities attract students to nuclear engineering?

The industry and national labs do offer a lot of internships and scholarships for students, but there's not a lot of buzz about it because it's done quietly. They also try to do research at universities when possible. Many times, universities may not have the capabilities to conduct the research they need, so a common refrain from them is that more industrial support would be helpful. I think DOE would like to see more private sector assistance, and the new INIE program is one way this will occur. The INIE program is helping to bring universities in touch with utilities and the private sector, including companies like Framatome and Westinghouse. A lot of it right now is "in kind" contribution versus cash. But I suspect that as things develop, it will become financial.

Are there any problems that nuclear engineering university programs are facing, apart from financial difficulties?

One of the problems is that the universities are struggling to meet new compensatory measures outlined by the Nuclear Regulatory Commission for the shipment of spent fuel. Most of the schools don't ship spent fuel, of course, but there are several that do it on a regular basis. There has been a lack of shipments over the past several months and that is due to new regulatory measures. Those measures have had a detrimental impact on the movement of spent fuel to storage sites.

So, we want to make sure that there is a spent fuel transportation program that functions evenly and takes the spent fuel when it needs to be taken. We need to get over that hump right now, and I suspect we will shortly.

Is it a cost problem with these new measures?

Cost is one of them. Also, ownership of the fuel is another. The DOE owns the fuel, but we're not the shipper of record, and a few schools would like us to be just that. But DOE can't be an NRC licensee, and so the schools have to be. A few universities think that the new NRC measures are very demanding and put too much of the onus on them. Some schools don't want to assume the risks in shipping spent fuel as implied under the new compensatory measures without additional assistance from the government. They want to make sure that things are done more carefully so incidents do not happen, since the schools remain the licensee. There is reluctance on the part of a couple of universities to assume that role.

The fact is, the DOE owns the fuel at university research reactors. We own it and the schools just use it. We pay for its fabrication, and when the schools are done with it, we take it back. This arrangement was established by legislation at the beginning of the nuclear era. Progress is being made to resolve the spent fuel shipment issue for all of the affected parties. NN