TARGETED INITIATIVES

SUPPORT FOR NUCLEAR ENGINEERING EDUCATION IN THE USA

BY JOHN GUTTERIDGE

Recruitment and education of a new generation of nuclear engineers stands to benefit in the United States from a range of programmes involving governmental bodies, universities, and industry groups. They are part of efforts to attract more students to consider and prepare for careers in the nuclear industry, and to provide financial support for nuclear research and education.

Career prospects in the nuclear field are brightening. While the number of nuclear engineering programmes and research reactors have declined precipitously since the mid-1980s, the demand for nuclear engineers and nuclear trained personnel is on the rise as the new century opens. This is due to the strong job market, the lack of large numbers of recent nuclear engineering graduates, and the increasing number of retirements in the nuclear field.

During the past year several studies have been completed in an attempt to ascertain the problems in nuclear engineering education and define initiatives to address these problems.

■ The Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development completed a review of nuclear engineering education in 1999 that covered 16 countries including the USA. *(See article, page 2.)*

■ Another study -- done by the Nuclear Energy Department Heads Organization -- surveyed US industry and universities concerning personnel requirements. The conclusions of this study, as well as the NEA survey, were that more students must be educated in nuclear engineering to provide the expertise required today and in the future, but that trends in enrollments through the 1990s were not encouraging.

■ A third study was conducted in the USA by an independent team appointed by the Nuclear Energy Research Advisory Committee. It recommended major increases in funding to maintain the nuclear engineering infrastructure in the United States. Highlights of this study are featured in this article. *(See pages 10-11.)*

University Programmes. To retain the USA's capability to conduct research, address pressing environmental challenges, and preserve the nuclear energy option, the US Department of Energy (DOE) is working with US university nuclear engineering programmes. The University Reactor Fuel Assistance and Support programme provides funding for US university nuclear engineering programmes and university research reactors, which play a critical role in providing education and training.

University nuclear engineering programmes supply highly skilled workers to industry active in fields such as electricity generation, medical research and supply, environmental restoration, and advanced materials, as well as to government agencies and national laboratories.

To help ensure the continued viability of these programmes, DOE provides assistance through various activities. They include the DOE/Industry Matching Grants programme, which leverages public sector funds with private contributions in a 50/50 cost share arrangement. These funds can be used by univerisity nuclear engineering departments to support students and faculty, conduct research, purchase equipment, upgrade laboratories, among other purposes.

The Department also provides vital funding to university nuclear technology programmes through the Nuclear Engineering Education Research (NEER) programme reinstituted in 1998 after a five year hiatus. Additional academic assistance to outstanding students and

Mr. Gutteridge is Director, University Programs, Office of Nuclear Energy, Science and Technology, US Department of Energy.

CAREERS IN THE NUCLEAR INDUSTRY: WHAT STUDENTS THINK

The Nuclear Energy Institute (NEI) in the United States is among organizations working with government, industry, and educational communities to motivate talented engineering students to consider careers in the nuclear industry. During the past year, NEI requested Bisconti Research Inc., a communications research firm, to spend some time on US university campuses with engineering students to obtain their points of view. The firm's President, Ann Bisconti, highlighted the study's findings in an edition of *Nuclear Energy Insight*, NEI's newsletter.

Most engineering students never think about majoring or working in the nuclear field, she reported. Sudents say that nuclear majors and careers are invisible to the majority. But those who are made aware of the field most often see nuclear engineering study as too narrow. They also see nuclear industry careers -- for any engineering majors -- as too narrow.

Today's students are looking for a wide variety of opportunities to do new things. They want new problem-solving challenges and stimulating multidirectional career path options. If non-nuclear engineering majors see the field as narrow, they might be surprised to hear the main reasons why nuclear engineering majors say they chose the field:

- Fascinating things to study in nuclear engineering;
- Variety of applications and many career possibilities in nuclear engineering;
- Multidisciplinary nature of nuclear engineering study, which increases the value and marketability of graduates.

In group discussions with students, Bisconti Research heard nuclear engineering majors talk about good career opportunities, the supportive family-like atmosphere of their relatively small department, the special programmes and scholarship opportunities, the unique opportunities to work with faculty on research, and pride because people think nuclear engineering majors must be very smart.

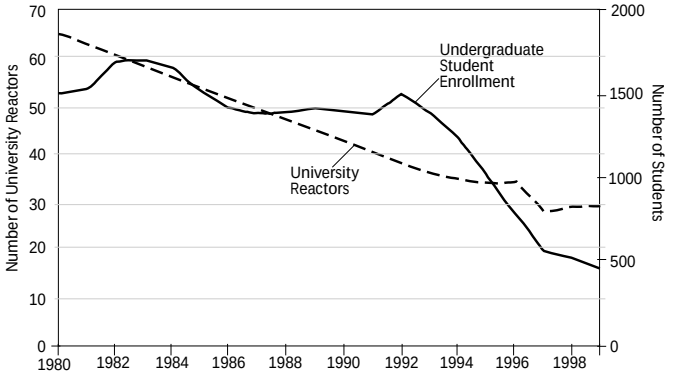
But most nuclear and non-nuclear engineering majors can't envision what work would be like in a nuclear power plant or other nuclear industry environment -- unless they happened to grow up next to a nuclear energy plant. And most have never spoken to a representative of the industry.

Now that the industry is starting once again to give serious attention to campus recruiting, Ms. Bisconti says that a few students are noticing the presence of recruiters. But they say that company brand and industry image must be established before the students will listen to the message recruiters may bring.

Currently, young engineers are still in a minority at most nuclear power plants, according to Mr. C. Goodnight, a consultant with Tim D. Martin & Associates in the USA. The average age of a US nuclear plant employee now is 47, and some 12% of engineers will be eligible to retire within the next three years. Mr. Goodnight expects the demand for engineers to increase as attrition begins to take effect.

In March 2001, NEI held its first Industry-University Engineering Recruiting Workshop. It brought together representatives of industry and academia to identify collaborative recruiting practices that are proven effective, as well as innovative recruiting approaches. More information may be obtained from NEI; its Web site is at http://www.nei.org

TRENDS IN NUCLEAR ENGINEERING AT USA UNIVERSITIES



Source: US DOE.

faculty occurs through the Scholarships and Fellowships programme benefitting about 75 students per year. An added dimension to this programme began in 2000. It offers students at minority institutions without a nuclear engineering department an opportunity to earn a nuclear engineering degree by attending a university with a nuclear engineering department while completing primary degree requirements at their minority institution.

University research reactors in the United States form a fundamental and key component of the national research and education infrastructure. Research conducted using these reactors is critical to many national priorities such as health care, materials science, and energy technology. Currently, there are 28 operating university research reactors at 27 campuses in 20 states.

University reactors are the source of neutrons for research in such diverse areas as medical isotopes, human health, life sciences, environmental protection, advanced materials, lasers, energy conversion, and food irradiation. University research reactors directly support the development of highly qualified, technically knowledgeable personnel needed by national laboratories, private industry, the federal government and academia, for basic and applied research critical to US technological competitiveness. In addition, with the help of the Reactor Sharing programme, these reactors serve as centers for education programmes offered to other colleges and universities and high school students and teachers who visit the reactor for instructional programmes, research and training.

Other steps include the University Reactor Fuel Assistance programme, which funds the supply of fresh fuel to and spent fuel from university research reactors. This allows universities to continue their important research and education activities. Funding also is supplied through the Reactor Upgrade programme for equipment upgrades at the reactors, increasing their value as research tools. Another programme, targeted on the field of radiochemistry, supports students and faculty in the discipline of radiochemical science, which supports the US nuclear energy infrastructure.

Funding to prepare students for nuclear engineering and science careers is provided by the Nuclear Education Training programme. Started in 2000, the programme addresses the knowledge gap of pre-college science teachers and students, and incoming college freshmen in areas of nuclear science and engineering.

Advisory Panel. The independent Nuclear Energy Research Advisory Committee (NERAC) was established in October 1999 to provide expert advice and guidance for DOE's nuclear programmes. Within NERAC, a "Blue Ribbon Panel" was convened and charged with considering the future of the US nuclear education infrastructure, with particular focus on the future of the US university research reactors and the relationship between universities and the national laboratories in the conduct of nuclear engineering research.

In May 2000, the panel, with representatives from universities, national laboratories and government, presented its final report to NERAC. The panel recommended several initiatives to strengthen nuclear engineering education. *(See box, next pages.)* They include:

- increasing the number of doctoral and masters students supported;
- assisting universities in recruiting and training faculty through junior faculty research grants;
- expanding research in nuclear science and engineering by increasing the NEER programme to $20 million per year; and
- better support to US university research reactors through the existing upgrade programme and adding a new more competitive programme with significantly greater funding to permit more costly upgrades to take place sooner.

Strategic Goals. The range of steps being taken in the US are part of the Department of Energy's Strategic Plan 2000. A vital component is to assist the country's universities in attracting and educating nuclear engineering students and maintain university research reactors.

The benefits of nuclear science and technology are real and enduring, and committed and active leadership is needed to maintain that investment and to assure an adequate technology base for the future. ❐

USA "BLUE RIBBON" PANEL ON NUCLEAR SCIENCE & EDUCATION

The US "Blue Ribbon" panel on nuclear science and education panel issued a report in May 2000 that reviewed trends and recommended actions on several fronts. Entitled "The Future of University Nuclear Engineering Programs and University Research & Training Reactors", the report is accessible on the Department of Energy's Web site at http://www.ne.gov. The panel was chaired by Prof. Michael L.Corradini, Associate Dean, College of Engineering, University of Wisconsin-Madison, and included six other participants. They were Prof. Marvin.L.Adams, Texas A&M University; Mr. Donald E. Dei, Chief Physicist, US Naval Nuclear Propulsion Program; Mr. Tom Isaacs, Senior Scientist, Lawrence Livermore National Laboratory; Prof. Glenn Knoll, University of Michigan; Mr. Warren F. Miller, Senior Advisor to the Laboratory Director, Los Alamos National Laboratory; and Mr. Kenneth Rogers, former Commissioner of the US Nuclear Nuclear Regulatory Commission.

The panel made the following points in surveying the situation:

■ Workforce requirements at operating US nuclear power plants are increasing and will undoubtedly remain high, given the plans for plant-life extension in the vast majority of operating light-water reactors in the USA. In addition, there is a continued growth of nuclear power in the Pacific Rim and continued advances in the design of a future generation of nuclear fission reactors. Moreover, new initiatives have begun in applied radiation sciences in collaboration with industrial and medical researchers as well as new biotechnologists. Finally, nuclear science and engineering continues to be needed in national security and includes technology related to arms reduction and verification and enforcement of international treaties as well as providing the US Navy with effective, safe nuclear propulsion. Thus, the future of nuclear science and engineering university programmes must be reevaluated and refocused as the new century begins.

■ Public perceptions of the nuclear industry in the US are a cause of concern, particularly in view of nuclear's important roles.

■ Environmental sustainability is an important component of nuclear science and engineering application areas, and will require a continuing expertise to properly manage nuclear science and engineering by-products.

Such a contradiction between perception and actual facts seems to stem from the events of the last decade in which there has been no clear vision articulated for the need and benefits of nuclear science and engineering in the upcoming century. This situation is even more distressing given the growing concern over global warming associated with the increasing use of fossil fuels in all energy sectors, the increased demand by the public for improvements in biomedical advances that improve public health, and the need for increased vigilance regarding our national security.

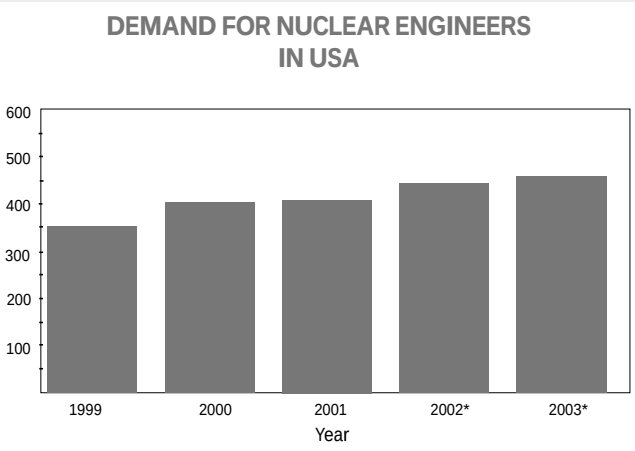
■ Nuclear science and engineering needs to be an important part of the USA's research and development landscape for this next century. Most importantly, the US Department of Energy (DOE) has a mission to support nuclear science and education through its research and educational programmes so that our manpower is allowed to thrive and so that the associated infrastructure is preserved.

Central Issue. A central issue that the panel addressed is the future of nuclear engineering as a discipline. Nuclear science and engineering is undergoing an identity crisis at the undergraduate level, it said. The survival of some departments

US SENATORS SEEK MORE FUNDS

Legislation was introduced in the US Senate earlier this year to increase financial support for nuclear education programmes.

Senators Pete Domenici and Mike Crapo have sponsored a bill that would authorize funding for the US Department of Energy's university nuclear science and engineering programmes for fiscal years 2002-2006. The funds will be for undergraduate fellowships, recruiting and retaining new faculty in the nuclear sciences and enginering, and research grants. Funding also would help upgrade training reactors and support a sabbatical fellowship programme for university professors to spend extended periods at DOE laboratories.



Demand for nuclear engineers is rising in the USA. The graph shows the gap between the annual employment needs of the nuclear power industry and the number of students graduating with bachelor of science and master of science degrees.
*Estimates

Source: American Society of Engineering Education, 1999.

and their nuclear engineering majors is becoming problematic. The panel was unanimous in its belief that the nation must maintain nuclear engineering as an undergraduate discipline and carry on an open discussion as it evolves in the 21st century.

Another feature that compounds the problem is that the faculty in the discipline are aging. Over two-thirds of the faculty are 45 years or older and the number of new faculty hires has diminished by over 10% in the 1990s.

Panel Summary Findings. The panel made a series of recommendations related to research, education, and training.

University Nuclear Engineering Programs. The panel said its vision is to have the US Department of Energy (DOE) assist universities as they refocus their programmes to enhance advances in nuclear science and engineering as applied to security, power and medicine and to maintain the necessary human resource for continuing the discipline through the 21st century. These efforts would be to:

- Enhance the graduate student pipeline to maintain the health of the discipline by increasing doctoral fellowships and masters scholarships with funds of $5 million per year.
- Assist universities in recruiting and retaining new faculty in nuclear science and engineering by establishing a Junior Faculty Research Initiation Grant programme for peer-reviewed grants in basic research.
- Expand research discoveries in nuclear science and engineering by increasing the Nuclear Engineering Educational Research programme (NEER) to $20 million per year.
- Help improve the undergraduate nuclear science and engineering discipline and maintain a core competency in nuclear systems engineering and design.
- Encourage and support a national activity of communication and outreach in nuclear science and engineering to identify its basic benefits for the country in the next century.

University Research and Training Reactors. University reactors are an important part of the nuclear science and engineering infrastructure that must be maintained, because experimental facilities (particularly facilities involving ionizing radiation and nuclear reactions) must be part of the educational basis of the discipline for undergraduate training and graduate research. To insure that such facilities are properly supported the panel recommended that a competitive peer-reviewed programme augment DOE financial support these university reactors. The programme would maintain the current base programme, and institute a competitive peer-reviewed university reactors research and training award programme. with awards for research, training, and/or outreach purposes for the total competitive programme at a level of $15 million per year.

University-DOE Laboratory Initiatives. The panel examined several approaches that could increase collaboration between universities and laboratories. These include:

- Increased nuclear engineering and health physics fellowships.
- Increased personnel exchanges between laboratories and universities.
- Designated university awards.

The full text of the panel's report is accessible on the Internet at the following address: http://www.ne.gov/nerac/finalblue.pdf