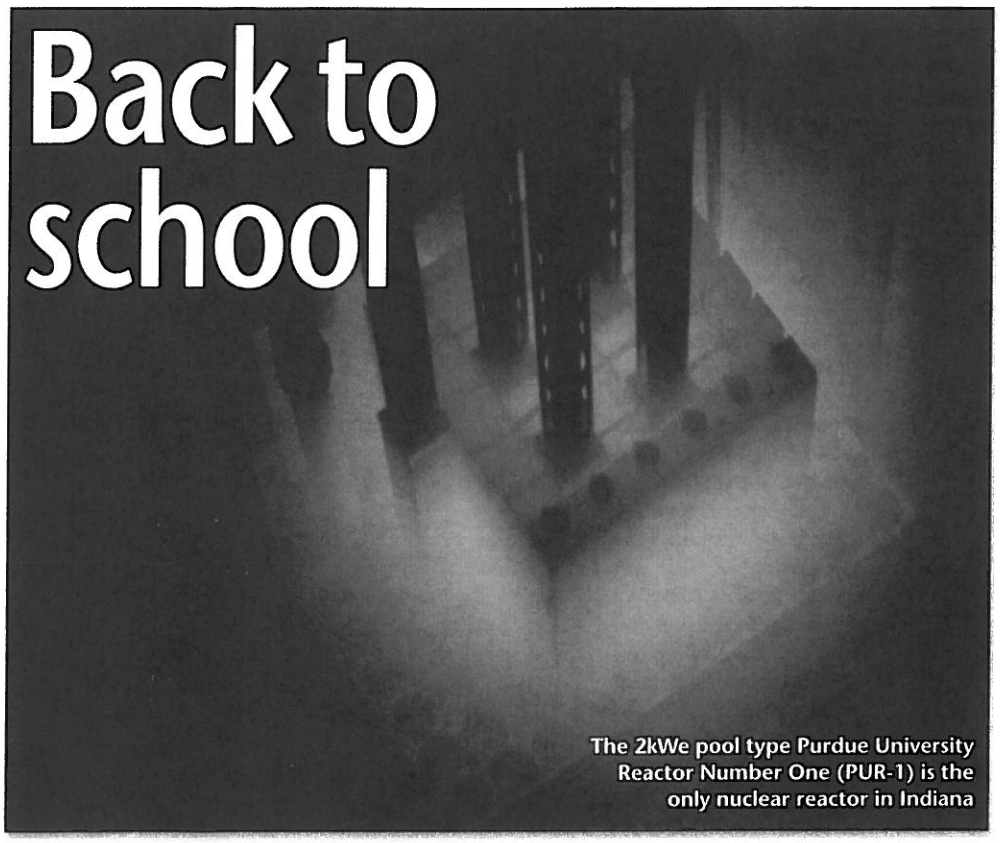
Back to school



The 2kWe pool type Purdue University Reactor Number One (PUR-1) is the only nuclear reactor in Indiana

Nuclear engineering higher education is struggling to keep up with the renewed demand for its courses and expertise. ***By Alan Osborn***

Few things say more about the growing enthusiasm for nuclear power than the rush of young students eager to make a career in the industry. It is happening mainly in the USA but other countries are now beginning to see the same development.

In some cases, like France, the popularity of nuclear sciences as a clear career pattern has been steady since the 1950s – though now that France has begun exporting nuclear plants, some strains in its human resources capacity might be observed in future. In the USA and Britain, nuclear power is returning as a significant factor in energy policy and a scramble for relevant university courses has been observed by nuclear education specialists. China has embarked on the fastest expansion of all and seems intent on turning out nuclear engineers by the thousand, though not without foreign help.

What do these developments mean? Could the resurgence of nuclear power be held back by a shortage of qualified personnel? And, if so, where? Are nuclear scientists about to mark a sharp break with recent history and become the stars of the engineering world, commanding higher salaries than in the past and a range of enticing job prospects? Opinion derived from a survey of international nuclear institutions and academic bodies is that while these outcomes are possible, the main development is likely to be an internationalisation of the nuclear workforce centred on a cadre of professionals working to globally-accepted standards: wholly mobile where political and physical locations are concerned, and almost certainly English-speaking.

GROWING INTEREST

Professor Ian Hutchinson, head of the department of nuclear science and engineering (NE) at the Massachusetts Institute of Technology (MIT) said that while there are "great concerns in the nuclear industry as to whether they will have enough students, there are encouraging signs at the undergraduate level of a resurgence of interest among young undergraduates at all the major US nuclear programmes." This interest is increasing by a factor of two or three "and that's very encouraging," he told *NEI*, though he admitted that the same pattern was not being shown at the graduate level.

"One of the reasons is that the number of graduates that any of our departments can accept is largely constrained by the amount of financial aid that is available, and that in turn is constrained by how much research funding is available," he said. In the USA there has been a slight increase in nuclear engineering-related masters, of around 20% in the past five years but almost no increase in PhD levels. "Here at MIT we are predominantly a graduate department with just over 100 graduates doing masters and PhDs together, and about 50 undergraduate students," he said.

"Is there growing interest in nuclear science as a career? If the interest shown by undergraduates is anything to go by, yes there is," said Hutchinson. This was driven by a number of factors "but they include the fact that students, who are a leading indicator of opinion in society, think that nuclear power is important and has an important contribution to make to the challenges we face in energy and to the realisation that there are a lot of good jobs out there. I also think that interest in energy generally is a factor. In the USA at any rate there has been something of a swing back away from computing and IT-related professions and talented maths and science graduates are turning back to industries like nuclear."

Hutchinson said that China was "obviously a place where they're educating vast numbers of engineers, including nuclear engineers." But, he continued, "I think the important thing to recognise is that the nuclear industry is very much globalised and no country is going to be isolated by calling on just its own population for the expertise it requires. That's as much true in China as it is in Europe or the USA."

UNITED STATES

Earlier this year the magazine *US News & World Report* rated the MIT as the number two nuclear engineering graduate school in the USA, after the University of Michigan-Ann Arbor. Others in the top 10 included Texas A&M University, Pennsylvania State University and the University of California-Berkeley. In all, there are around 40 recognised nuclear engineering (NE) programmes running in US colleges and universities at present, turning out around 180 qualified nuclear scientists each year.

Some surveys put the numbers somewhat higher than this but there is general agreement that NE education in the USA is currently running at about half the levels of 30 or so years ago. This reflects the retrenchment in the nuclear energy industry caused in large part by the turn-off in public opinion after the Chernobyl and Three Mile Island disasters. The Nuclear Regulatory Commission (NRC) for instance has said there are now only 24 research and test reactors run by universities in commission today, down from almost twice as many in the 70s, mainly because of the fall in student enrolment over this period.

Now the wheel appears to have turned full circle. "Most NE departments in the USA are at capacity with regard to enrolment," said Professor Lee Dodds, head of NE at the University of Tennessee, regarded as the leading nuclear engineering school in the American southeast. "Nuclear engineering has become a very popular major in the last few years. What we need now are more resources such as faculty and space, to handle the increase in enrolment."

Detailed information on NE in the USA is published annually by the American Nuclear Society's education and training division where the main criterion for school listing is that the graduate nuclear engineering programme "have at least two full-time faculty or six full-time graduate nuclear engineering students." The Nuclear Energy Institute in the USA publishes a more comprehensive list of schools specialising in the field under geographical headings, and both associations (and many others) give extensive practical advice on applying for courses, scholarships and other aspects of NE study.

Much of the experience in the USA – both in the relative unpopularity of NE as a career choice over the past 30 years and in its sudden re-emergence today – is repeated in other countries, though there are often special factors at work arising from overall governmental policy towards nuclear energy. This is especially so in countries that took the nuclear route many years ago and have embraced it fully, so that NE is a conventional career option in France and Japan and, more recently, in China.

EUROPE

In Europe, opinion has been divided and there is yet to appear an enthusiasm for NE qualifications on the scale of that in the USA. Back in the year 2000 when the European Union's 'Lisbon' policy of promoting hi-technology was conceived, NE was considered "a matter for concern," according to the OECD (Organisation for Economic Cooperation and Development). The number of nuclear scientists and technologists "may appear to be sufficient today (but) in some countries there are indicators that future expertise is at risk. In most countries, there are now fewer comprehensive, high quality nuclear technology programmes at universities than before. The ability of universities to attract top quality students, meet future staffing requirements of the nuclear industry, and conduct leading-edge research is becoming seriously compromised," said the OECD.

That judgement is probably just as true today but, unlike in the USA, there is no up-to-date source of useful statistics. "We're preparing a technical report, *Status and Trends in Nuclear Education*, which will be the first proper global picture though it will not be out until next spring," said Yanko Yanev, head of the Nuclear Knowledge Management department of the International Atomic Energy Agency (IAEA). "I'd say there were less than 200 nuclear engineering graduates per year in the USA and this is probably as much as all the European universities can produce. Besides France and the UK there are quite a number of engineering specialists in Eastern Europe, mainly Russia, the Czech republic, Romania. These countries are currently running nuclear power plants and nuclear engineering qualification is reasonably well established. But of course they have a lot of problems," he said.

One of these is the popular perception of the nuclear profession "which is still not high, although in terms of finding good, well paid jobs it's reasonably attractive compared to civil engineering," he said. Yanez mentioned in particular the negative attitude taken by Germany. "There have been five or six zero years in which nobody was getting a diploma in the nuclear industry, but Germany is going to need these engineers at the minimum for 60 to 70 years, regardless of whether they stop nuclear power. They still have to operate, still have to decommission and they have been creating a generation gap for themselves."

Yanez said the UK was not so badly placed because of initiatives taken by BNFL and Manchester and Liverpool universities. However, he noted that 30 or 40 years ago the UK had close to 10,000 people involved in nuclear activities including research and development, "and now it's shrunk to only several hundred."

Elsewhere the Chinese and the Indians were producing large numbers of nuclear specialists "but these specialists in China are more or less for China," he said. "The Indians are in a better position, as long as they are English-speaking. They can be marketed globally much more easily." In France, where nuclear has had a consistent 75-80% share of electricity generation, people knew it was a profession where they would find a job and have a reasonable career with good pay.

Among the world's best colleges identified by the IAEA were MIT and Texas A&M in the USA, the two British ones and the French atomic energy commission's (CEA's) Institut National des Sciences et Techniques Nucléaires (INSTN), he said.

Yanez praised the European colleges for being "extremely cooperative in creating the European Nuclear Engineering Network (ENEN) and agreeing a common curriculum and common system of point transfer so that you can study in France and complete in Hungary and vice versa." But this kind of collaboration was far more difficult in Asia, Africa or Latin America where there were political borders and "intolerance" between countries. For this reason the IAEA was now actively trying to promote 'cyber-learning'. "If the physical borders are a real obstacle we can probably work through the web and make sure that the students in Vietnam, for instance, get the same quality educational materials as students in other places," Yanez said. This approach is being pushed by MIT through its OpenCourseWare (OCW) initiative – a free publication of MIT course materials "that reflects almost all the undergraduate and graduate subjects taught at MIT."

A full list of colleges and universities providing nuclear engineering courses in Europe is available through ENEN, which lists 28 "effective members" in 16 European countries plus 18 associated members which have NE interests but do not run programmes. Similar lists for the USA are accessible through the Nuclear Energy Institute among others, and in Asia through the Asian Network for Education in Nuclear Technology (ANENT). A central contact is the World Nuclear University (WNU), which serves to strengthen nuclear education and build future leadership in nuclear science and technology.