THE ASIAN NETWORK FOR EDUCATION IN NUCLEAR TECHNOLOGY (ANENT)

F. Amin
Malaysian Institute for Nuclear Technology Research (MINT), Malaysia

R. B. Grover
Bhabha Atomic Research Centre (BARC), India

K. W. Han
Korea Atomic Energy Research Institute, The Republic of Korea

Email address of main author: fatimah@mint.gov.my

Abstract. The per capita electricity availability in the Asian region is below the world average. Nuclear energy is considered by several countries in the region as a potential source to meet their growing energy demand. Thus, there is likely to be an expansion of nuclear power programme in the Asian region. Additionally, as the economies in the region expand, there will be an increasing role for isotope and radiation technologies in the health care, agriculture, and industrial sectors. The growing demand for power and non-power applications of nuclear technologies would require a sustainable supply of well-qualified nuclear workforce. The Asian Network for Education in Nuclear Technology, ANENT in short, was established in February 2004 in response to this need. The state of nuclear education in the region is at different levels in different countries. This diversity provides an opportunity for sharing of knowledge and resources. ANENT will facilitate cooperation in education, related research and training through: (i) sharing of information and materials on nuclear education and training; (ii) exchange of students, teachers and researchers; (iii) establishment of reference curricula and facilitating mutual recognition of degrees; and (iv) facilitating communication between ANENT member institutions and other regional and global networks. By focusing on education, ANENT complements existing activities undertaken by the International Atomic Energy Agency (IAEA) and supports IAEA activities for the preservation of nuclear knowledge. ANENT is a comprehensive initiative in education and training in that it will give equal importance to power and non-power technologies, thus meeting the diverse needs of the countries in the Asian region.

Introduction

Demand for energy (including electricity) has been increasing more rapidly in developing Asian economies than anywhere else in the world. In meeting this rising demand, these countries must address two main issues namely, the growing concern with global warming and the enormous capital requirements for energy generation. Nuclear power is a strong option to meet the growing energy demand since it produces no greenhouse gases and well-run nuclear power plants are currently the least-cost source of electricity in several countries (WNA,2002).

Today, the greatest expansion in the nuclear industry is seen in the Asian region. The two most populated countries in Asia namely, China and India are pursuing ambitious plans for their nuclear industries and together account for 11 out of 32 nuclear power plants under construction worldwide (IAEA, 2003). China plans to quadruple its nuclear capacity to 36,000 MWe by 2020 (WNA, 2004).

One major obstacle towards realizing these ambitious plans could be the shortage of nuclear workforce. Expansion in the nuclear industry requires a sustainable supply of qualified and experienced workforce to ensure a high level of safety and performance as well as the

generation of new and innovative technologies. The root causes of some nuclear incidents of recent years can be traced to inadequate education and training of operators. The demand for manpower is not confined to the operation of nuclear power reactors but also for increasing the application of nuclear technology in agricultural production, healthcare and industrial processes.

An emerging problem facing the nuclear industry today is the erosion of valuable knowledge accumulated over several decades. A study conducted by the Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development (OECD) on nuclear education and training draws attention to several worrying trends (OECD/NEA, 2000). The study found the number of universities offering nuclear programmes on the decline, a 10 percent decrease in the number of degrees awarded between 1990 and 1998 and a decline in enrollment. Nuclear education programmes in many OECD member countries are at risk of further deterioration due to ageing faculty members (average age is 48 years) and few recruitment of young faculty members. While the situation in Asian countries is not as critical as that in Europe, this issue of sustainable supply of nuclear scientists and engineers needs urgent attention if nuclear power is to be a viable option for meeting the needs of increasing energy demand and if nuclear technology applications in the non-power sectors is to be further exploited.

Several countries in Asia have taken proactive measures to address the human resource issue. One of the measures is to consolidate nuclear education programmes through the establishment of networks such as those in Japan and the Republic of Korea. As a region, the Asian countries have come together to establish the Asian Network for Education in Nuclear Technology, in short ANENT, to promote, manage and preserve nuclear knolwedge and to ensure the continued availability of talented and qualified human resources in the nuclear field.

Status of Nuclear Education and Training in Asia

The development of educational and training programmes in nuclear science, technology and engineering follows closely the development path of the national nuclear power and nuclear technology application programmes. The countries in the Asian region are diverse with respect to the development of these programmes. Countries with nuclear power programmes include Japan, the Republic of Korea, India, China and Pakistan. Several developing countries such as Vietnam and Indonesia have plans to introduce nuclear power programme in the near future. Nuclear power programme was initiated in the 1970s in the Philippines but the first nuclear power plant had been mothballed due to a change in the political climate and strong anti-nuclear sentiment. Applications of nuclear technology in the non-power sector namely, agriculture, health care, manufacturing and construction are common in most countries but the level of penetration is still below optimum in many countries.

The breadth and depth of nuclear education varies from country to country depending on whether or not nuclear power programme is implemented as well as the level of experience of the nuclear industry and nuclear institutions. Countries that have large nuclear power programmes namely, Japan, the Republic of Korea and India have well established nuclear education programmes. Fourteen universities in Japan offer nuclear and nuclear related courses and six universities in the Republic of Korea offer courses in nuclear engineering. India follows a different approach whereby nuclear related courses are offered at the Bhabha Atomic Energy Research Centre (BARC) Training School and at its affiliate Training Schools. On completion of these courses, placement is offered to all successful students in the various estblishments of the Department of Energy. Several developing countries which are considering the nuclear power option such as Thailand and Vietnam have also introduced nuclear engineering programmes in the their institutions of higher education. In addition to

institutions of higher education, national authorities responsible for nuclear technology development, research institutions, industry and associations also provide various types of training in nuclear technology and engineering.

The approach for nuclear education and training varies from one country to another. One approach is to develop programmes in specialized disciplines such as nuclear engineering at all levels namely, bachelor, masters and doctoral degrees. The other approach is to develop programmes that are more generic for example electrical engineering or mechanical engineering with additional courses in nuclear-related subjects. In Japan, nuclear engineering courses were offered in the early years since the introduction of nuclear power programme. Since then most nuclear engineering departments have been renamed to quantum or system engineering departments following reforms undertaken during the period from 1993 to 1998 (Ishino, 2000). Nuclear engineering courses at the bachelor, masters and doctoral levels are offered by three universities in the Republic of Korea while three other universities offer courses in nuclear and energy engineering, nuclear and quantum enginering, and nuclear and systems engineering. In India, graduates in various engineering and science disciplines undergo courses in nuclear science and engineering at the Bhabha Atomic Research Centre (BARC) Training School.

The diversity in approaches in human resource development may be the result of historical or organizational factors or it may due to adjustments that need to be made to meet the changing supply- demand situation. Courses in nuclear engineering may attract students in countries where the nuclear power programme is expanding and therefore prospects for jobs are bright. On the other hand, in countries where there is minimal growth in the nuclear power programme, it may be more prudent to offer generic rather than specialized courses especially at the undergraduate level.

It may be argued that the “dilution” of nuclear engineering and nuclear science and technology courses may have adverse effect on the long-term supply of qualified nuclear scientists and engineers. This is because the disappearance of nuclear engineering and nuclear science departments may affect the justification for maintaining or replenishing critical facilities such as research reactors. This in turn may adversely affect research and development (R&D) activity which is an important activity that will attract young faculty members. Training of young scientists and engineers from the developing countries may also be adversely affected by the discontinuation of nuclear engineering programmes in the more developed countries since developing countries would need the assistance of developed countries while their training programmes and facilities are being developed.

Addressing the Issue of Nuclear Education and Training through ANENT

A network arrangement among nuclear institutions is a potential option to address the diverse needs for capacity building in the nuclear field. The Asian Network for Education in Nuclear Technology (ANENT) was officially established in Febuary 2004 following the First Coodinating Committee meeting in Kuala Lumpur, Malaysia. ANENT is open to universities, research centres, government agencies and other institutions involved in nuclear education and training. An individual institution becomes a member of ANENT through an authorized country representative’s statement at a Coordination Committee meeting or through a direct confirmation by the representative who attended the last Coordination Committee meeting. To date ANENT has 17 participating institutions as shown in Table 1. ANENT is also open to international or regional networks as collaborating members and to date three networks have joined ANENT as shown in Table 2.

ANENT operates based on the principle of cooperation for the mutual benefit of its members. The objective of ANENT is to facilitate cooperation in education, related research and training in nuclear technology through:

- Sharing of information and materials in nuclear education and training;
- Exchange of students, teachers and researchers;
- Establishment of reference curricula and facilitating mutual recognition of degrees; and
- Facilitating communication between ANENT member institutions and other regional and global networks

Table 1. ANENT Participating Institutions

Country	Participating Institution
China	Beijing Institute of Nuclear Engineering
India	Bhabha Atomic Research Centre (BARC)
Indonesia	National Nuclear Energy Agency (BATAN)
Malaysia	Malaysian Institute for Nuclear Technology Research (MINT)
Malaysia	University Kebangsaan Malaysia (UKM)
Malaysia	University Putra Malaysia (UPM)
Mongolia	National University of Mongolia
Pakistan	KANUPP Institute of Nuclear Power Engineering (KINPOE)
Pakistan	Pakistan Institute of Engineering and Applied Sciences (PINSTECH)
Republic of Korea	Korean Atomic Energy Research Institute (KAERI)
Republic of Korea	Department of Nuclear Medicine, Seoul National University
Sri Lanka	Atomic Energy Authority
Sri Lanka	University of Colombo
Thailand	Office of Atoms for Peace (OAP)
Philippines	Philippine Nuclear Research Institute (PNRI)
Vietnam	Hanoi University of Technology (HUT)

Table 2. ANENT Collaborating Institutions

Asian School of Nuclear Medicine (ASNM)
European Nuclear Engineering Network (ENEN)
World Nuclear University (WNU)

A pragmatic and stepwise approach is adopted in the implementation of ANENT activities. At the first Coordination Committeee meeting, five activities were identified for implementation during the first phase beginning in 2004 and ending with the full operation of ANENT at the beginning of 2006. The activities are:

1. Exchange of information and materials for education and training.
2. Exchange of students, teachers and researchers.
3. Distance learning
4. Establishment of reference curricula and facilitating credit transfer and mutual recognition of degrees.
5. Liaise with other networks and organizations.

The first activity implemented involves taking stock of resources and materials for education and training in nuclear technology in the Asian region. These information and materials are to be collated and placed on the ANENT website, which is expected to be fully operational by the end of 2004. The Korean Atomic Energy Research Institute (KAERI) is taking the lead in the development and later in the operation of the website. Information on the website include institutions that offer nuclear science, technology and engineering courses together with descriptions of the courses offered and facilities available. Such information would be useful to member institutions when identifying education and training programmes to fit their requirements.

For the second activity, a working mechanism will be established to support the exchange of students, teachers and researchers. There exist already such programmes in the Asian region such as those offered by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan, the post-doctoral fellowship programme offered by the Regional Cooperative Agreement (RCA) office in the Republic of Korea and cooperation programmes on a government-to-government bilateral arrangements. Member institutions are encouraged to implement the exchange of students, teachers and researchers through bilateral cooperation as a starting point for multilateral networking.

The exchange of students and teachers would be greatly facilitated with the mutual recognition of degrees and transfer of credits. Towards this end, ANENT member institutions will exchange and evaluate existing curricula and establish recommended requirements for reference curricula in nuclear science, technology and engineering. In implementing this activity, ANENT will draw upon the experience of other networks, in particular the European Nuclear Engineering Network (ENEN). Information on curricula of nuclear science, technology and engineering courses in universities and institutions in member institutions are being collated and will placed on the ANENT website.

Distance learning would be one of the main approaches used by ANENT to teach and train students and the nuclear workforce from diverse locations. Education and training materials already available will be compiled and made available through the ANENT website. ANENT will utilize whatever material already available, for example, training material produced by the International Atomic Energy Agency (IAEA) and other regional networks and associations and will only consider developing new materials where none exist.

ANENT will seek to learn from experiences of other networks already in operation such as ENEN and RCA and where appropriate collaborate with them. ANENT will serve as a facilitator to link its member institutions with other regional and global networks. At the First Coordination Committee meeting, representatives of ENEN, the World Nuclear University (WNU), the Asian Regional Cooperative Council for Nuclear Medicine (ARCCNM) and the Asian School of Nuclear Medicine (ASNM) were invited to share with ANENT member institutions their experiences in nuclear education and training.

Conclusion

The issue of the sustainable supply of qualified and well-trained workforce needs to be given serious attention for nuclear power programmes to expand to meet increasing energy needs as well as for ensuring the optimal exploitation of nuclear technology in the non-power sectors. Countries in Asia are at different levels of development and as such have different levels of knowledge and resources. Cooperation through ANENT is a viable solution towards maximising the utilization of existing education and training infrastructure in the region and would help accelerate capacity building in the developing countries. By focusing on education, ANENT complements the IAEA initiatives in the preservation of nuclear knolwedge. ANENT is a comprehensive initiative in education and training in that it will give equal emphasis to power and non-power applications of nuclear technology, thus

meeting the diverse needs of countries in the Asian region. ANENT aspires to become an important contributor towards national efforts in the development of skilled and qualified workforce that is critical for the sustainable development of the nuclear industry.

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