ABSTRACT

The Australian School of Nuclear Technology was founded in 1964 as a joint enterprise of the Australian Atomic Energy Commission and the University of New South Wales to support nuclear developments primarily in Australia. However, ASNT has developed into an important centre for nuclear science and technology training within the South East Asian Region with participants also attending from countries outside this Region.

I. INTRODUCTION

The Australian School of Nuclear Technology (ASNT) is located adjacent to the Lucas Heights Research Laboratories (LHRL), 40 kilometres south west of Sydney, New South Wales. The Lucas Heights Research Laboratories houses the Australian Atomic Energy Commission (AAEC), soon to be re-named The Australian Nuclear Science and Technology Organisation, and some specialist sections of the Commonwealth Scientific Industrial Research Organisation (CSIRO). Participants attending courses at ASNT have the opportunity to receive "on the job" training in one of these organisations within the Lucas Heights Research Laboratories.

It was recognised at the formation of ASNT that it would have a considerable advantage in having access to the major facilities of the AAEC. Normally such facilities would be beyond the capacity of a standard academic institution and therefore training programs at ASNT make full use of both the expertise of the staff and the associated laboratories, including a 10 mega-watt research reactor.

The training courses at ASNT cover a wide range of nuclear science applications, and have provided training to date for approximately 560 participants from other countries and areas representing 140 different organisations. Participants who complete courses at ASNT have the opportunity not only for attachment to the Lucas Heights Laboratories, but also in a number of other organisations within Australia including Universities, Hospitals, Government Departments and Industrial Organisations.

The School also conducts a number of Regional training courses on behalf of the International Atomic Energy Agency (IAEA) either sponsored by the Agency or by the Australian Government who provide special funds for agreed Regional courses. ASNT also provides training courses to support programs under the Regional Cooperation Agreement (RCA) or under United Nations Development Programs (UNDP).

A further program of training undertaken by ASNT is to support the IAEA by accepting IAEA sponsored fellows for training periods of up to one year duration. This training is a mix of courses at ASNT together with periods in appropriate laboratories.

II. STAFFING

ASNT has a small resident staff of lecturers and administrative personnel but have access to 46 external lecturing staff from the AAEC, CSIRO, Australian Commonwealth and State Government departments and Private Companies.

The major lecturing load is taken by the AAEC which makes available its expertise through staff from its various Research Divisions. The opportunity to use research staff and practising experts at the forefront of their respective disciplines provides ASNT with a special strength in its training programs. A special feature of training at ASNT is the small class arrangement to ensure that all participants receive personal support to complete their theoretical studies and the laboratory experiments.

Provision of residential accommodation enables the participants to support each other during the actual course programs and encourages a strong inter-relationship between participants from overseas and the Australian groups.

III. STANDARD COURSE PROGRAM

The standard program of courses at ASNT are
those which are programmed on a regular basis and repeated at the same dates once each year, which assists organisations in Australia and overseas to plan for participation in the respective courses.

Courses at ASNT aim to provide intensive instruction in the application of nuclear science and technology at the undergraduate and postgraduate levels. Courses are structured to introduce participants to a new career in nuclear science and technology, or to enlarge their knowledge of a particular area.

The basic 1987 course program at ASNT outside of the Regional Training and Bilateral programs consists of:

(a) Radiation Protection No. 10
   (2 - 27 March)
(b) Radioisotope Course for Non-Graduates No. 36
   (25 May - 19 June)
(c) Radioisotope Course for Graduates No. 33
   (20 July - 14 August)
(d) Radionuclides in Medicine Course No. 15
   (14 September - 2 October)
(e) Nuclear Techniques in Industry Course No. 4
   (19 October - 6 November)

(a) Radiation Protection Course

The objective of the Radiation Protection Course is to train personnel to the standard necessary to become Radiation Protection Officers. This training covers a wide field of organisations in Industry, Tertiary Institutions and Government Departments. The course has a strong laboratory basis to ensure the practical application of radiation protection is made familiar to the participants. It is important to train the participants to a level which allows them to undertake independent action within their organisations confident that they are capable of controlling radiation associated incidents within the framework of the external regulatory authorities.

(b) Radioisotope Course for Non-Graduates

The Radioisotope Course for Non-Graduates often has a mix of participants of graduates and non-graduates. The graduate participants in this course are generally from teaching institutions and find the extensive laboratory periods of considerable benefit for their teaching role. The undergraduates are normally technical staff who are required to support graduate staff within their respective organisations. This course is also used as a pre-requisite for non-graduates who wish to undertake the Radiation Protection Course at a future date.

(c) Radioisotope Course for Graduates

The Radioisotope Course for Graduates attracts participants who are preparing to enter a new career direction or are already engaged in research activities involving radioisotopes. This particular course is of a very intensive nature and it is important that the graduates have some background in the appropriate disciplines in order to achieve the award of a certificate of competence.

(d) Radionuclides in Medicine Course

The Radionuclides in Medicine Course is directed to a fairly wide field of expertise which illustrates the particular nature of nuclear medicine. The areas of radiochemistry, electronics, computers and medicine are drawn together to provide the medical specialist with the facility to make clinical analysis of a variety of conditions affecting his patients. Nuclear Medicine in Australia has developed through the Public Hospital System and hence the strength of this branch of medicine occurs within that structure.

This course has been arranged as two courses in parallel to overcome the difference in expertise which normally exists between the Overseas and Australian participants. Generally the Australian participants have a strong degree of proficiency in some area of nuclear medicine and therefore has a distinct advantage to the Overseas participant. For this reason the Overseas participants commence the course one week prior to the local participants and continues for one week beyond the period of the Australian participants. Further, the Overseas participants then continue training for a further six weeks to make the total length of the course eleven weeks. The course is accredited to the Royal College of Australian Physicians as satisfying part of the overall training needs of a nuclear medicine physician.

(e) Nuclear Techniques in Industry Course

The Nuclear Techniques in Industry Course provides specialist training in the industrial application of radioisotopes. These applications cover steel mills, chemical plants, coal preparation and monitoring etc. In addition, a significant amount of radioisotope tracer work covering tidal effects, sand movements, erosion etc. is included in the course.

This course has a special five weeks field work as part of the overall eight week course.

IV. SPECIALIST COURSES

Other courses offered at ASNT are specialist courses in:

(i) Nuclear Materials Safeguards
   (once per year)
(ii) Nuclear Science for Science Teachers
   (three per year offered)

(iii) Nuclear Techniques in Coal Preparation
   and Utilisation
   (on demand)

(iv) Use of Tritium in Oil Exploration
   (on demand)

(v) Reliability Engineering for Practicing
   Engineers and Managers
   (on demand)

V. REGIONAL TRAINING

A. Courses
   In addition to the standard program of courses ASNT coordinates and conducts a number of Regional Training Courses for the IAEA.

The most recent courses include:

(i) Workshop on the Commercialisation of Ionising Energy Treatment of Food
    May 1985
    (In conjunction with the AAEC and Australian Industry)

(ii) Hospital Radiopharmacy
    October 1985
    (In conjunction with the AAEC, Royal Prince Alfred Hospital, Sydney and the Sir Charles Gairdner Hospital, Perth)

(iii) Nuclear Techniques in Health Related Environmental Research and Monitoring
    May 1986
    (In conjunction with the CSIRO; AAEC, Division of Water Research; Northern Territory Department of Mines and Energy, Darwin; Ranger Uranium Mines, Jabiru, Northern Territory; and the Office of the Supervising Scientist, Jabiru, Northern Territory)

(iv) State Systems of Accounting for and Control of Nuclear Materials
    June 1986
    (In conjunction with the AAEC Australian Safeguards Officer and the Ranger Uranium Mines, Jabiru, Northern Territory)

In some cases the courses are fully funded by the IAEA and in others the funding is part of an additional Australian contribution to the IAEA. In the particular case of the Food Irradiation Workshop the Australian Government agreed to fund a three year program in the Region to assist in the application of the food irradiation technique.

B. Bilateral Programs

Australia, through the AAEC, has long been involved with the provision of training in the peaceful application of nuclear science on a bilateral basis. This involvement requires the training aspects to be undertaken by ASNT.

The most recent program of bilateral technical cooperation involved the training of approximately 50 staff from a National Atomic Energy Agency within the Region.

Further bilateral programs are under discussion. These programs cover training at ASNT and technical cooperation with the AAEC.

C. Full Academic Training

ASNT has the capacity to provide bridging courses in the physical sciences to enable participants from other countries and areas to prepare for entry into higher degree studies in Australia at the major tertiary institutions.

In the field of nuclear science and technology it is important that developing countries maintain and develop their research expertise to support the national goals set for the use of nuclear technology.

One important aspect necessary to achieve these objectives is to ensure a cadre of scientists and engineers have the opportunity to undertake higher degree studies. However the key to satisfying this objective is to ensure that the tertiary institutions to which the participants are enrolled are of the calibre capable of producing post-graduates who will be able to undertake fundamental research responsibilities in their own countries and areas.

To achieve this standard of research the necessary conditions are:

(i) sufficiently high academic standard for entry to the respective higher degree.

(ii) a post-graduate course at an internationally recognised tertiary institution (home or overseas).

For a number of developing countries the increasing number of graduates at their own tertiary institutions has brought particular pressure on the graduates in the physical sciences. One of the natural consequences of this pressure which is well understood by developed countries who themselves have had to cope with similar problems, is to inhibit the attainment of the necessary laboratory skills of the students. Laboratory equipment is expensive and requires constant maintenance, a problem faced by all institutions teaching the physical sciences. Under previous student intake the amount and quality of the laboratory equipment could be satisfactory but with increasing numbers there is not necessarily a corresponding increase in equipment. The result is a graduate with a lack of sufficient independent laboratory skills to support his particular discipline. Such graduates are at a considerable disadvantage when studying for higher degrees at an overseas institution where the laboratory skills of the
host country's students have been developed from their final two years of secondary school through at least three years of undergraduate study.

It is this feature to which ASNT directs a large proportion of its bridging courses for entry to higher degrees. A high standard of entry provides the student with a greater opportunity for a higher standard of achievement at the completion of the course which is the pathway to future research scientists and engineers necessary for the exploitation of the nuclear technology.

VI. EVALUATION OF STUDENTS PERFORMANCE

In providing courses in the peaceful applications of nuclear science under an intensive teaching pattern it is important to make an evaluation of the efficacy of the whole process.

Transfer of technology by means of intensive training courses is becoming a standard requirement within developed countries where industrial patterns change and manpower demands result in a new direction for the local work force.

The level of knowledge necessary to become proficient in a particular scientific discipline is related to the education levels of the personnel and the relative scientific needs of the new discipline. In the case of courses at ASNT the direction can be readily identified which results in a number of basic courses to cater for the major needs of the nuclear science applications.

Participants are graded at ASNT in relation to their performance in laboratory experiments and the theoretical material provided during lectures. In order to ensure the participant is not "lost" during training the staffs are conscious of problems which might develop during the first few days of the course. In the type of intensive training conducted at ASNT, the first 3 - 5 days are seen as critical to the integration of the participant to his classroom surroundings and responses to the lectures and practical tests.

A number of factors must be taken into account in providing true statistical data on performance problems under intensive training conditions where the student is required to produce a performance index continuously throughout the course.

Whilst there appears to be little formal information available for this type of teaching climate ASNT is developing a number of review procedures which will be tested in an effort to increase the available data in this important educational area.

VII. CONCLUSIONS

ASNT has for over twenty years conducted intensive courses in a number of related disciplines in the peaceful applications of nuclear science and technology. A significant element supporting ASNT's role in the Region is the dominant value of the English language which is the national language of Australia.

A large proportion of scientific knowledge in the Developed countries is recorded in the English language. This fact encourages a number of developing countries to undertake training in English speaking countries for their educational needs in nuclear science and technology. Australia is well placed because of its position in the Region to provide such training both because of its language and its high educational level throughout the primary, secondary and tertiary educational institutions.

Further, there is a strong government policy in Australia to provide technical assistance to countries within the South East Asian and Pacific Regions.

A large number of participants from other countries and areas attending courses at ASNT are sponsored by the Australian Development Assistance Bureau, an Agency of the Department of Foreign Affairs.

Table 1 is a list of the different countries and areas which have provided participants to the School of Nuclear Technology. One of the most satisfying aspects of the School's operation is the success rate of the participants which supports the School's basic policy to limit class sizes to a maximum of twenty participants in order to provide strong personal support to each individual.

Since courses were first offered in 1965 some 1750 people have attended the School, of which approximately 1200 have been Australian. A graphical summary of the statistics and participants since 1972 is given in Figure 1.

The School looks forward to an increasing role in the future of the Region and is confident that the achievements of the past participants will encourage even greater use of ASNT for training in the Region.
<table>
<thead>
<tr>
<th>Overseas Nations and Areas Represented</th>
</tr>
</thead>
<tbody>
<tr>
<td>On ASNT courses</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>Bangladesh</td>
</tr>
<tr>
<td>Barbados</td>
</tr>
<tr>
<td>Burma</td>
</tr>
<tr>
<td>China (People's Republic of)</td>
</tr>
<tr>
<td>Fiji</td>
</tr>
<tr>
<td>Ghana</td>
</tr>
<tr>
<td>Guyana</td>
</tr>
<tr>
<td>Hong Kong</td>
</tr>
<tr>
<td>India</td>
</tr>
<tr>
<td>Indonesia</td>
</tr>
<tr>
<td>Iraq</td>
</tr>
<tr>
<td>Iran</td>
</tr>
<tr>
<td>Jamaica</td>
</tr>
<tr>
<td>Japan</td>
</tr>
<tr>
<td>Jordan</td>
</tr>
<tr>
<td>Korea (DPR)</td>
</tr>
<tr>
<td>Korea (Republic of)</td>
</tr>
<tr>
<td>Lesotho</td>
</tr>
<tr>
<td>Malaysia</td>
</tr>
<tr>
<td>Mauritius</td>
</tr>
<tr>
<td>Mexico</td>
</tr>
<tr>
<td>New Zealand</td>
</tr>
<tr>
<td>Nigeria</td>
</tr>
<tr>
<td>Pakistan</td>
</tr>
<tr>
<td>Papua New Guinea</td>
</tr>
<tr>
<td>Philippines</td>
</tr>
<tr>
<td>Singapore</td>
</tr>
<tr>
<td>Sri Lanka</td>
</tr>
<tr>
<td>Sudan</td>
</tr>
<tr>
<td>Syria</td>
</tr>
<tr>
<td>Taiwan, China</td>
</tr>
<tr>
<td>Tanzania</td>
</tr>
<tr>
<td>Thailand</td>
</tr>
<tr>
<td>Vietnam</td>
</tr>
<tr>
<td>Western Samoa</td>
</tr>
<tr>
<td>Zambia</td>
</tr>
<tr>
<td>Zimbabwe</td>
</tr>
</tbody>
</table>
FIGURE 1

ASNT COURSE STATISTICS

Origin of students
Australia
Other Countries and Areas

Number of Courses per year

Number of Students Graduated per year

Year

1986-227

72 74 76 78 80 82 84 86

72 74 76 78 80 82 84 86

72 74 76 78 80 82 84 86

723