Training in support of radiation technology

A variety of specialized courses have proved effective for transferring skills and technology

by Vitomir Markovic

Technical personnel and skills are esssential for the successful transfer of technology and implementation of industrial projects, at any level in any country. Technical knowledge plays a significant role in all phases of project development, starting from project recognition or identification of a project opportunity, through different pre-investment and investment phases, and through the operational period. Although the transfer of radiation technology is not different from other technology transfer, opportunities for training may vary considerably from country to country due to the highly specialized type of training required.

Academic education and research in fundamental and applied radiation chemistry is declining in most industrialized countries, despite the fact that the radiation processing industry continues to grow. This was a major conclusion of an advisory group meeting sponsored by the IAEA in the USA in 1987. While most universities provide basic knowledge in related sciences, on-the-job training and training through research are the main mechanisms of producing specialists necessary for the radiation processing industry. A similar situation exists in most developing countries, except that the opportunities for on-the-job training are scarce or non-existent.

This is partly because the present demand cannot justify the introduction of special academic curricula on radiation technology. More important, however, is the general lack of related courses in standard programmes in areas such as chemistry, chemical engineering, and material sciences, with photochemistry or radiochemistry, for example. This leaves future scientists, engineers, and managers without a fundamental awareness of the benefits and opportunities of radiation processing applications in industry.

Specialized training activities

The Agency works to address the need for specialized training in developing countries, through technical cooperation projects and assistance in building up infrastructures in support of nuclear power programmes. Executive management seminars (EMS), training courses, individual fellowships, and expert missions are the principal components.

The first two types of activities (group training) will be discussed here in some detail, focusing on recent activities.

Executive Management Seminars. They are generally organized at the national level. The Agency assists in the preparation of the programme and supports the participation of key guest lecturers with significant scientific and industrial experience. The local counterpart is responsible for its organization, announcement within the country, selection of participants, and any local costs involved.

The seminars are meant to promote radiation technology and to initiate industrial projects and technology transfer. Participants come from medium- and high-level management, representing industry, end-users, research organizations, academia, and national atomic energy authorities. The programme consists typically of one-and-a-half-day lectures, with sufficient time left for discussions, and a half day allotted to round-table discussions on topics such as the feasibility of industrial radiation projects.

A number of these seminars have been organized or planned in different countries on various subjects, mainly within the framework of the IAEA/UNDP Regional Co-operative Agreement (RCA) for Southeast Asia and the Pacific on "Industrial Applications of Isotopes and Radiation". They include:

- "Industrial radiation sterilization of medical products" (Thailand, Sri Lanka, Republic of Korea, Malaysia, People's Republic of China, Pakistan, all in 1986; Philippines and Indonesia — planned for 1988).
- "Industrial radiation curing technology" (Malaysia, Thailand — 1986; Indonesia, Pakistan, People's Republic of China, Sri Lanka — 1987).
- "Radiation crosslinking applications in the wire and cable industry" (India and Republic of Korea — 1987; People's Republic of China and Pakistan — planned for 1988).
- "Review of industrial radiation processing" (Bangladesh — 1988).

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Lecturers and participants at the National executive management seminar on industrial radiation sterilization of medical products held in Beijing, China, from 10–12 September 1986.

National seminars were also held on industrial radiation sterilization in Bulgaria (1986) and Zambia (1987).

Between 20–80 participants have attended each seminar. Participants agreed in general that the seminars contribute significantly to the awareness of benefits and problems associated with the transfer and application of radiation technology, even in countries where transfer had already taken place to a certain extent. Feedback was positive and provided valuable input for further programming of Agency training activities.

Training courses. These are directed towards technical personnel involved in the identification and implementation of radiation technology projects. In this sense, the training course is partly promotional and partly oriented towards technology transfer. However, within the time limits of a typical training course, the knowledge imparted, though sufficient for planning and management of an industrial project, may not be sufficient for in-depth understanding of all aspects of the technology (individual fellowships and expert missions provide this dimension of training).

Training courses are usually programmed for a 2–4 week period, or a total of 80–160 hours of intensive training, approximately equivalent to an average full semester academic course. Typically, 15–20 participants from all regions take part in these training courses.

The interregional training course on "Radiation technology and engineering" was held in Budapest, Hungary, in 1986 and again in May 1988. The emphasis of the 4-week training course is on well-established radiation applications: sterilization of medical supplies, radiation curing, and crosslinking applications. The engineering aspects, including process control, are also covered for both gamma and electron beam facilities. The 106 hours of this course are divided into lectures (40%); classroom exercises (6%); laboratory exercises (20%); technical visits to industrial installations and demonstration of technology (22%); and tutorial sessions (12%).

Regional training

The previously mentioned regional project on "Industrial applications of isotopes and radiation" has provided an excellent ground for the development of training activities in Asia and Pacific countries. The project was initiated by Member States from Asia and the Pacific with support from the Agency, UNDP, Australia, and Japan. The focus of activities has been on well-established industrial applications (sterilization, curing, crosslinking), and on one of the developing areas of special interest to the region — radiation vulcanization of natural rubber latex.

Training centres on different technologies have been established throughout the region, through Agency, UNDP, and participating Government support:

- Industrial radiation sterilization (India, Republic of Korea, Thailand)
- Radiation curing (Indonesia)

- Radiation crosslinking (People's Republic of China)
- Radiation vulcanization of natural rubber latex (Indonesia, Japan)
- Radiation engineering (India, Japan).

Training activities organized within the region were based, to the extent possible, on actual interest and needs. During the first phase of the project, general introduction training courses were held.

A training course on "Radiation sterilization of medical products" was jointly organized by the Bhaba Atomic Research Centre (BARC), India, and the Korean Atomic Energy Research Institute in the Republic of Korea. Three courses (three weeks each) were held in 1983, 1984, and 1986. The purpose was to provide basic training and knowledge about radiation technology for the sterilization of medical products. Thirty-seven participants from the region attended. The training was primarily designed to assist potential users of this technology in project planning and implementation.

Further, through feedback and interactions at executive management seminars, as well as training courses, it was realized that the status of development in the region requires a more in-depth and more specialized type of training. Subsequently, two types of training courses were prepared and are being executed on the subject of radiation sterilization:

- "Radiation sterilization — quality control and sterility assurance" (2-week training course, Bangkok, Thailand, one organized in 1987 and one scheduled for early 1989)
- "Radiation sterilization — quality control and compatibility of materials" (2-week training course, BARC, Bombay, India, one organized in 1987 and one scheduled for 1988).

These training courses are more oriented towards actual users of technology, with the objective of upgrading quality control standards to the level of the most advanced industrial practice.

Other introduction training courses organized include:

- "Radiation crosslinking applications in wire and cable industry", 3-week training course (People's Republic of China, 1985, 1986, and 1988)
- "Radiation curing applications" (Indonesia, 1984, 1985, 1986)
- "Radiation engineering — electron beam facilities", 2-week training course (Japan, 1987)
- "Radiation engineering — gamma radiation facilities", 2-week training course (India, 1988).

The Agency's training courses potentially provide a powerful mechanism for supporting and supplementing standard academic curricula in developing countries by providing specialized training in subjects related to different aspects of radiation technology. A particularly efficient way to achieve this is through regional co-operation programmes. This has been demonstrated by the regional project in South Asia and the Pacific, in which, for the period 1982–1988, more than 200 persons were trained and an appreciable transfer of technology was intiated. *(See accompanying box.)*

In the future, it is conceived that this level of activity will reach other regions as well, in accordance with actual needs. Further, the publication of training guidelines, manuals, and course materials supports training at the national level and becomes a basis for the development of learning materials applicable to all Member States.

Technology transfer in industrial radiation processing in Southeast Asia and the Pacific

- ***Radiation sterilization of medical products***
  Commercial facilities are in operation in India, Republic of Korea, Malaysia, Singapore, Thailand, Pakistan, People's Republic of China.
  They are in the planning or construction stage in Bangladesh, People's Republic of China, Malaysia, Indonesia, India (2).
- ***Radiation crosslinking in the wire and cable industry***
  Commercial facilities are in operation in the Republic of Korea (3) and People's Republic of China (3).
  They are in the planning or construction stage in India (2) and Pakistan (1).
- ***Radiation curing***
  A demonstration facility is operating in Indonesia.
- ***Radiation vulcanization of rubber latex***
  A demonstration facility is operating in Indonesia.