# Training scientists from developing countries

*Since 1959, the IAEA's programme of training courses has grown considerably*

**by Peter Schultze-Kraft**

Only 2 years after the IAEA's foundation, the Agency's first training course was held at Cornell University in Ithaca, New York, marking the programme's beginnings. Conducted from 20 July to 10 September 1959, the course focused on the subject of radioisotope techniques in agricultural research. It was organized with a budget of US $14 000 and attended by 18 participants.

Since then, thousands of scientists have participated in IAEA courses held around the world. From the beginning, developing countries have played a prominent role in the programme: Out of the first 26 courses, held between 1959 and 1963, sixteen were hosted by developing countries and 10 by industrialized countries.

The programme has experienced a vigorous expansion over the years. Between 1976-86, the number of annual training courses rose from 9 to 71. Of the 71 courses in 1986, 33 belong to the Agency's regular programme of technical co-operation (including one study tour financed by the United Nations Development Programme — UNDP); 7 were organized within the UNDP project on non-destructive testing (NDT) in Latin America; and 16 and 15, respectively, were part of the RCA and ARCAL training schemes.* In 1986, most courses, namely 51, were hosted by developing countries; 19 were held in industrialized countries.

Mr Schultze-Kraft is Section Head for Training Courses in the IAEA's Division of Technical Assistance and Co-operation.

### Types of courses

The Agency offers interregional, regional, and national training courses. Interregional training courses, which are open to candidates from more than one geographical region, call for worldwide participation in

* RCA is the acronym for the IAEA's Regional Co-operative Agreement for Research, Development, and Training Related to Nuclear Science and Technology for Asia and the Pacific. ARCAL is the acronym for the IAEA's regional programme in Latin America and stands for Arreglos Regionales Cooperativos para la Promoción de la Ciencia y la Tecnología Nucleares en América Latina.

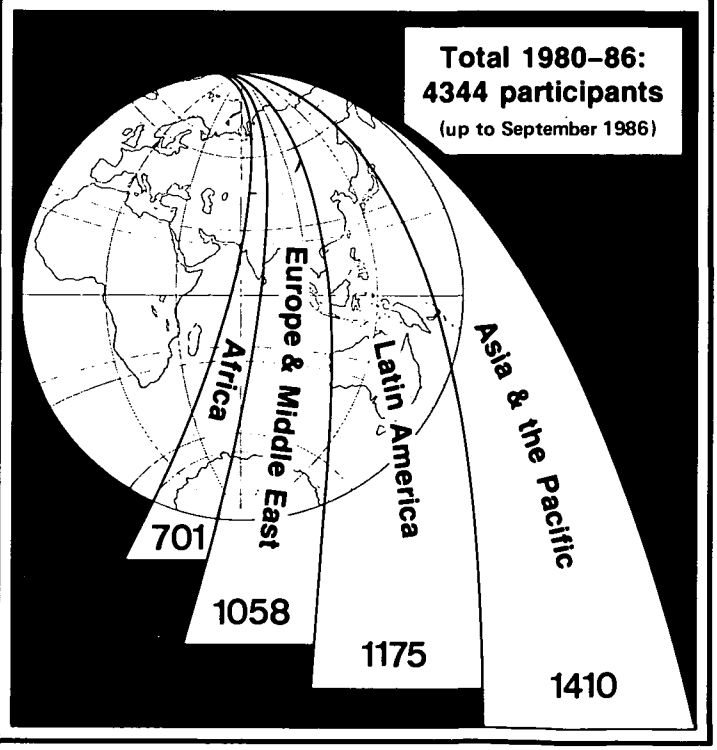
**Training course participants:**

**Where they come from ...**

More than 4000 scientists from developing countries have studied in IAEA training courses around the world between 1980 and September 1986: 3399 scientists attended interregional courses, while 945 others studied in regional ones. Participants came from countries in Asia and the Pacific, Latin America, Europe, the Middle East, and Africa (see figure). Overall during this period, there were more than 9200 applicants for the Agency's regional and interregional training courses covering 10 general fields of study in nuclear energy and its applications.

**... and what they study**

From 1980–86, most regional courses focused on the application of isotopes and radiation in industry and hydrology. In interregional courses, most participants studied topics relating to four areas: nuclear engineering and technology; safety in nuclear energy; general atomic energy development; and the application of isotopes and radiation in agriculture. Other areas of study were nuclear physics; nuclear chemistry; prospecting, mining, and processing of nuclear materials; and the applications of isotopes and radiation in medicine or biology.



At the IAEA's Seibersdorf Laboratories, an Agency expert briefs scientists during an interregional training course in plant breeding.

most cases. Regional training courses — for participants from one geographical area only — achieve a greater homogeneity among participants and allow for the study of certain techniques in an environment similar to that in which they will be applied. In a national training course, the idea is that one or several experts will address and teach a whole group, as opposed to a one-on-one basis, mostly in connection with a technical co-operation project. (National training courses must be requested, and are administered, like technical co-operation projects. They are handled by the IAEA's area office concerned and not by the training courses section.)

### Programming procedure

The Agency's programme of interregional and regional training courses is set up by the training course programme committee. This committee consists of the four area officers, and the heads of sections for programme co-ordination, fellowships, and training courses. It is chaired by the Director of the Division of Technical Assistance and Co-operation. This committee meets several times each year between March and May to consider all training course proposals received from the Agency's technical divisions and from interested Member States. In the case of courses on nuclear power and safety, the recommendations of the Nuclear Power Training Advisory Committee are also taken into account. This is a body composed of representatives of host countries, as well as of the IAEA's Departments of Nuclear Energy and Safety, and Technical Co-operation. Once the training course programme committee has chosen the subjects to which it gives highest priority, the chairman forwards the list to the Deputy Director General in charge of the Department of Technical Co-operation who in turn will submit it to the Director General for approval.

### Criteria for selecting subjects

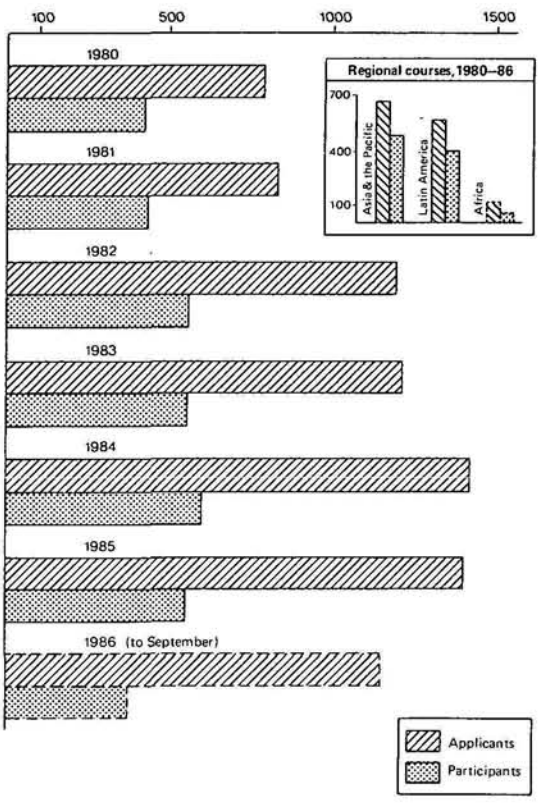
The main criterion for selection of a training course subject is the existence of a training need in a given field in the recipient countries. Member States' training requirements are best known to area officers, who are in constant direct contact with countries in the region of their responsibility. Therefore, their judgement is decisive in the programming process.

Another criterion is the number of applicants for earlier courses in a given subject. Also, linkage to nominating countries' development plans and to technical co-operation projects is an important factor. At the moment, about one-third of the Agency's "regular" training course programme is devoted to nuclear power and safety, one-fourth each to physical sciences and agricultural applications, and the remainder to other fields.

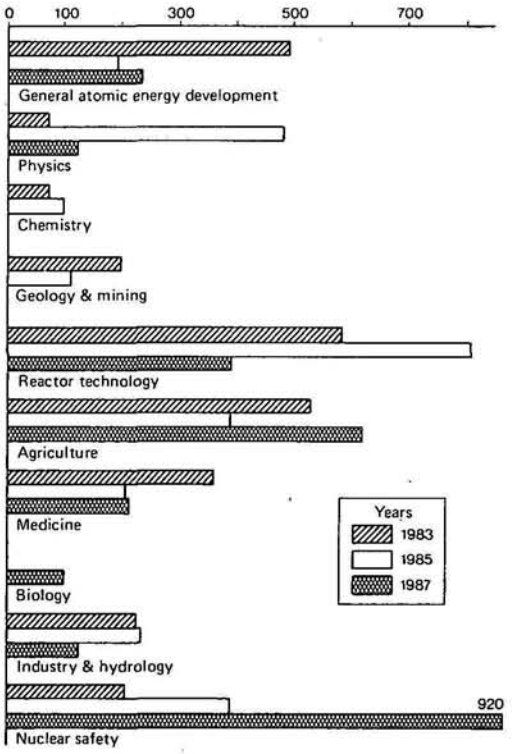
### Course fields

The fields in which courses are offered comprise the whole spectrum of subjects in which the Agency has been given responsibility, starting with nuclear legislation and regulatory aspects and ending with specialized subjects of reactor technology and decommissioning. *(See accompanying charts.)*

**Applicants/participants in interregional training courses, 1980–86**




**Training course expenditures by general field**
(thousands of US dollars)



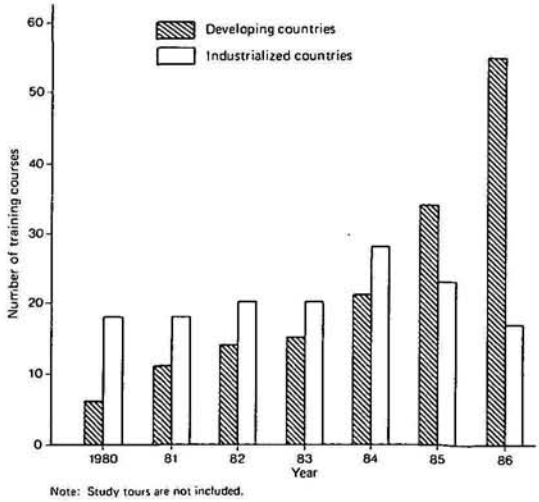

Notes: Covers the IAEA's regular programme (interregional and regional). 1987 spending is estimated.

For a long time, the main emphasis of the Agency's training course programme — as in other activities — was on the application of radioisotopes and radiation techniques in various fields. David Fisher, the IAEA's former Assistant Director General for External Relations, once remarked in a speech that in its early years the IAEA could as well have been called the "International Radioisotope Organization". The picture changed drastically after the energy crisis of 1973, when many developing countries turned to the IAEA for advice and assistance in the planning and implementation of nuclear power programmes.

### Nuclear power and safety

As a consequence, the Agency's nuclear power and safety training programme was set up in co-operation with the Governments of the Federal Republic of Germany, France, and the United States. They were later joined by Spain, Canada, Argentina, and the United Kingdom. In June 1975, an IAEA technical co-operation seminar on nuclear power planning was held in Kingston, Jamaica. In autumn of that year, it was followed by the first training course on nuclear power project planning and implementation at the Kernforschungszentrum Karlsruhe, Federal Republic of Germany. This nuclear centre — as well as the Institut national des sciences et techniques nucléaires in Saclay, France; the Argonne National Laboratory in Argonne, Illinois, USA; and the Centro de Estudios Nucleares in Madrid, Spain — have subsequently become the main training places for IAEA courses in the fields of nuclear power development, energy planning, reactor engineering, fuel cycle, and nuclear safety. After a series of overview courses (six on nuclear power project planning and implementation, and seven on nuclear power plant construction and operation management), the Agency concentrated, starting in 1978, on offering courses in more specific subjects under three categories:

**Host countries for training courses, 1980–86**




Note: Study tours are not included.

- Specialized planning courses (electric system expansion planning, electricity demand forecasting)
- Specialized management courses (project management; qualification of reactor operation personnel; commissioning; quality assurance; waste management; planning for radiological emergencies; safety and reliability in nuclear power plant operation; and radiation protection, among others).
- Specialized technical courses (control and instrumentation; inspection of nuclear power plant construction; siting; safety analysis review; and probabilistic safety assessment, among others).

Introductory courses continued to be given. But, as of 1982, the newly shaped course entitled "Energy planning in developing countries with special attention to nuclear energy" is being held exclusively in developing countries, alternately in English, Spanish, and French.

Selection of subjects for the nuclear power and safety training programme was mainly steered by the previously mentioned Nuclear Power Training Advisory Committee. By 1984, the IAEA realized that high expectations, which prevailed in 1974 concerning a considerable increase of nuclear power in developing countries, were not being fulfilled. Two important decisions were consequently taken:

- To decrease the number of interregional training courses on nuclear power subjects
- To dedicate more attention to organizing national training courses, i.e. for participants of one country only (national courses on nuclear power subjects, in fact, have been given since 1980).

It was considered that courses on specialized management subjects should mostly be given on an interregional basis, whereas courses on specialized technical subjects are especially suitable for national training.

### Continuous development

After the reactor accident at Chernobyl the Agency has quickly responded to preoccupations of Member State governments and public opinion by giving clear priority to safety and safety-related subjects in its 1987 training course programme.

Such adjustments are continuously being made for a number of reasons:

- Technology is changing rapidly (thus, the programme of the Agency's annual interregional training course on nuclear electronics in 1986 had nothing in common with the same course given, for example, in 1976 and had only little in common with the same course given in 1981)
- Member State training requirements are changing (depending on policy decisions and the continuously advancing level of technological development in countries)
- New training concepts are being developed by the Agency.

**Developing countries have played a big role in training, hosting many courses over the years. This course, in mutation breeding, was held in Jakarta, Indonesia, in 1979.**

### Train-the-trainers courses

One new training concept that has come up in recent years is the "train-the-trainers" course. This type of course is aiming at participants who already have good technical qualifications and sufficient professional experience and who want to learn teaching techniques to enable them to pass on their knowledge and expertise in local training courses in their home countries.

After completing their training, they take with them teaching materials, (e.g. slides, posters, tapes, video tapes, computer programs) that they can use in their national courses. Technical training is always better in one's own country, where both the teachers and the trainees are familiar with the resources, limitations, and needs. This training also has the advantage of being less expensive and avoids the language barrier present in at least some developing countries.

The train-the-trainers course leads to a sort of "chain reaction" so that the participants are prepared to be — in the future — leaders in their own national

**Two of many participants at IAEA's interregional training course on radiation protection in the mining and milling of radioactive ores, in Poços de Caldas, Brazil, from 3 to 21 November 1986. (Credit: J. Ahmed, IAEA)**

programmes. The emphasis here is not only on cultivating their technical competence, but also on teaching them finer aspects of the subject of training that they can use for teaching later. In this way, two objectives are being served: Participants can become self-sufficient and self-reliant, more precise and dependable in their work, and they are able to teach independently.

As each geographical region of developing countries has its own scientific standards, the train-the-trainers concept is especially suited in regional courses.

### Training in physical sciences

In this field, the training courses organized by the Agency closely follow the requirements and needs as demonstrated by the technical co-operation (TC) programme. This is true both for the subjects and for the level of training. Thus, in the last 5 years several courses were prepared and implemented on an advanced level, in support of TC projects which have already reached some degree of maturity.

Parallel to the rapid development of physical sciences in the nuclear field, the topics of training courses have been adjusted to trends. While 15 years ago the Agency's courses emphasized the operation and physics of the research reactors or accelerators, the focus now is on the many facets of such facilities for applied, and sometimes fundamental, research.

The main areas of training courses in physical sciences are nuclear instrumentation (nowadays including the use of small computers); application of nuclear analytical techniques; and production and control of radioisotopes and radiopharmaceuticals.

Because many developing countries are mainly interested in introducing nuclear analytical techniques, a number of successful courses were organized on this topic. Some courses attempted to present participants with a broad view of application of different techniques; others, very specialized courses, dealt only with one technique, applied to a limited number of problems. Although both types of courses have found a good "echo" in developing countries, it seems that the specialized ones yield the best long-term effects.

# Two of many: Reflections of a technical officer

*What does it take to make a training course work?*

**by Joze Dolnicar**

At the IAEA, two staff members are responsible for a training course: a member of the training course section makes the administrative arrangements, and a technical officer is appointed with responsibility for the course's scientific or technical contents.

Yet it takes more than two to make a training course effective.

Many more elements are needed: A closer look at two courses I have been involved with may help to illustrate the point.

### Ghana, 1980

The IAEA's first training course in nuclear analytical techniques showed what can be accomplished with preparation and work. Observations on the proposals for technical co-operation projects submitted to IAEA from African countries every year indicated an increasing interest for applications of nuclear analytical techniques. They also indicated that guidance was needed as to what exact technique — nuclear or other — would be the best one to solve the specific analytical problem at hand. In developing countries, it is difficult to collect information and literature on modern techniques. So the idea was pursued to organize a training course, with the objective of familiarizing participants with several nuclear analytical techniques, their advantages and limitations, and with the preferable field of application. This is how the first IAEA training course on nuclear analytical techniques was born. Later, a number of similar courses were organized, with slight modification of the contents and emphasis.

Sixteen participants from African countries, and one from Jamaica, met in Ghana in July 1980, for this training course. I remember how difficult it was to select them; in the Agency we did not have experience with training courses in this field, and it is very difficult to be objective in the selection, which is based on sometimes scarce information contained in application forms. Selection of participants, by the way, is one of the most critical steps in arranging a training course and is made much easier when authorities in nominating countries are careful in their presentation of the candidates. In 1980, we were lucky: The team that assembled in the Kwabenya Nuclear Research Centre was composed of young and serious African scientists who were eager to get as much as possible from the course and its instructors. They did. Years after the course, I maintained contact with most of them, and several students today are the leaders of nuclear analytical laboratories in their countries. This might not be the only criterion by which to evaluate the course, but it is one of the good ways to judge the value of the training.

Why was this course held in Ghana? Would it have been more profitable if it had been convened in one of the largest research centres in an advanced country where all the

Mr Dolnicar is an IAEA technical officer in the physics section of the Division of Research and Laboratories.