Fellowship training: 28 years and over 11000 fellows

An overview of how the programme works and how it has developed

by Michael F. L'Annunziata

Fellowship training is one component of the IAEA technical assistance programme that helps Member States to develop their nuclear science and technology infrastructure. Fellows are provided the opportunity to broaden their professional knowledge and operational experience by learning new skills and advanced technologies. Since the programme began in 1958, more than 11 000 fellows from around the world have been trained.

Training takes a variety of forms. It may include attendance at an academic institution, participation in a research group, on-the-job training in a particular industry, engineering practice, short visits to research laboratories and institutes, or a combination of these. When the training is obtained at an academic institution, the fellow may receive an academic degree. The IAEA does not discourage fellows from receiving academic degrees when it is an outcome of the training programme; however, an academic degree cannot be the primary objective of the training programme.

Fields of training

Fellowship training is provided in many fields of study and work directly related to IAEA programmes of technical assistance and co-operation. For administrative purposes, training in the IAEA fellowship programme is grouped according to the following fields:

- ***General atomic energy development.*** This may comprise training in the planning of national atomic energy programmes, nuclear materials management (safeguards), legal and economic aspects of atomic energy, library and scientific documentation, administration in nuclear fields, and planning and design of nuclear centres and laboratories.
- ***Nuclear physics.*** This field may include theoretical and atomic physics, neutron physics, reactor physics, solid-state physics, plasma physics, high-energy physics, and analytical nuclear physics.
- ***Nuclear chemistry.*** This may include nuclear radiochemistry, analytical chemistry, radiation chemistry, physical chemistry, the preparation of labelled compounds, and the production and control of radiopharmaceuticals.
- ***Prospecting, mining, and processing of nuclear materials.*** This may include the prospecting of nuclear raw material deposits, the evaluation of uranium and thorium ore deposits and other ores of nuclear interest, and the mining, analysis, and processing of nuclear raw materials.
- ***Nuclear engineering and technology.*** The many fields under this broad heading include research and power reactor technology, reactor metallurgy and materials, nuclear chemical engineering, nuclear instrumentation, electronics and reactor control, isotope production, fuel element reprocessing, irradiation effects, radiation engineering, and reactor quality assurance.
- ***Application of isotopes and radiation in agriculture.*** This heading comprises more down-to-earth fields such as soil science, irrigation and plant nutrition, plant breeding and genetics, entomology, animal production and fisheries, animal health, agricultural biochemistry, irradiation preservation of food, and plant pathology.
- ***Application of isotopes and radiation in medicine.*** This includes nuclear medicine, radiotherapy, fundamental medical research, radiotoxicology, medical physics, and radiopharmacy.
- ***Application of isotopes and radiation in biology.*** Specific fields under this heading are somatic and genetic effects of radiation, radiation sterilization, radionuclides and radiation in aquatic biology, dosimetry in radiation biology, the preparation of radiation-attenuated vaccines, and environment radiation biology.
- ***Application of isotopes and radiation in industry and hydrology.*** Under this heading fall non-destructive testing, level and thickness gauging, physical metallurgy, soil density and moisture-probe measurements, radiation processing, multi-purpose irradiation, isotope tracer techniques in industrial processes, groundwater and surface-water hydrology, analytical instrumental techniques for low-level counting, mass spectrometry, and nuclear logging of environmental isotopes.
- ***Safety in nuclear energy.*** This last major field may be subdivided into various aspects such as safety standards, regulations and procedures, radiation protection, reactor and nuclear material safety, treatment and disposal of radioactive wastes, nuclear installation and radioactive waste safety evaluation, and environmental protection.

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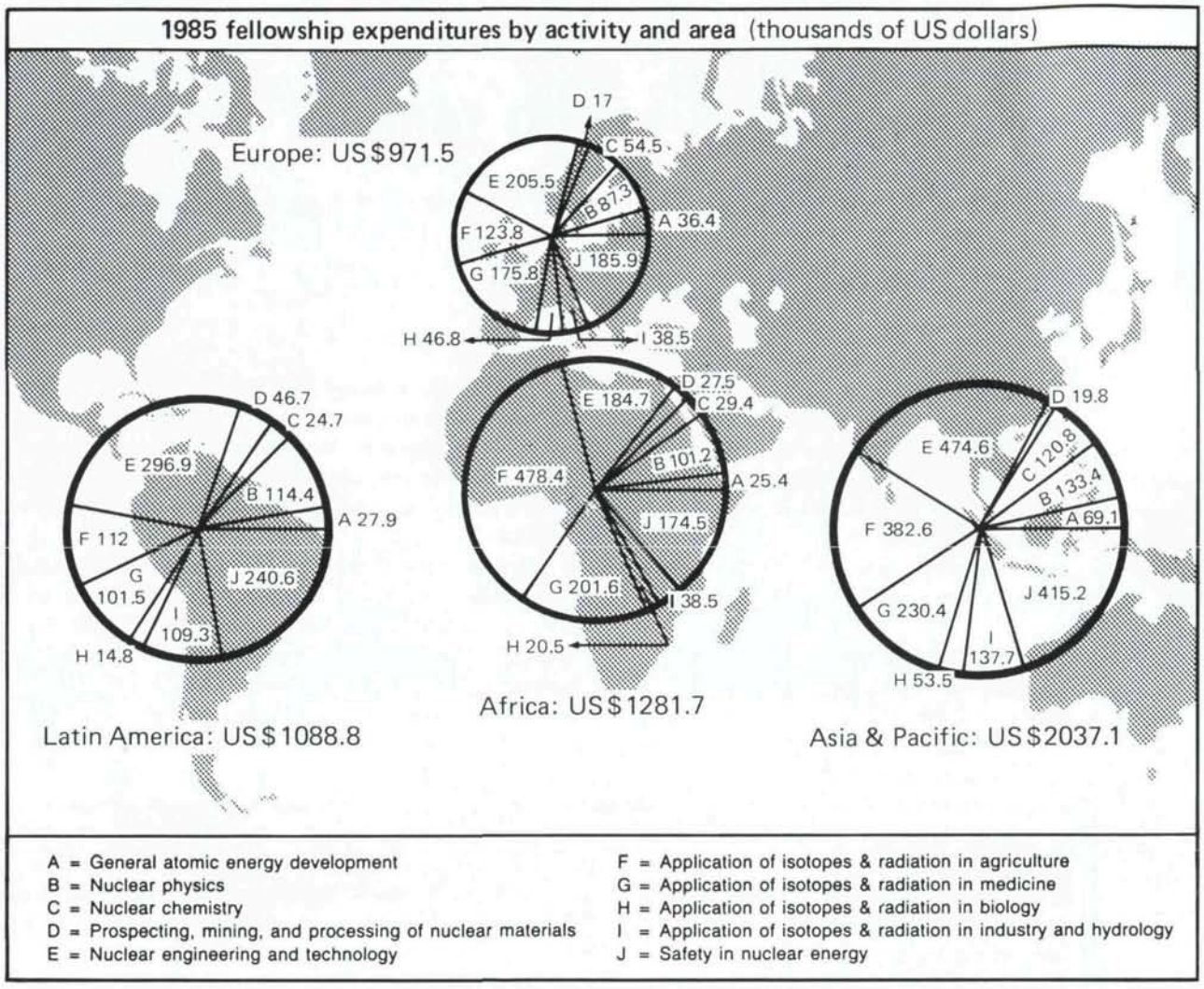


Needs, priorities of Member States

Although many fields are listed here, most fellowship awards are for training in a few specific fields that can have the greatest impact on development in Member States. Over the last 2 years, most fellowships have been awarded in the general fields of nuclear engineering and technology, agriculture, medicine, and nuclear safety. In all during 1985 and 1986, over 1700 fellows and visiting scientists were trained. *(See accompanying bar graph on page 14.)*

As Member States have particular development needs and priorities, they will request fellowship training in line with those needs. Therefore, there can be an emphasis of training on only one or two fields for a particular Member State. These needs may also be apparent in a regional perspective. For example, in 1985 Africa received over 50% of its fellowship training programmes in the fields of agriculture and medicine; in Europe, on the other hand, the fields of nuclear engineering and technology, medicine, and nuclear safety were supported most through fellowship training. *(See accompanying map for a breakdown by region and field of training.)*

Fellowships in support of projects

Fellowship training provided in support of projects approved and financed by the IAEA is programmed in conjunction with the provision of equipment and expert visits. In general, the training is programmed to be concordant with dates of experts missions and the provision of equipment. A fellow might even train in the home institute of an Agency expert to the project. He would ideally complete his fellowship in time to return home to apply his training, sometimes with equipment newly acquired from the Agency, and at times with an Agency expert who would be assigned to visit the fellow's institute.

Visiting scientists

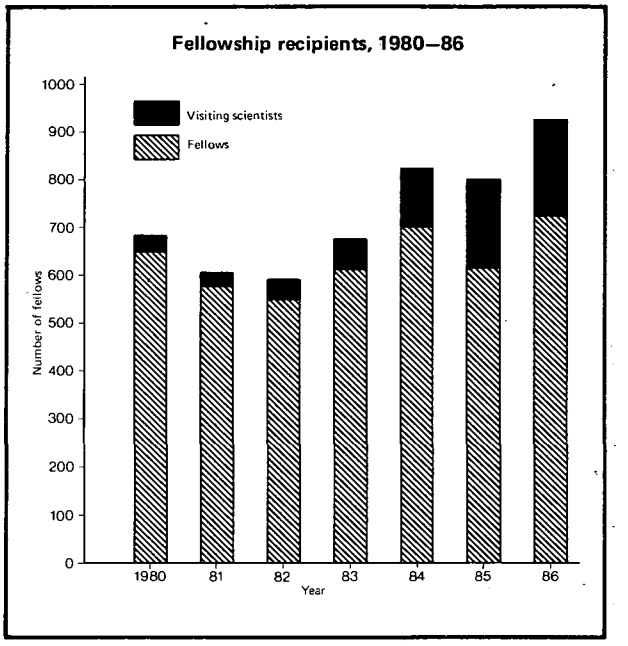
Visiting scientists are short-term fellows having fellowship awards usually not exceeding one month. These short fellowships, referred to as scientific visits, are awarded to scientists to enable them to visit research institutes, nuclear centres, nuclear power facilities, and laboratories with the objective of observing the development of nuclear science, research, and technology in

their particular field of expertise, or to observe the organizational aspects and function of special services related to the nuclear field. Scientific visits are generally awarded to senior scientists, heads of research groups, and directors of research centres.

The visiting scientist may stay for up to a month at only one institute or he may visit several institutes for shorter periods of time, generally one week, in as many as three countries. These visits also give the senior scientist the opportunity to make important close contacts with scientists or experts in his or her own field of work and to jointly exchange scientific experiences and current trends in their research work. These short fellowship awards are intended to broaden the qualifications of specialists from developing countries and to enable them to contribute more effectively to scientific progress upon their return home.

This programme has been expanded to enable scientists from developing countries to participate in Operational Safety Review Team (OSART) missions. These missions consist of eight to ten experts in nuclear safety who form a team to review, on request, the safety of any nuclear power plant in a Member State. The first OSART mission was carried out in 1983, and fellowship training by attachment to these review teams started in 1984. This exercise provides fellows with the opportunity to join the team to train first-hand in all aspects of a nuclear power plant safety review.

During the last 5 years the number of visiting scientists in the field on a yearly basis has seen steady growth. In 1981 there were only 31 visiting scientists in the field, whereas in 1982 the number rose to 41. For the years 1983 through 1986, the number of visiting scientists in the field were 65, 123, 188, and 202 respectively. *(See accompanying graph.)*



Fellowship costs

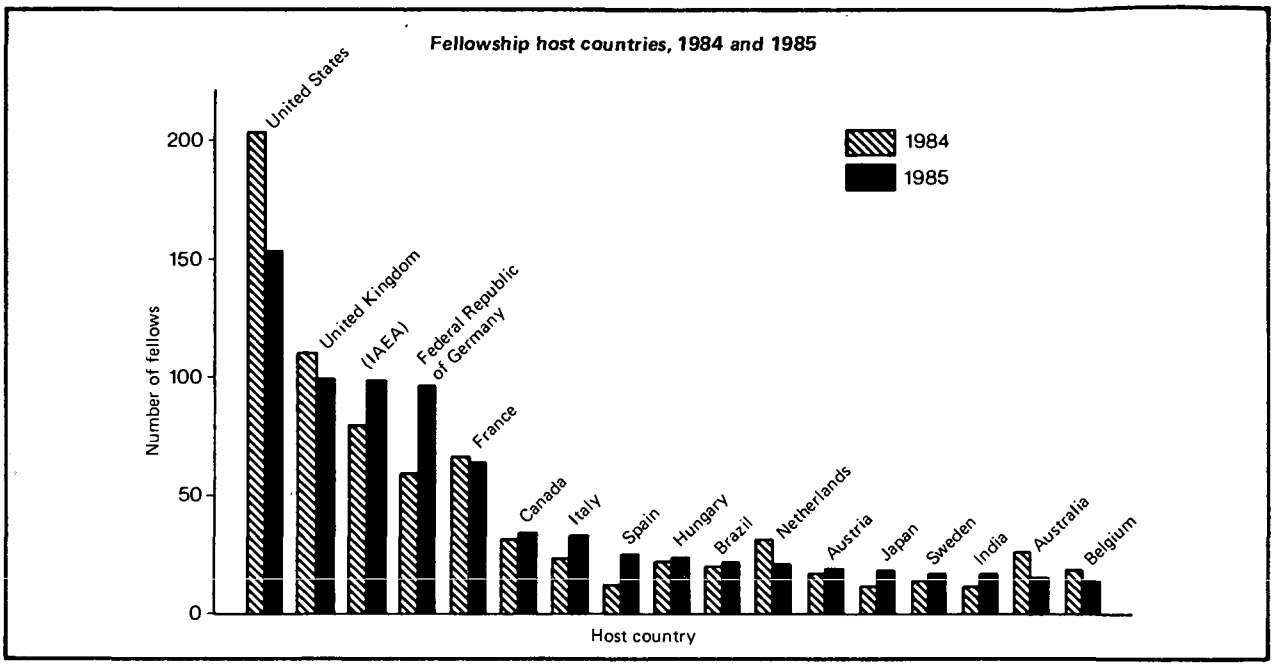
The overall share of fellowships in technical assistance expenditures in 1985 was approximately US $5.4 million. This might appear at first to be a very expensive training programme. However, if we look at the number of fellows (803) in training in the field during 1985, the average cost per fellow was US $6700. Taking into account the total number of man-months (3431) of training provided to fellows and visiting scientists during 1985, the average cost per man-month fellow amounted to $1570. This is a rather cost-effective programme when considering that it provides travel, stipend, training fees, and health insurance for the fellow. The funds used for the financing of fellowships are classified into two groups:

- Fellowships that include a stipend paid directly by the Agency from IAEA funds (known as Type I fellowships), or by funds deposited with the Agency by national or international organizations, or by funds from the United Nations Development Programme (UNDP).
- Fellowships offered by IAEA Member States that include a stipend paid by the host country at a rate established by it (known as Type II fellowships). Many Member States finance such fellowships or provide funds to the IAEA in support of fellowships. Among these are Argentina, Austria, Belgium, Brazil, Canada, Chile, Czechoslovakia, Denmark, France, Federal Republic of Germany, Hungary, India, Israel, Italy, Japan, Poland, Romania, Spain, United Kingdom, USA, USSR, and Yugoslavia.

Fellowship host countries

In all, 67 developing Member States of the Agency had fellows trained under the programme during 1985. They were young and senior scientists, medical doctors, engineers, and technicians. Most training is provided in industrialized Member States, although developing countries host Agency fellows as weil. During 1985, as many as 46 countries provided training for Agency fellows or served as hosts to visiting scientists.

During the last decade, the number of fellows trained in developing Member States and the number of these States providing training have been increasing at a steady rate. *(See bar graph, page 19.)* For example, in 1977 only 18 fellows were trained in eight developing Member States, whereas in 1984 over 160 received training in as many as 28 developing countries. Over these and preceding years, IAEA technical assistance and co-operation programmes in certain Member States have helped to improve the facilities and to bolster the expertise in certain nuclear energy applications to a level comparable to that found in the industrialized countries. The Centro de Energia Nuclear na Agricultura (CENA) at Piracicaba, S.P., Brazil, and the Mediterranean Fruit Fly Eradication Centre (MOSCAMED) at Tapachula, Mexico, are only two examples of many centres that were supported through IAEA projects during their initial years of development and that now are among the



most outstanding institutes for the training of IAEA fellows. These centres, which once received technical assistance, can now provide it.

Eligibility and qualifications of candidates

Fellowships financed under the Agency's regular programme of technical assistance and co-operation are awarded to candidates from developing Member States. Candidates must, therefore, be employed in their respective countries and have the need to better their professional qualifications significantly, thus accelerating the development of the peaceful applications of atomic energy in their countries. They must also have the assurance of suitable employment upon the completion of their training, and they must agree to return to their country to work in the field of their expertise. Preference is given to candidates who are participating in a comprehensive IAEA technical co-operation project, although fellowship awards are also made to candidates on an individual basis when the training would make a direct contribution to a national atomic energy project of importance in the candidate's home country.

Applications must be made on official IAEA forms for fellowship/scientific visits (available at the national atomic energy commission or government office responsible for nuclear energy matters). Completed forms must be duly endorsed and submitted to the IAEA by this government body. Applications must be made through these government channels and cannot be accepted from individuals.

Candidates should have the academic background and experience necessary to undertake the training they are requesting. Generally, the candidate should be working in the requested field of training. Fellowship awards for training are not made if suitable training and facilities are available in the candidate's home country.

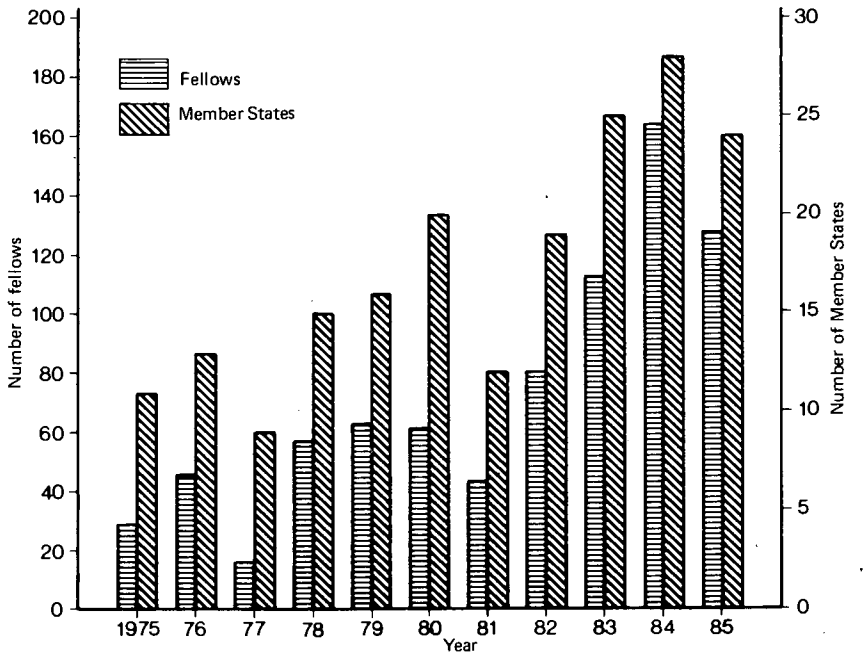
A candidate must have a suitable level of proficiency in the language of the country where the training would be received. For training in the USA, a suitable score on the Test of English as a Foreign Language (TOEFL) is required. Information concerning this test is obtained from the US embassy in the candidate's home country. The United Kingdom usually requires a language proficiency test at the British Council or British embassy situated in the country of the candidate. Many other countries and international organizations provide scientific training with English as the language of instruction. Among these are Austria, Australia, Canada, Denmark, Federal Republic of Germany, Finland, India, Italy, Hungary, Japan, Netherlands, Norway, Sweden, and the IAEA's Seibersdorf Laboratories. For training in France, a proficiency test may be taken at the French embassy. A high level of proficiency in Spanish is desired for training in Spain and Latin American countries; Russian is desired for training in the USSR.

Evidence of the candidate's level of proficiency in a language is generally required before a training programme can be arranged in a host country. This is not a condition set by the IAEA; rather, it is a stipulation made by the host country. It, of course, provides the host country with a certain level of confidence that the fellow will be able to follow without difficulty the training programme that is offered.

Selection of candidates and awards

The submission of endorsed fellowship application forms through official channels does not guarantee that a fellowship award will be made. All applications are evaluated by several offices of the IAEA, and the selection is made according to many criteria. Among these are the recommendations of the IAEA's area and technical officers; the candidate's educational and professional

Distributions of fellowship training in developing Member States, 1975–85



The chart shows the distribution of fellows trained in developing Member States, as well as the distribution of developing Member States that received and provided fellowship training.

qualifications; the relationship of the application to IAEA technical co-operation projects or national atomic energy programmes in the nominating country; the candidate's language qualifications; geographic factors; the development needs of Member States; and the funds available to the IAEA for the financing of fellowships.

The duration of the award, if made, will depend on some of the above criteria as well as on the training programme that can be provided by the host country. In all cases, a fellowship award does not exceed 12 months; this is considered sufficient to accomplish the training objectives in most cases. Extension of a fellowship is sometimes possible when justified and supported by the fellow's supervisor in the host country. Approval by the host government and the fellow's own government are also needed. Training may be given in a place and country different from that requested by the candidate. It is not always possible to arrange suitable training programmes in countries proposed by candidates, and, at times, a fellow is assigned to a country not of his selection because of technical, financial, and language factors.

Impact of fellowship training

It is difficult to quantify the impact of a fellowship programme. Fellows are asked to submit reports to the IAEA on the progress of their training. After their return to their home countries, they are requested to complete a form to evaluate the merits of their training programme and indicate to the Agency how the training they received relates to their present work. An evaluation of the fellowship programme is currently being undertaken.

In 1984, the Division of Educational Programmes of the United States Department of Energy made a mail survey of 426 fellows trained during the 1975-79 period to assess the IAEA fellowship programme. Of these, 225 questionnaires were completed and returned. From these questionnaires, the following information was obtained:

- Approximately 70% of the respondents were in different positions from those they were in before the fellowship, and 62% attributed the change, a positive development, to the IAEA fellowship programme.
- Over 70% stated that their individual objectives had been achieved to a large or great extent.
- Nearly 60% stated that they had been able to use the training received upon return to their country to a great or large extent.
- Nearly 70% stated that the fellowship training was relevant to their countries' development to a great or large extent.
- Approximately 50% believed their own work was contributing to the development of their country to a great or large extent.
- Over 70% stated that they taught or trained others in what they had learned during the fellowship.
- Approximately 60% exchanged scientific or technical materials pertaining to their fellowship.
- Approximately 57% published technical papers related to the fellowship.
- Approximately 55% made presentations at professional meetings about their fellowship research or training.
- Approximately 94% recommended participation in the IAEA fellowship programme to others.