IAEA technical co-operation: Strengthening technology transfer

New strategies and approaches have been initiated to more effectively support and assist countries in safely applying nuclear technologies

by Paulo M.C. Barretto

While the transfer of nuclear technology takes place through various bilateral and multilateral channels, the IAEA has long served as the key international mechanism for scientific and technical co-operation in the nuclear field. Worldwide, more than 80 countries today receive IAEA-supported technical assistance, and altogether more than 1200 projects are in the IAEA's 1995 technical co-operation programme.

The underlying basis for the IAEA's work to facilitate the peaceful development of nuclear energy is its Statute, which entered into force in 1957 and sets the framework for activities.

When the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) came into force in 1970 — more than a decade after the IAEA's creation — its provisions reflected these aims. Specifically, Article IV of the NPT states *inter alia* that "All the Parties to the Treaty undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy. Parties to the Treaty in a position to do so shall also co-operate in contributing alone or together with other States or international organizations to the further development of the applications of nuclear energy for peaceful purposes, especially in the territories of non-nuclear-weapon States Party to the Treaty, with due consideration for the needs of the developing areas of the world."

As they have at past NPT Review Conferences, parties to the Treaty are expected to closely consider the IAEA's technical co-operation activities when they meet in April 1995 to decide on the NPT's extension. This article provides an overview of the IAEA's programmes for assisting the transfer of peaceful nuclear technologies. It particularly addresses the programme's organization, scope, funding, and policy directions. *(See the related article on IAEA technical co-operation projects and activities, beginning on page 21.)*

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IAEA mechanisms for technology transfer

Within the IAEA, the Department of Technical Co-operation and two technical departments — the Department of Research and Isotopes and the Department of Nuclear Energy and Safety — are the main channels for technology transfer activities. Financing of activities undertaken by these two technical departments is through the IAEA's regular budget. Technical assistance provided by the Department of Technical Co-operation is funded largely from extrabudgetary resources, namely voluntary contributions by IAEA Member States.

Technology transfer through technical departments. A range of technology-transfer activities are carried out by technical departments. They include those within the framework of the:

- ***International Nuclear Information System (INIS).*** This system continues to be one of the IAEA's principal channels for disseminating scientific and technical information. It covers virtually every aspect of the peaceful uses of nuclear energy, incorporating a database of some 1.8 million records. Participation today extends to 65 developing and 23 industrialized countries, as well as 17 international organizations.
- ***Meetings and publications.*** The IAEA holds some 400 meetings on various topics in nuclear science and technology each year, including 10-14 major conferences, symposia, and seminars. In 1994, the meetings attracted nearly 2500 participants. Many meetings,

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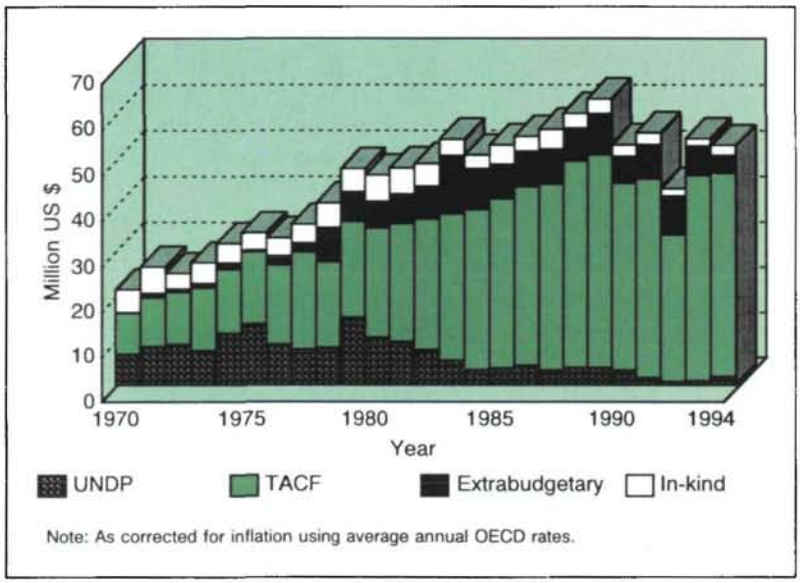


Note: As corrected for inflation using average annual OECD rates.

Available resources for IAEA technical co-operation, 1970-94

projects, and programmes of the technical departments result in publications and technical documents that are widely distributed within IAEA Member States.

- ***Research centres and laboratories***. Alone among other international organizations, the IAEA operates its own research and service laboratories, which contribute significantly to the transfer of nuclear technologies. The IAEA's Seibersdorf Laboratories, near Vienna, provide a diverse range of technical services for programmes in physics, chemistry, hydrology, nuclear instrumentation, and agriculture. The IAEA's Marine Environment Laboratory in Monaco carries out studies of pollution and radioactivity in the oceans, lakes, and other water bodies. It frequently collaborates with oceanographic institutes worldwide and undertakes projects in co-operation with other international environmental programmes and institutions combining nuclear and non-nuclear techniques. The International Centre for Theoretical Physics, in Trieste, Italy, is financed jointly by Italy, UNESCO, and the IAEA. It serves as an important mechanism for the exchange and transfer of advanced scientific knowledge and skills.
- ***Research contracts.*** Research work supported by the IAEA is being carried out under 1950 research contracts and agreements in more than 90 developing and industrialized countries. Most contracts and agreements are components of Co-ordinated Research Programmes (CRPs) through which groups of scientists in various countries co-operatively investigate problems and their solutions in a range of fields. Over the past 10 years, the IAEA has directly financed research activities amounting to nearly US $43 million.

Technology transfer through technical co-operation projects. For 1995, the IAEA's technical co-operation programme — the major channel of technology transfer — includes more than 1200 projects in more than 80 developing countries. These projects — either at the national, regional, or interregional level — cover a wide range of scientific and technical work related to nuclear power; the nuclear fuel cycle; radioactive waste management; food and agriculture; human health; industry and earth sciences; physical and chemical sciences; radiation protection; safety of nuclear installations; and programme direction and support.

Conditions and controls. In view of the technical co-operation programme's scope, size, and nature, specific conditions and controls have been established for the implementation of projects. Within the framework established by the IAEA Statute, the delivery of technical assistance is regulated by two documents, including an agreement known by the acronym RSA, that contain, *inter alia*, provisions to ensure the exclusively peaceful use of technical assistance provided through the IAEA's technical co-operation programme, as well as the requirement that the IAEA's Safety Standards and measures be applied to such assistance. Almost all IAEA Members States receiving technical assistance have concluded an RSA. After the breakup of the former Soviet Union and developments in Central and Eastern Europe, a number of newly independent States joined the IAEA during 1992-94. Although these countries had not yet signed the RSA, the IAEA responded immediately to requests for technical assistance in order to address some of the most pressing problems.

Types of assistance. Assistance is provided mainly through three components that support the establishment or upgrading of nuclear techniques and facilities: experts, equipment, and training, which includes fellowships, scientific visits, and training courses. A particularly important area is the provision of support to set up or improve regulatory practices and radiation safety infrastructures as a prerequisite for assistance in certain fields of activity.

Since 1970 — when the NPT came into force — more than 17,000 scientists and specialists from developing countries have been awarded fellowships or scientific visits and more than 18,600 participants have attended training courses. Nearly 30,000 experts have been assigned to assist nuclear-related development in countries worldwide. Project equipment and materials valued at more than US $290 million have been delivered over this time period.

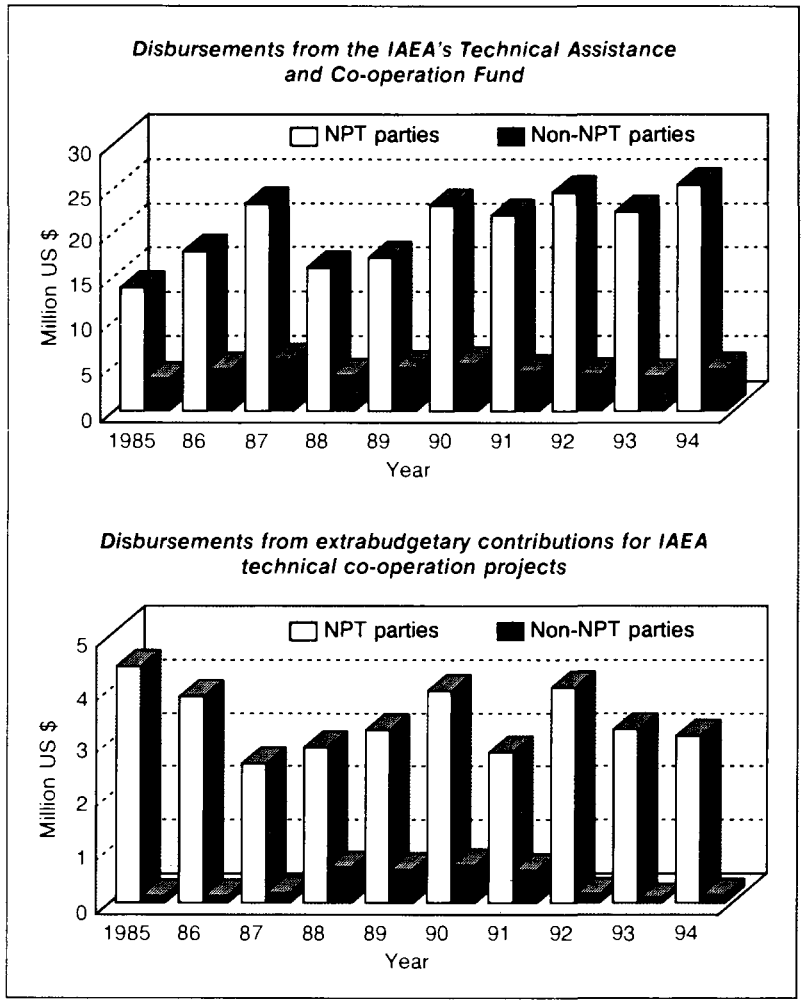
Funding and resources. While the costs of administration and related support for technical

co-operation projects is fully borne by the IAEA regular budget, the technical assistance actually provided to countries comes from voluntary contributions that States directly make through the IAEA or the United Nations Development Programme (UNDP). About 75% of total resources in recent years has come from the IAEA's Technical Assistance and Co-operation Fund (TACF), whose annual target is set by the IAEA's governing bodies. Since 1971, the target has been increasing, reaching US $58.5 million in 1994. While all IAEA Member States are encouraged to share in the fund's financing, not all of them do so. Other sources of financial support include extrabudgetary income, which donor States contribute for specific projects; assistance-in-kind, whereby States provide expert services, donate equipment, or arrange fellowships on a cost-free basis; and UNDP funds, for those UNDP projects involving nuclear science and technology.

Since 1970, total new resources available to the IAEA's technical co-operation programme have grown from about US $4 million in 1970 to more than $53 million in 1994. *(See graph, page 4.)*

Technical co-operation and NPT membership. In the preparation of the technical co-operation programme, the IAEA does not differentiate between States on the basis of their NPT status. Projects are assessed exclusively in terms of technical and practical feasibility, national development priorities, and long-term advantages to end users.

In practice, the proportion of disbursements from the TACF to non-NPT States has remained relatively constant over the years, fluctuating between 16% and 20%. The distribution of the IAEA's Research Contracts evidences similar trends. The situation for sound projects that require additional funding outside the TACF (known as "footnote a" projects) is quite different. In this case, donor countries have shown a clear preference for financing projects in countries that are parties to the NPT. For non-NPT countries, the proportion of such disbursements fluctuates between 2% and 5%. *(See graphs.)*



Trends and challenges

In terms of overall economic development, and particularly concerning the stage of nuclear development, there are significant differences among developing countries. Seventeen of the 32 States operating or constructing nuclear power plants are developing countries. Some of them also possess nuclear fuel cycle technology and facilities, including such sophisticated techniques as uranium enrichment, reactor fuel fabrication, spent fuel reprocessing, and heavy water production. Some of these countries are already exporting certain nuclear technologies and materials and are providing bilateral assistance to other States in research, development, and application of nuclear technologies.

Technical assistance and NPT membership

Concerning other applications, 38 developing countries operate 85 research reactors of various types and capacities. Nuclear scientific and technological infrastructures have been formed around these facilities, enabling these countries to conduct basic and applied research and development, radioisotope and radiopharmaceutical production, and other research-related activities. Most developing countries have gained experience in the application of isotopes and radiation in many fields, including agriculture, medicine, industry, and hydrology, and many may be relatively advanced in them. At the same time, there are States, particularly among the least developed countries, where nuclear activities consist mainly in the introduction of limited nuclear techniques and related training.

In terms of supplying technical assistance to such a diverse range of countries, one noticeable

trend is that end users are being more clearly defined and targeted. Whereas techniques once were transferred to specialist groups working at research establishments of national atomic energy commissions, the training and equipment for specific technologies today are increasingly being delivered more directly. For example, hospital staff are the end users of nuclear medical diagnostic techniques, and professionals at water management institutions are the end users for applications of isotopes in hydrology.

Another trend is the increasing contribution of developing countries to regional IAEA technical co-operation activities, both as hosts for training courses and as providers of experts. Three regional co-operative agreements now are in place, for Africa, Latin America, and Southeast Asia and the Pacific. Regional membership has grown steadily and today 54 IAEA Member States are participating in these agreements. More than 30 multi-year regional projects are in operation, and about 40 regional training activities are carried out each year.

A third trend is the growing share of technical co-operation funds for projects in areas of radioactive waste management, radiation protection, and safety of nuclear installations. This reflects the needs and interests of many developing countries. The radiation safety situation, for example, still needs improvement in many developing countries. In more than a third of the IAEA's Member States, the existing control mechanisms for radiation safety are deemed inadequate. A few countries have yet to establish the appropriate infrastructure. In light of the situation, and the continuing rapid growth in the application of nuclear techniques, the IAEA has initiated steps to strengthen its assistance in areas of radiation safety. In its planning over the medium term, the IAEA further has given high priority to areas of nuclear safety, radiation protection, and waste management.

Fourth, the IAEA is seeing increasing requests for technical assistance of an advanced and more complex nature. In some measure, this development reflects the effectiveness of past support. Many developing countries that have received IAEA technical assistance have reached high levels of sophistication in the application of nuclear techniques. They now are seeking support for larger projects — for example, the establishment of a radioisotope production facility, research reactor and/or cyclotron, the treatment and storage of radioactive wastes, or the eradication of agricultural pests. Such projects will require long-term commitments and, in many cases, complementary bilateral co-operation.

Also worth noting in this connection is the different types of problems countries are facing, particularly newly independent States of the former Soviet Union. Many of these countries, for example, face major problems arising from previous programmes in nuclear power and nuclear-related applications. Technical assistance is needed to replace defunct infrastructures, establish regulatory bodies, train personnel, and support implementation of remedial measures to upgrade nuclear facilities to modern operational and safety standards while bringing environmental problems under control. As a basis for these activities, the countries need to establish internationally proven regulatory practices, and they need to prepare for decommissioning of some nuclear facilities. Several initiatives have been undertaken by international organizations including the IAEA to address these problems, but more needs to be accomplished.

Strengthening transfer of technology

Since most of the IAEA's Member States also are parties to the NPT, they understandably share some common interests and requirements that are specifically reflected in the IAEA's medium-term plans and biennial programmes. These plans and programmes take into account present and expected developments in the peaceful uses of atomic energy.

One important development is the world's growing population, which in turn will influence demands for more energy, particularly electricity. As there is no global intergovernmental energy organization, the IAEA will stimulate and, where necessary, co-ordinate international efforts required to assess the benefits and problems of various power options, including nuclear energy.

When considering the IAEA's role in contributing to the transfer of nuclear power and related activities, it should be recognized that the nuclear industry has made great progress in commercializing many technologies and that new suppliers have appeared on the market, some of them developing countries. The IAEA's future role should be to find more ways of supporting and assisting buyers and to remove obstacles to free choice. The IAEA's traditional function of providing a forum for information exchange in this area also may expand if demand for nuclear power increases and if this increase is followed by expanded development programmes in the field of power reactor technology and design. Additionally, the IAEA should be ready to respond to requests for assistance from developing countries that are considering the nuclear option, particularly concerning the training and development of the necessary human resources.

The world's people, most of whom live in developing countries, also need greatly increased supplies of food and fresh water, better health care, and greater access to industrial goods. Nuclear methods that can lead to improvements in the production and preservation of food, in health care, in industrial production, and in the provision of water supplies are increasing in number. They are often competitive with other methods — indeed in some cases they are the only methods available. The scope for the exchange of experience in using nuclear methods and in transferring them to developing countries is therefore expanding. Non-power applications of nuclear energy will remain the area of technology transfer of greatest interest for most developing countries.

The IAEA's task in the medium term will almost invariably be to create or strengthen capabilities at the national level, primarily through its technical co-operation programme. Achieving this goal will require greater precision in identifying those areas where assistance will have the most impact. Special emphasis is being placed on projects that are in line with national development plans, are of a practical nature, are oriented towards specific end users, and are intended to have a significant impact on the country's overall development. Projects that combine all of these features have been identified as "model projects" and are intended to serve as beacons for the direction in which the IAEA's technical co-operation programme is moving.

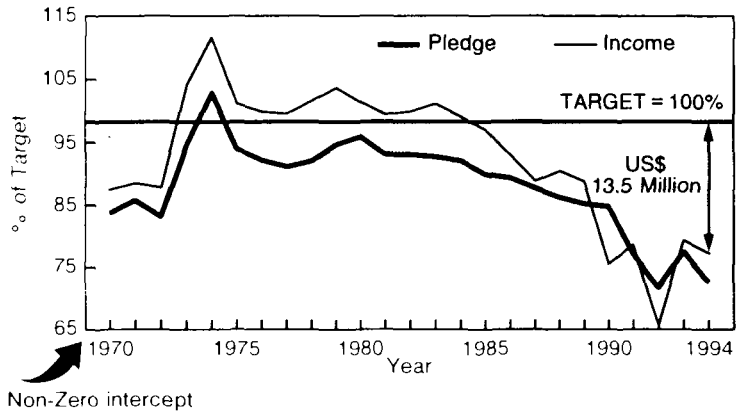
On the basis of its assessments, the IAEA has formulated a number of overall objectives for its activities over the medium term. One objective is to enhance the transfer of nuclear technology and know-how to developing countries, and more specifically to:

- ensure, through increased interaction with responsible governmental authorities, that the Agency's technology-transfer activities are in line with national development plans. The aim of IAEA assistance will be to strengthen the relevant national infrastructures so that they become self-supporting. Development of human resources, quality control services, and maintenance of nuclear instrumentation will receive more attention under this strategy;
- help establish and strengthen national nuclear safety, radiation protection, and waste management systems as a prerequisite for the development of nuclear energy programmes, mainly through the provision of training and advice;
- give priority to provision of assistance in the transfer of technology to areas involving basic human needs, such as food and water resources, health, and energy supply, and to the transfer of techniques contributing to environmental protection and sustainable development;
- promote only those nuclear techniques in developing countries which have a clear advantage over other techniques, and to this end, compare nuclear and non-nuclear techniques, taking into account the conditions prevailing in the recipient countries;
- co-operate with relevant international organizations in establishing appropriate databases and systematically analyzing the economic, health, environmental, and climatic impacts of various energy options; in particular to contribute analyses and data concerning nuclear power to such studies and to make the results of this work widely available to experts in IAEA Member States;
- promote the exchange of information and international discussions with interested Member States, and such parties as the World Association of Nuclear Operators and international financial institutions, with the aim of developing new schemes for financing, constructing, and operating nuclear power plants in developing countries;
- perform global analyses and strategic studies of selected aspects of nuclear power and the fuel cycle, including assurance of supply.

Another objective is to assist countries in achieving and maintaining a high level of nuclear safety worldwide and minimizing the environmental impact of all types of peaceful nuclear activities and applications. More specifically, this entails activities to:

- provide international leadership and assistance to national nuclear safety authorities, especially to governmental nuclear regulatory bodies, with a view to detecting and correcting safety deficiencies in operating nuclear facilities and to preventing accidents.
- support the efforts of international and national bodies in reaching a consensus on safety principles for the design of future nuclear power plants;
- take the lead in developing an international technical consensus on the acceptability of methods for the management and disposal of nuclear waste of all kinds, and to help gain public confidence in these matters;
- provide expanded international guidance and assistance to national nuclear safety authorities to ensure the safety of research reactors, spent fuel management facilities, and installations using radiation sources, with special attention to large research reactors and irradiation facilities;
- establish a harmonized international approach to all aspects of nuclear safety, including the incorporation of recommendations of the

Pledges and income compared with target contributions to the Technical Assistance and Co-operation Fund by year.



Patterns of pledges and income for the IAEA's Technical Assistance and Co-operation Fund

International Commission on Radiological Protection into the IAEA's standards and guides.

Financing the needs

What does this changing pattern and redirection of technical co-operation activities mean in terms of funding? Surprisingly, the additional resources required are remarkably small in relation to the importance and magnitude of the tasks ahead. Most of the resources could be obtained from fuller contributions to the IAEA's Technical Assistance and Co-operation Fund.

Over the past 5 years, available funds for the IAEA's technical co-operation programme, in terms of delivery of services, have fluctuated around a rather constant value of about US $40 million per year. At the same time, however, there has been a negative trend since 1984 in the receipt of financial resources, both with respect to pledged contributions and the actual income received to meet the target amount for the TACF. Pledges and payments started to decline after 1984, reaching a level of 71.3% of the targeted amount in 1992. The drop in total income was even more marked with a low of 65.1% of the target being registered in 1992. *(See graph.)* This trend has affected the past delivery of services. In fact, over the 1987-94 period, between 6% and 20% of the approved IAEA technical co-operation programme could not be funded or implemented.

If projected into the IAEA's next programme cycle for 1995-96, the present gap between the TACF target and actual income would amount to about US $13-20 million per year. Consequently, if the pledges and payments were made according to their designated shares and targeted amount, most of the IAEA's approved technical co-operation programme for the 1995-96 period could be funded.

Bridging technological gaps

As this overview shows, the IAEA undertakes a multitude of activities in line with Article IV of the NPT that have substantially contributed to the peaceful use of nuclear energy in developing countries. In fact, for most of these countries, IAEA-supported projects have provided the key inputs for building the national infrastructures required for the introduction of nuclear techniques in the areas of basic human needs, ranging from food production and water supplies to public health and safety.

Over the course of the years, basic policies and mechanisms for the transfer of nuclear technology to developing countries have evolved enabling the IAEA to efficiently provide various types of support. In particular, it is worth noting that the transfer of technology and techniques has always ranked highly among the main objectives of the IAEA, which also include the establishment of health and safety standards, and the development and implementation of safeguards. They further extend to such matters as, for example, the establishment of guidelines and an international convention relating to the physical protection of nuclear materials. As a result, there has been a growth of resources and an extensive involvement of the IAEA's overall efforts in technology-transfer activities, both under the technical co-operation programme and through activities of IAEA technical departments.

Moreover, the IAEA has a well-established mechanism for considering policy matters, assurances against nuclear proliferation, and safety and operational issues related to technical co-operation. This process involves the participation of the IAEA's policy-making organs and a number of advisory and technical committees and groups. By these means, the IAEA can identify, generally in good time, the modifications and technical adjustments necessary to maintain the efficiency and quality of its assistance.

At the same time, it is recognized that there is plenty of scope for improvement of technology-transfer activities that contribute to bridging the technological gap between industrialized and developing countries. In view of its structure, experience, and control mechanisms against nuclear proliferation, the IAEA provides a unique opportunity for all NPT parties — and in particular for the most technologically advanced of these States — to contribute to the further development and utilization of nuclear energy for peaceful purposes, as envisaged under Article IV of the NPT. ❐