the iaea: its promotional role

The beginning of a new year seems an appropriate time to take stock of the work of the International Atomic Energy Agency in attempting to attain one of the objectives set out in its Statute:
"to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world."
An assessment is made here by Mr. Upendra Goswami, Deputy Director General, Department of Technical Assistance and Publications,
in an article based on a speech made by him in Vienna a few weeks ago.

The Agency's Statute does not even mention the term "technical assistance" and, throughout, the emphasis is on the prevention of the non-peaceful uses of nuclear energy. One gets the impression that the founding fathers were interested in establishing an organization which would prevent proliferation of nuclear arms rather than promote peaceful uses, although Article III of the Statute [Functions] does pay homage to the promotional aspect.

Even today, after a lapse of 14 years, the Agency often presents to the outside world the aspect of an organization in which the control activities loom large and the promotional activities appear as a bit of thin icing on a 'safeguards' cake. But a closer look at the organization today would convince the intelligent observer that whatever might have been the object of the founding fathers, the organization promotes peaceful uses no less vigorously than it controls proliferation of nuclear arms. This is manifest from the fact that of a total membership of 102 countries about 70 are what one might call developing or less-developed countries; their interest in the Agency's control activities is marginal. In fact, they are members of the Agency because of its promotional activities.

The emphasis on promotional activities receives an impetus, at irregular intervals, from occasional manifestations of discontent by the less-developed countries about the alleged inadequacy of the Agency's effort in promoting the peaceful uses of atomic energy. In 1970, during discussions in the Safeguards Committee [which considered the structure and content of agreements to be entered into between the Agency and States Party to the Treaty on the Non-Proliferation of Nuclear Weapons], it was stated repeatedly that the expected increase in the Agency's safeguards activities should in no way affect the promotional part of the Agency's programme. This tendency to place equal emphasis on the promotional and control aspects is also manifest from the incorporation of Article IV in the Non-Proliferation Treaty, emphasizing the need to make increased resources available for promoting peaceful uses of atomic energy, and from the fact that resources placed at the disposal of the Agency by developed member States have registered a modest increase since the NPT came into force.

The first attempt to spell out the rôle of the Agency in some detail emerged from the resolutions adopted at the Conference of Non-Nuclear Weapon States in 1968. These led the Secretary General of the United Nations to set up a group of experts to prepare a full report on all possible contributions of nuclear technology to the economic and scientific advancement of developing countries. This Group's report (issued in 1969) is the first attempt at codification of the Agency's promotional activities, and is therefore of real importance. In what follows, I shall attempt a thumb-nail sketch of the possible contribution of nuclear technology to the developmental process in less-developed countries, and of the Agency's efforts in facilitating these contributions.

The narrowing of the development gap

Time was when scientific pundits used to say that the various applications of atomic energy were much too sophisticated and the infra-structure required for their effective utilization much too complex to justify their widespread use in less-developed countries. They should learn first to exploit more fully the available conventional techniques. As late as July 1968 the World Bank produced a report which positively discouraged developing countries from considering nuclear power for a long time to come. If such views had prevailed we should be facing a situation in which advances in nuclear science and technology and, in particular, the introduction of nuclear power, would widen further the wide gap which already exists between the developed and developing countries.

Fortunately the view that has ultimately prevailed is that nuclear energy placed in the hands of mankind a new tool which made it possible to do very many things cheaper and better than could be achieved by conventional methods. Furthermore, the speed with which applications of modern science and technology spread to different parts of the globe has been increased as a result of the greatly increased speed in transport and communication. The time-interval between the introduction of new technology in the more advanced countries and their effective use in less-developed countries will, in future, be measured in terms of years rather than decades. Beside all this, the desire to derive advantage from this new technology is in itself a very powerful incentive towards the building-up of a scientific infra-structure in the less-progressive and custom-ridden atmosphere of a less-developed country.

The applications of nuclear science require usually an interdisciplinary approach. A dynamic scientific group built up under the impact of an atomic energy development programme soon establishes full collaboration with existing institutions in the country which carry out agricultural and medical research; the collaboration is fruitful, and tends to spur future activity.

An IAEA expert
on assignment in Tunisia
uses portable equipment
in the search
for possible deposits of
radioactive ores.
Photo: IAEA/Moir

The term 'nuclear technology' embraces scientific and technical knowledge, methods and engineering design and 'know-how' connected with the nuclear power industry, and with all the widespread applications of nuclear phenomena in the country at large. We have found that developing countries use nuclear technology on a modest scale initially with applications of radioisotopes; but sooner or later they manifest an interest in the whole range of nuclear technology on a time scale determined largely by their rate of approach to an electric grid system partly powered by nuclear plants. The most notable peaceful application of nuclear technology is in the generation of electric power and, unfortunately, it is here that progress so far has been remarkably slow.

The introduction of nuclear power

The first industrial-sized nuclear power plants went into operation in 1956 and 1957. Installed nuclear capacity now stands at about 25 000 MW(e), and is expected to increase fivefold by 1975. It will probably pass the 320 000 MW(e) mark by 1980. Nuclear power has become an accepted component of electric power utilities in many parts of the world; it is beginning to be treated as a 'conventional' method of producing electricity and is selected primarily on the basis of economic considerations.

But, while nuclear power is growing rapidly in advanced countries, it has had relatively little impact in developing countries. Of the rough total of 290 nuclear power plants in operation, under construction or firmly planned at the present time only 14, or less than 5 per cent of the total capacity, are located in seven developing countries.

This is unfortunate, because for developing countries taken as a whole nuclear power has a number of inherent advantages:

* Many developing regions are deficient in conventional fossil fuel. This is especially true of South and East Asia, where more than half of the population of the world now lives. The relatively low fuel costs of nuclear power can represent for such countries significant economies in the cost of imported fuel (and therefore foreign exchange) over the lifetime of a plant. This economy could be larger if indigenous, commercially workable supplies of uranium could be developed, since the cost of uranium accounts for about 20 to 30 per cent of the total fuel costs for a nuclear power plant. It is believed that uranium in commercially-workable deposits, may be found in a broad spread of developing countries.

* The relatively small transport and storage costs of nuclear fuel compared with fossil fuel make it possible to locate nuclear power plants in areas where transport costs would rule out fossil-fuelled plants. This offers an opportunity to mitigate inequalities in the development of various regions within large developing countries. Even spent fuel from

nuclear reactors, which requires heavily-shielded containers, is far more economically transported than the equivalent fossil fuel.

* In certain cases the adoption of this up-to-date and sophisticated method of power generation can stimulate and produce side-benefits in fields such as chemistry, metallurgy and electronics.

* The possibility of using a new source of energy can, in some cases, lead to a better bargaining position for the purchase of conventional fuels.

Among the problems that face developing countries in introducing nuclear power are those of organization, 'know-how' and infrastructure. But the biggest problem is financial — because of both the economic characteristics of nuclear as compared with conventionally-fuelled power plants, and the general difficulty faced by developing countries in obtaining financing for capital-intensive projects. A 200 MW(e) nuclear power plant would cost between $70 million and $80 million, depending on the type of reactor employed.

Where to strike the balance?

The recent sharp increases in the price of fuel oil have important significance; for the developing countries rely upon imported fuels. The prospect of spending increasingly large amounts of their scarce foreign exchange for oil imports is forcing them to consider the use of nuclear power. Further, in view of the higher fuel oil prices, the size of the competitive nuclear unit has decreased considerably under average conditions, to bring it down within the reach of smaller grids in developing countries. A 2000 MW grid in a developing country could use a unit of 300 MW(e). Such a plant could be competitive with an oil-fuelled station using oil at 35 to 50 cents per million BTU ($14 to $20 a ton), depending upon the interest and fixed charge rates on the capital employed. Considering that fuel oil prices are likely to range from 40 to 60 cents per million BTU by the mid-70s, if not earlier, nuclear power could make economic sense for many countries.

It should be noted that in almost all of the advanced countries the first commercial-sized nuclear power plants were not regarded as 'economic' propositions, and they were not required to satisfy or even approach strict economic criteria. The first and, in some cases, the first few plants were seen as ventures into a vital new branch of technology required by the national interest. All the early commercial power plants which are now working in the advanced countries, where capital is more freely available, were subsidized. Nevertheless, prima facie economic considerations will make nuclear power plants of the large sizes currently being manufactured interesting to many developing countries only when their overall energy demands have increased considerably. It is expected that by 1980 another ten developing countries will be in a position, economically and technically, to install nuclear power plants. In some of the other developing countries, however, the availability of particularly cheap fossil fuel may continue to make nuclear power relatively less attractive.

Another factor which militates against the use of nuclear power in developing countries is the limited interest among major manufacturers in developing and marketing small and medium-sized reactors, of the sizes which are most suitable for smaller grids in developing countries. They are too preoccupied with domestic demands to devote attention to reducing the capital costs of smaller reactors through standardization, design simplification and multiplication. Savings of 15 to 20 per cent in cost per kilowatt of installed capacity are possible if the nuclear industry applies itself to these problems.

The IAEA believes that a large potential market for small and medium power reactors exists in developing countries. In order to explore this proposition, the IAEA convened a group of experts to discuss the problems of power reactors of interest to developing countries; upon the recommendations of this group the Agency is now embarking upon a market survey of nuclear power plants which could be ordered in the developing countries in the next five to ten years. It is expected that this Survey will be completed by early 1973, and that it will provide for industry the information needed for the development of standardized power reactors of proven design with reasonable capital costs, particularly for use in developing countries. This Survey could also help to persuade the loaning agencies of the need and economic merit of nuclear power plants for developing countries, so that the necessary financing could be made available.

The Agency is thus engaged in a major effort to bring the developing countries, nuclear industry and loaning organizations closer together, to help spread the potential benefits of nuclear power to its less developed member States.

A look to the future

Closely allied to the introduction of nuclear power is the possible use of nuclear energy for converting seawater into freshwater. For the very large desalination plants necessary to satisfy the water demands of the future large quantities of low-cost energy will be required. For such projects nuclear energy may be economically attractive, since economies of scale favour particularly very large reactors. A nuclear power plant which can be used for the dual purpose of producing water and electric power is attractive in theory since, from a thermodynamic standpoint, effective use can be made of the available low-grade heat. By combining the two processes in one plant a larger nuclear reactor can be used – a reactor of a size whose cost per kilowatt is in a low range. Lack of markets for large quantities of electric power may delay the advent of nuclear desalination plants in developing countries. Nevertheless, it is important to bear this possibility in mind and to keep it under constant review; because the demand for potable and agricultural water is accelerating throughout the world and more than one third (37 per cent) of the land surface of the earth consists of warm, arid regions which belong, to a large extent, to developing countries.

The rapid growth of nuclear power provides the uranium mining industry, for the first time in its history, with a stable and promising commercial market on which reasonably firm plans for exploration and production can be based. The amount of low-cost uranium which should be found and proved before 1980 is of the order of 1 million short tons of U_3O_8. The proved low-cost ore reserves are now approximately 800 000 tons of U_3O_8, of which more than 90 per cent are in developed countries. It may reasonably be expected that a more substantial proportion of the reserves to be located in the future will be found in the developing countries.

The average time between the start of an exploration programme and full operation of a new mine may be six to ten years. Early exploration for uranium is therefore essential if a shortage of uranium in the late 1970s is to be avoided. The Agency has always encouraged developing countries in their efforts to locate economically workable deposits of uranium. As examples of such efforts the two UNDP Special Fund projects in Greece and in Pakistan, for which the Agency is executive agent, may be cited. If as a result of these efforts significant uranium deposits are located the developing country concerned could benefit from:

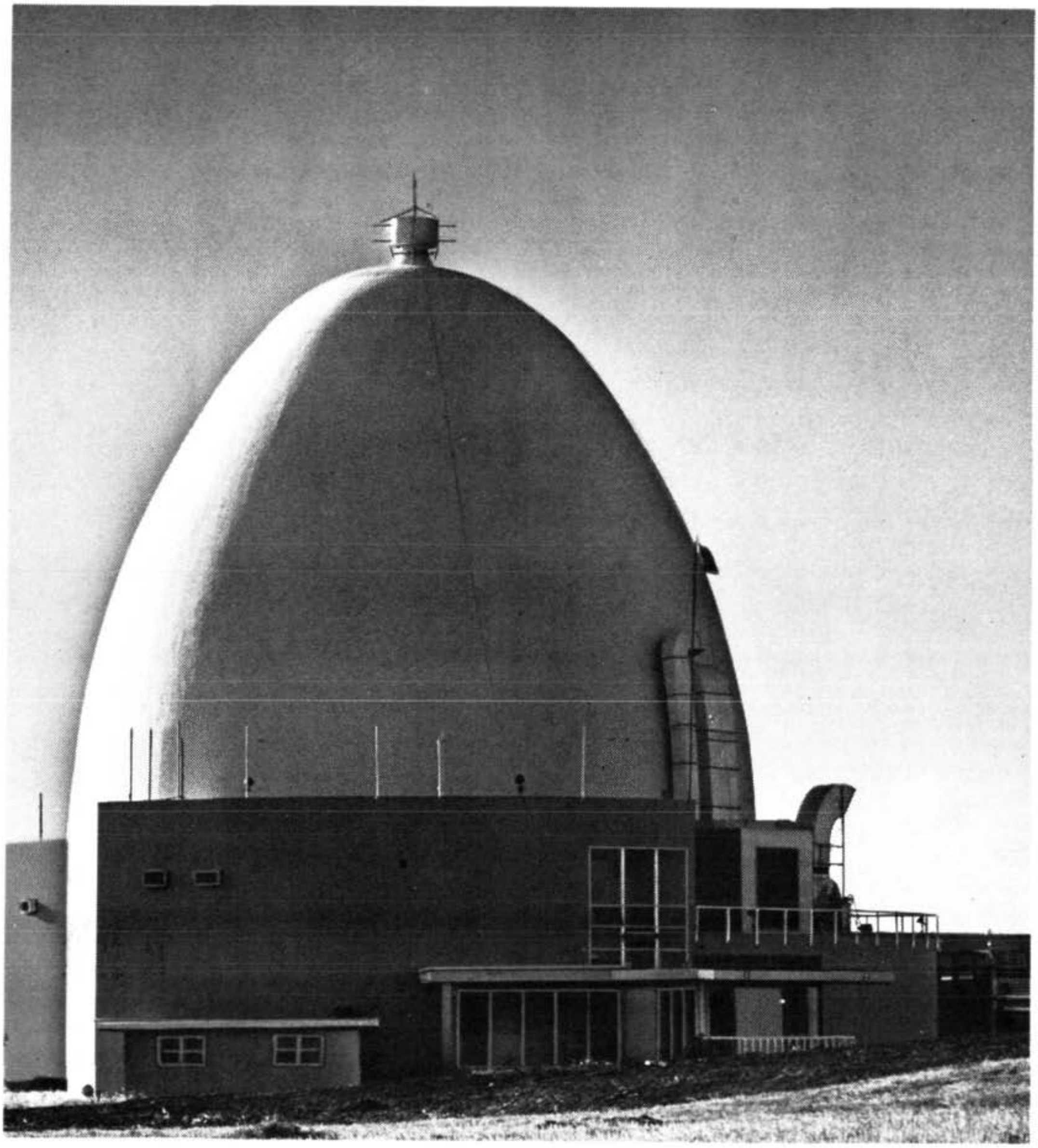
* the utilization of national uranium in national nuclear power stations, and
* the commercial export of the uranium.

Aparting from providing an important energy source, nuclear technology has two other aspects which are relevant to the needs of developing countries. These are the use of ionizing radiations, and the use of radioactive isotopes. Ionizing radiation may be used in biology, food production and preservation, in industry and, in medicine, for therapeutic and diagnostic purposes; while radioisotopes have applications in many fields including biology, medicine, agriculture, hydrology and industry.

Food and agriculture are major fields in which nuclear technology can benefit the developing countries in both the short and long-term. Therefore, all possible aid in this connection should be extended to them. The utility of nuclear methods is evidenced by the millions of hectares of land on which high-yield radiation-induced-mutant crop varieties are already under cultivation.

Isotopes are used to study the uptake of fertilizers by plants as affected by the way they are introduced into the soil, their distribution, time of application and chemical composition.

The Philippine
Atomic Research Centre
at Quezon City.
The Radioisotope Production Unit
at this centre
began operation in 1965,
meeting demands for a wide variety
of radioisotopes
particularly for use in medicine;
help to it has been given
by the UNDP with the IAEA
as executing agency.
Photo: United Nations/Nagata



Insects can be studied by marking with radioisotopes; the so-called sterile insect release method for the control of insect pests is important since it is specific to predetermined species and minimizes the use of chemical insecticides.

Nuclear techniques find numerous applications in medicine and biology. Radioactive materials are used as tracers in medical research as well as in clinical diagnosis and investigation. They are also used as radiation sources in the radiation therapy of cancer and other diseases; and in public health applications.

In industry, large radiation sources have been installed for various purposes, chiefly for sterilization. The sources utilize gamma radiation and beams of fast electrons. Gamma sources are frequently employed in the radiography of welds and castings, where they have the advantage of small size, portability and independence of electric power supplies.

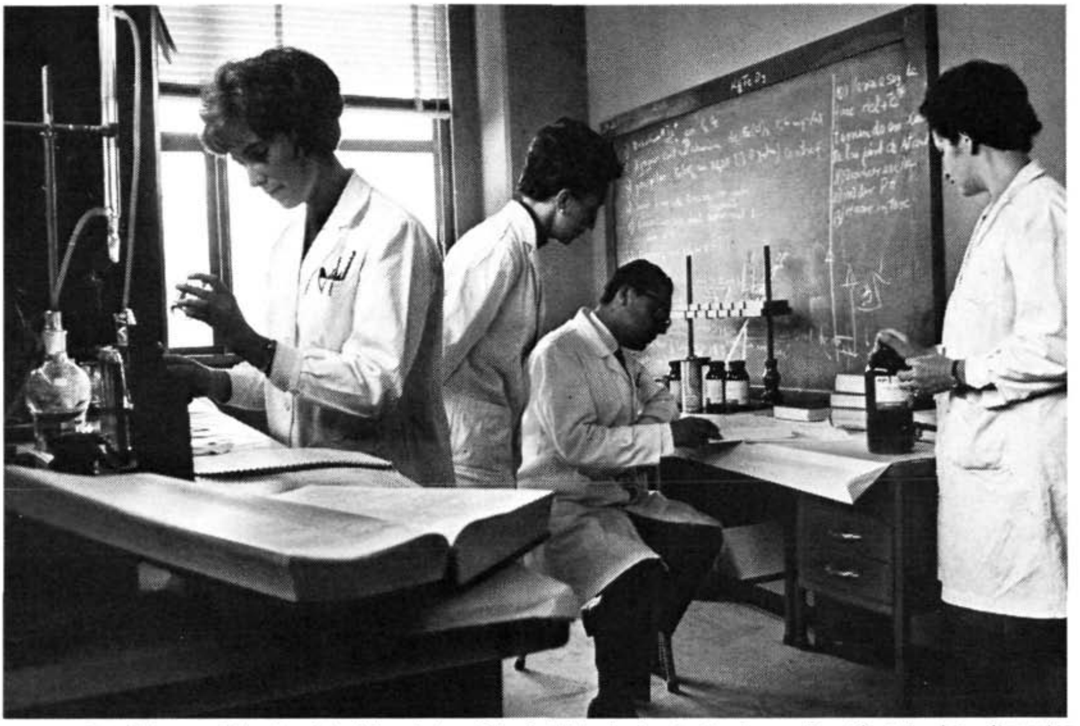
Radioisotopes have found great application in measuring and controlling physical parameters in industry; instruments for measuring thickness, level, density and moisture content are only a few examples. Radioactive tracers are used both for laboratory research and for investigations in industrial plants. They have the advantage of being detectable in very low concentrations and even through the walls of pipes or process vessels. Thus, investigations can be made without the expense of shutting down a plant.

Nuclear techniques have also been applied successfully in the search for petroleum, particularly in the exploration of bore holes. Radioisotope gamma and neutron sources of various kinds, coupled with gamma and neutron detectors capable of operating at depths of several kilometres may be used. There is growing need for fresh water for drinking and agricultural purposes; often, new methods must be used to locate water sources, especially in arid areas. Radioisotopes are making a major contribution to the solution of this problem.

Paying the bills

The implementation of the various projects I have mentioned requires expenditures which vary widely in magnitude. Projects using small quantities of radioisotopes require funds not exceeding tens of thousands of dollars; a large project using large radiation sources would cost in the neighbourhood of a million dollars, the exploration and proving of economically exploitable uranium ore deposits might involve the spending of a few million dollars; mining and milling investment costs would be of the order of ten million dollars for a capacity of 500 short tons of U_3O_8 per year and construction of a nuclear power station of 200 MW(e) would cost more than $70 million.

Bilateral programmes of assistance played a major rôle in the late 1950s and early 1960s in introducing nuclear technology in developing countries. In view of the tapering off of bilateral aid from certain sources developing countries have had to turn to the IAEA in order



A group of staff in one of the chemistry laboratories of the Instituto de Asuntos Nucleares, Bogotá, Colombia, discussing radiochemical methods of separating nuclear isomers. Photo copyright Agencia Grafica Colombiana/Juan Fonseca

to launch new programmes as well as to maintain the momentum of those started with bilateral help.

The Agency draws upon three main sources for its technical assistance: its 'regular' programme financed by voluntary contributions to its 'general fund', gifts by governments which are administered by the IAEA — for example, equipment, cost-free fellowships and cost-free services of experts — and UNDP in its Technical Assistance as well as Special Fund sectors. The aggregate programme from these three sources is of the order of magnitude of $5 million a year.

Of these three sources the most crucial is the first — namely, the Agency's regular programme. This is used flexibly as 'seed money' to identify and initiate projects and to prepare the way for the larger and longer-lasting projects on which UNDP is increasingly concentrating its resources.

The Agency's regular programme depends entirely upon voluntary contributions by governments to a target set each year by the General Conference. The target remained static at $2 million from 1962 to 1971, when it was raised to $2.5 million; and the target has now been set at $3 million, which would barely compensate for the cost increase which has taken place since 1962.

The overall picture, therefore, is one of increasing realization in the developing world of the importance of the rôle that atomic energy can play in promoting economic and scientific development. It seems likely that the demand for the help that the Agency can offer will grow rapidly during the coming years and it is to be hoped that the affluent countries will make it possible for the Agency to discharge effectively this very important part of its responsibilities.

The Agency expects to provide during 1972 experts and equipment to assist in projects in 56 countries, at a budgeted cost to its own resources of $2 123 650.