Nuclear energy in Cuba: An indispensable link toward development

A review of progress in the introduction and use of nuclear technology in fields of energy, medicine, agriculture, industry, and science

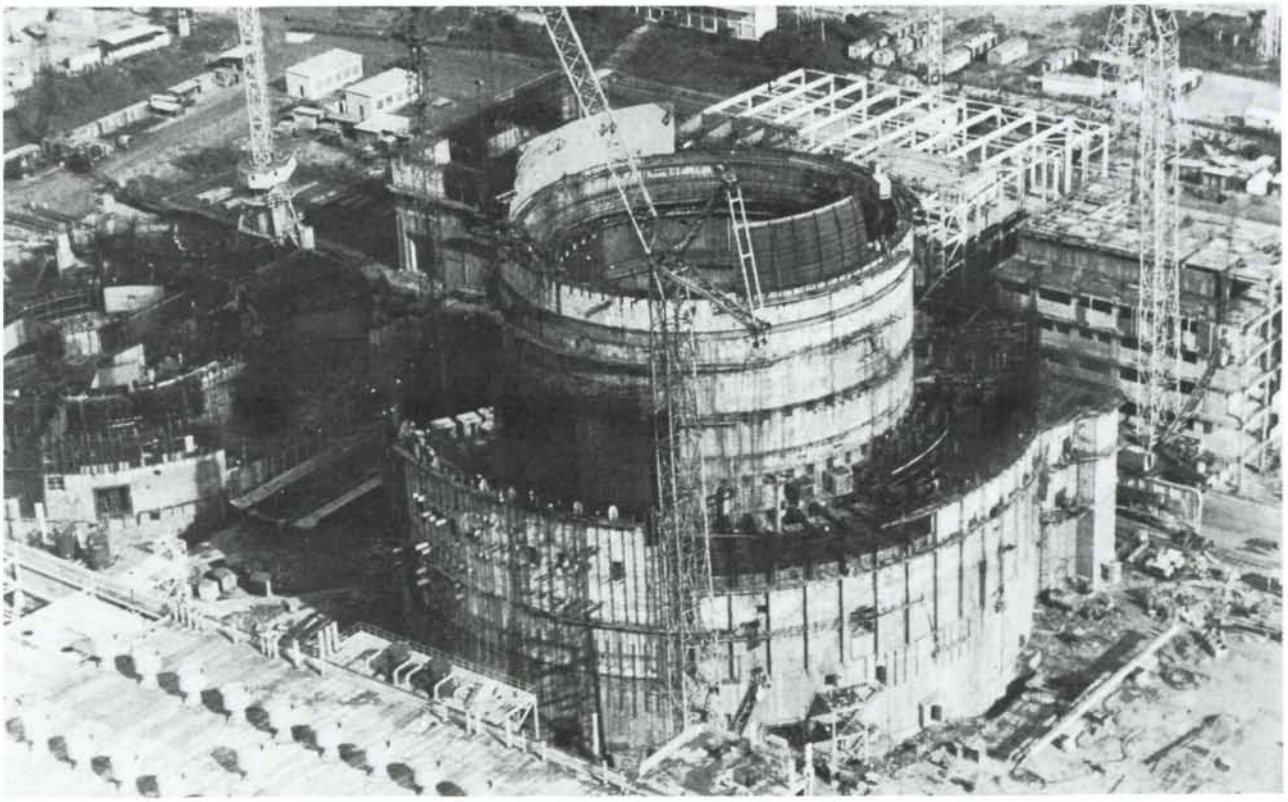
by Fidel Castro Díaz-Balart

With the chartering in 1990 of the Cuban Atomic Energy Commission (CAEC) and the Executive Secretariat for Nuclear Affairs (ESNA), Cuba took an important step toward the assimilation of the manifold peaceful uses of nuclear energy. Based on a well-structured programme and clearly defined objectives for each stage, the country was able to set up, in just under a decade, the essential elements and complex infrastructure required to build and operate nuclear power plants and begin a broad-ranging implementation of nuclear technology.

Energy for development

Cuba's first nuclear power plant is now under construction at Juraguá, in the province of Cienfuegos, the nation's nuclear activity centre.

Construction of the first reactor was begun in 1983 and the second in 1985. When fully operational, the plant will have four 417-megawatt Soviet VVER pressurized-water reactors. The plant's V/318 design is a more advanced version of similar units now in operation in several European countries and its containment



The Juraguá nuclear power plant is being built in the Cuban province of Cienfuegos.

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At Cuba's Center for Applied Nuclear Development Studies, medical and other research is being conducted employing radiolabelled compounds.

structure and other safety and operational parameters place it well within the present requirements of nuclear power generation technology. Plans include construction of a similar plant in the Easternmost region of the country, and studies are under way for a third plant in the Western region.

Realization of this essential part of the nuclear development programme is of vital importance for the country, which is lacking in energy resources and depends on imports for close to 70% of total energy requirements.

A gamma camera provided through the IAEA's technical co-operation programme is used for the study of cardiovascular disorders.

It is worth noting, in this context, that when all the Juraguá plant's reactors are fully operational, it will be turning out over 1600 megawatts of electricity, four times as much as Cuba's total installed power generation capacity in 1959, and 20% of its present installed capacity. This implies annual savings of 2.4 million tons of oil, which is twice the present production of domestic crudes and several hundred million dollars at current oil prices.

Of course, the assimilation of nuclear power generation is not circumscribed to the building of these plants. Work is also under way to develop a domestic capability to ensure maintenance services, chemical treatment of the cooling water, metrological validation of instruments, and a number of other aspects that are being studied together with the supplier, to ensure the safe and efficient operation of the reactors.

Conscious of the responsibility and the commitment undertaken, the specialists who are to be responsible for the operation of the plant are receiving the best available training and preparation in countries that have the necessary facilities and power plants similar to the one under construction. The country will gradually create the necessary conditions to undertake the retraining of the personnel on its own, and has already planned for a training centre with a simulator and other facilities, in line with the present requirements of nuclear energy.

Personnel training

Throughout the 1970s and into the mid-1980s, personnel training was done in the Soviet Union and other Eastern European countries. Ever since the opening of the Higher Institute for Nuclear Science and Technology in 1987, however, an increasing number are doing their studies in Cuba. (*See accompanying figure.*) Between 1980 and 1988, more than 650 college-level graduates, several times the total number that graduated before 1980, have joined the ranks of our technical personnel. Hundreds of technicians have also been trained abroad and at the Juraguá Nuclear Power Polytechnical Centre, since it was opened in 1981.

Radioisotopes in the economy

The use of nuclear technology and ionizing radiation has been considerably developed during the last decade.

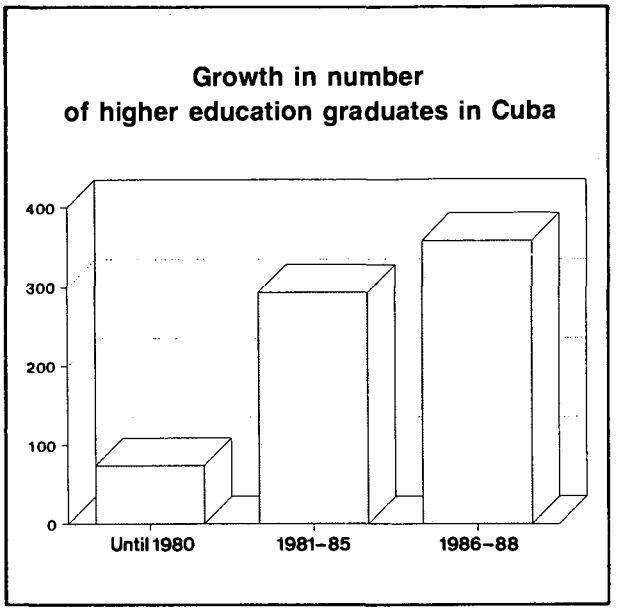
In the area of nuclear medicine, diagnostic methods using labelled compounds have already become important tools in the services provided by 15 specialized departments in all the country's provinces. Radiotherapy is presently being used in nine institutions for the treatment of malignant tumours, and a linear electron accelerator was recently put into operation for this purpose.

A pilot food irradiation plant was installed in the outskirts of Havana, and has been in operation since 1987.* During its initial operational stage, a number of agricultural products, such as potatoes, onions, garlic, cocoa, and spices, have been irradiated. A small irradiation device donated through a United Nations Development Programme (UNDP) project, has been used for research concerning radiation sterilization of medical and pharmaceutical products. Installation of an industrial-scale plant is presently in the study phase.

Also important are the prospects of employing nuclear technolgy in industry and agriculture, sectors that comprise the greatest number of entities that stand to benefit from these techniques.

Research using fertilizers labelled with nitrogen-15 has helped determine the precise timing and dosage to be used for nitrogen-based fertilizers. Furthermore, work is being done to introduce the sterile insect technique to control pests that attack sugar cane and corn. A pilot programme also is operational using radioimmunoassay techniques for early diagnosis of pregnancy in cattle.

Radioactive tracers and nuclear analytical techniques have been used successfully for some time in hydrological studies and in the sugar industry. These techniques will be gradually introduced in other industrial sectors. Ionizing radiation is already being used at over 160 centres throughout the country's 14 provinces.



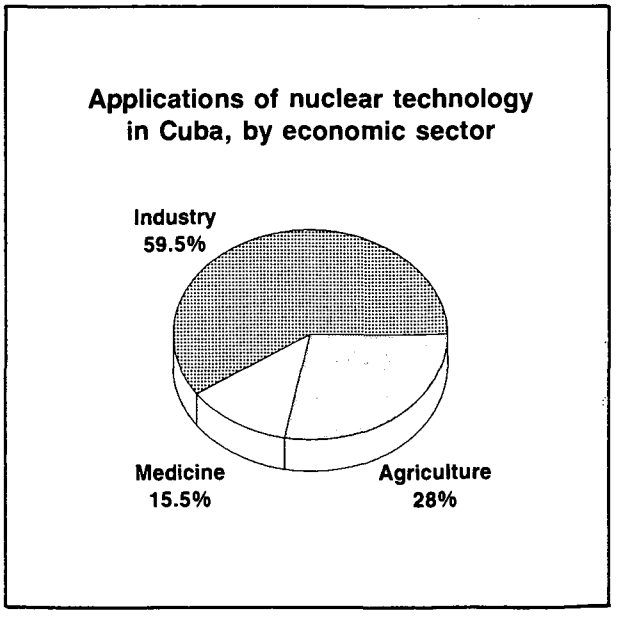
Scientific and technical infrastructure

All efforts made so far have required the development of basic and applied research as essential parts of the infrastructure needed to match the high scientific and technical demands posed by the nuclear project.

The establishment of the Centre for Applied Nuclear Development Studies was a positive step in this direction. The Centre's applied research provides scientific and technical services for various domestic institutions, and it incorporates and develops new technologies in the fields of the science of materials, electronics, and nuclear instruments.

The Centre, along with other institutions, has paid priority to quality control during the construction of the nuclear power plant. It has also given priority to the establishment of multi-disciplinary teams responsible for the solution of problems involved in operating nuclear reactors safely and maintaining them at optimum production levels. These teams have undertaken studies that cover, *inter alia,* reactor physics calculations and nuclear data evaluation. In coming years, the present experimental base will be expanded by the addition of a high-flux neutron generator, a 26-mega-electronvolt (MeV) microtron, a linear electron accelerator for industrial use, and a 30-MeV cyclotron for the production of radioisotopes.

An essential link in this infrastructure is the Nuclear Research Centre, a joint construction endeavour with the USSR since 1988, which will be equipped with a 10-megawatt research reactor, a critical ensemble for the study of the characteristic of VVER reactor cores, and various laboratories. The Centre will also comprise a group of new facilities, including the Isotope Centre, aimed at meeting growing domestic demands for radiopharmaceutical products and labelled compounds, and the Nuclear Instrument Application and Development Centre.



* The plant is the first of its kind to be established in Latin America with the support of the IAEA's technical co-operation programme and the United Nations Development Programme.

Nuclear safety and radiation protection

The passing of a number of laws, and the drafting of other regulations over the past decade, were a significant step toward the creation of the legal framework needed to ensure the safe use of nuclear energy and human and environmental protection against radiation. The need to monitor and operate this system determined the creation of the Centre for Radiation Protection and Hygiene, which is linked to an environmental radiological surveillance network covering laboratories located throughout the country. This Centre is also in charge of low-level radioactive waste management on a national scale.

This task becomes all the more significant when one considers that, although the major nuclear facilities are not yet in operation, Cuba has at present over 1200 instruments and facilities run by some 800 specialists and more than 1400 workers under occupational exposure. All of them are subjected to strict individual dosimetric control.

Nuclear safety is also monitored by a group of senior official inspectors from various government agencies, who together with the construction site inspectors and the ESNA territorial delegation, keep strict control of safety measures. In the near future, this activity will be entrusted to the National Nuclear Safety Centre, which is now being set up.

International co-operation

It should be stressed that the accomplishment of the proposed objectives in such a short period of time is largely due to the role played by co-operation with friendly countries, and international scientific organizations and centres.

Since 1981, bilateral co-operation has accounted for the training of over 550 specialists and more than 100 foreign experts have worked as technical advisers on various topics. Quantitatively assessed, this assistance amounts to more than 4.5 million Cuban pesos. Through the Council for Mutual Economic Assistance, the country has received equipment and aid valued at over three million transferable roubles. Another significant contribution has been the technical assistance and co-operation given by the IAEA which, in the past decade, totalled US $3.9 million. These funds went into the implementation of more than 30 projects and financed participation in various training courses. Also noteworthy was the technical assistance for about US $2 million provided by UNDP. Between 1980 and 1988 alone, assistance from these two agencies amounted to 87% of all the aid received in the nuclear field since 1958.

The nuclear option

All the above shows that Cuba has found understanding and support for its nuclear programme. The progress attained in little over a decade is based on the groundwork of the past 31 years, and on the priority attention the State has always granted to the development of this field.

The nuclear option is not only an unquestionable need for the country: it is, in fact, a right.

Whereas nuclear energy's introduction requires the creation of the necessary foundations, its multidisciplinary nature, in turn, converts it into a driving force for higher, faster, and more comprehensive development. This is an internationally well-known and indisputable fact, which also includes savings in costs, lower fuel consumption, and a reduction of the widely recognized impact on the environment.

The country's assimilation of the uses of nuclear energy is, therefore, an indispensable step toward development. Nuclear energy, now at the vanguard, will, in an unpredictably short span, become the "conventional" source of energy of the future. What may now demand 10 or 20 years of dedicated efforts might tomorrow become unattainable.