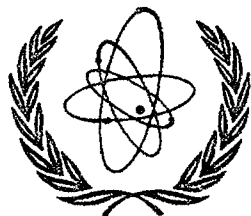


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ADVANCES IN THE APPLICATION OF NUCLEAR ENERGY FOR PEACEFUL PURPOSES

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BANGLADESH

1. The Bangladesh Atomic Energy Commission (BAEC) has been entrusted with undertaking research and development in the peaceful uses of atomic energy within the country, discharging international obligations and developing international co-operation in the field of atomic energy. Since its formation in 1973, the BAEC has formulated a development programme and organized its implementation on both a short-term and a long-term basis.

EXISTING FACILITIES

2. The BAEC has the following establishments:

- (i) Atomic Energy Centre, Dacca;
- (ii) Electronics Laboratory, Dacca;
- (iii) Space and Atmospheric Research Centre, Dacca;
- (iv) Institute of Nuclear Agriculture, Mymensingh;
- (v) Atomic Energy Medical Centre, Dacca;
- (vi) Atomic Energy Medical Centre, Chittagong;
- (vii) Atomic Energy Medical Centre, Rajshahi;
- (viii) Nuclear Minerals Centre, Chittagong; and
- (ix) Beach Sand Mineral Pilot Plant, Cox's Bazar, Chittagong.

3. These establishments have a wide range of equipment for research and development and also for field work. The main items of equipment are: a 3 MeV Van de Graaff accelerator, an IBM 1620 computer, a 5000 Ci source and a whole-body counter.

RESEARCH IN NUCLEAR SCIENCE AND ALLIED FIELDS

4. At the Atomic Energy Centre, Dacca, applied and fundamental research has continued in nuclear physics, solid-state physics, nuclear chemistry, radiation chemistry, electronics, theoretical physics, technical physics and health physics.

PROTOTYPE PRODUCTION OF ELECTRONIC AND OTHER SCIENTIFIC INSTRUMENTS

5. The Electronics Laboratory has been working on the design and small-scale production of electronic and scientific instruments for research and educational institutions. Most of the work is being done under contracts with the Bangladesh Equipment Development Bureau, the University Grants Commission and other Government agencies.

SPACE AND ATMOSPHERIC RESEARCH

6. The programme in atmospheric research is being carried out with a view to achieving a better understanding of cyclones, tornados, storms and similar phenomena. An automatic picture-receiving ground station has continued to receive cloud pictures sent by weather satellite. These pictures are analysed in co-operation with the Meteorological Department for weather-forecasting and storm-warning. The BAEC has also been participating in an Earth Resources Technology Satellite programme sponsored by the Planning Commission and conducted with UNDP assistance.

AGRICULTURE AND LIFE SCIENCES

7. The BAEC has intensified its research programme so as to contribute effectively to the national effort to boost agricultural production; it has been engaged in the development of high-yielding and early maturing crop varieties and the investigation of soil-plant relationships using radioisotopes and other nuclear techniques. Two improved varieties of rice (IRATOM-24 and IRATOM-38) have been distributed among farmers in a number of districts after successful trials; both varieties have been officially accepted for general use, and six more rice varieties are undergoing trials. Three varieties of jute (Atompat-28, Atompat-36 and Atompat-38) yielding 10-12% more fibre than the original varieties have also been developed and are now undergoing field trials. The BAEC has developed an improved variety of tomato (Anobik Tomato) and six varieties of disease-resistant, high-yielding sugar-cane; these are also undergoing field trials.

8. For better co-ordination and to facilitate such research work, the BAEC has completed the construction of the Institute of Nuclear Agriculture at Mymensingh. The Swedish International Development Authority, through the Agency, is providing US \$1 million for equipment, training and expert services. The Institute has already started research work and will be in full operation by early next year. Research projects have been started in collaboration with teachers from the nearby Mymensingh Agricultural University.

9. The BAEC has continued research relating to food preservation and pest control and obtained encouraging results, especially in the prevention of potato and onion sprouting and in the preservation of fish, fruit, vegetables and stored grains; the marketing life of some local fish has been extended up to 21 days. Such activities will be expanded when the construction of the Irradiation and Pest Control Research Institute (see para. 13 below) is completed.

10. In medicine, radioisotopes and ionizing radiation are being used for the diagnosis and treatment of diseases at the three existing Atomic Energy Medical Centres - at Dacca, Chittagong and Rajshahi. These centres, situated on the campuses of three medical colleges, have also been carrying out clinical research using radioisotopes obtained with the help of Agency grants, and papers on the results have been presented at international symposia.

EXPLORATION AND EXPLOITATION OF BEACH SAND MINERALS

11. On the basis of the findings of exploration by its geologists, the BAEC decided to set up a pilot plant for the exploitation of heavy minerals discovered at Cox's Bazar and on the off-shore islands. The construction of the plant and the installation of the equipment have been completed and trial operation is expected to start by the end of the year. To facilitate full exploitation of the heavy minerals, the BAEC is planning to establish an Institute of Beach Sand Minerals at Cox's Bazar. A commercial plant is expected to be set up in due course if the results obtained with the pilot plant are satisfactory.

12. The BAEC has been conducting nuclear material exploration surveys with Agency support in the form of equipment and experts.

ATOMIC ENERGY RESEARCH COMPLEX AT SAVAR

13. To streamline development programmes and facilitate the optimum use of its facilities and manpower, the BAEC has decided to establish an atomic energy research complex at Savar, near Dacca. The complex will include the following establishments:

- (i) Irradiation and Pest Control Research Institute (IPCORI);
- (ii) Institute of Nuclear Technology (INT);
- (iii) Institute of Nuclear Medicine (INM);
- (iv) Institute of Electronics (IE);

- (v) National Computer Centre (NCC);
- (vi) Institute of Space and Atmospheric Research (ISAR);
- (vii) Institute of Environmental Sciences and Health Physics (IESHP);
- (viii) Institute of Material Science and Technology (IMST);
- (ix) Nuclear Training Institute (NTI);
- (x) Institute of Nuclear Minerals and Materials (INMM); and
- (xi) Common facilities such as a workshop, a library, a cafeteria and residential quarters.

14. The establishment of the complex as a whole will take about ten years. It is proposed to establish during the first phase (up to 1978) IPCORI, INT, INM, IE and some common facilities such as the workshop and residential quarters. Completion of the remainder of the complex will be accomplished in subsequent phases. The land for the complex has already been allotted and the budgetary provisions necessary for the implementation of the first phase have been made by the Government. In addition, the BAEC has plans for establishing six more medical centres, attached either to medical colleges or to leading hospitals.

RESEARCH REACTOR

15. A 1 MW swimming-pool research reactor will be the main facility at the Institute of Nuclear Technology. The conceptual design of the reactor has already been completed by the BAEC's nuclear engineers and reactor physicists; detailed design work has started and is expected to be completed by the end of this year. It is hoped that the reactor will be in operation by 1978. A bilateral agreement has been concluded with India for technical assistance in this connection. For procuring reactor fuel and associated materials and equipment, the BAEC would need Agency assistance. The reactor will provide the BAEC's scientists and engineers with excellent facilities for research, training and isotope production; it will also be available to universities and different scientific research organizations for advanced work.

NUCLEAR POWER: ROOPPUR NUCLEAR POWER PROJECT

16. According to the Market Survey for Nuclear Power in Developing Countries, conducted by the Agency, there is scope for the construction of as many as ten nuclear power plants in Bangladesh during the decade 1981-90. The Government of Bangladesh decided that a 200 MW nuclear power plant should be established at Rooppur as the first phase of a nuclear power programme. Under the conditions prevailing in Bangladesh, a nuclear power plant as small as 100 MW(e) is economically advantageous compared to an oil-fired plant. The site at Rooppur was selected ten years ago. Since then, considerable money has been spent in collecting site data and in building residential quarters near the site for the plant staff. The 260 acre site is situated on the River Ganges, which will supply the cooling water; it is about 100 miles from Dacca and accessible by rail, road, river and air. Bangladesh has a corps of well-trained and experienced nuclear engineers and scientists for the project.

17. Every effort is being made to implement this nuclear power project, but suppliers of nuclear plant of the size in which Bangladesh is interested are difficult to find. The special discussions on small and medium power reactors which are to take place during the General Conference are expected to be of immense help to the prospective buyers of such reactors.

18. In view of the recent energy crisis, the Agency decided to review the market survey report on Bangladesh which it had prepared in 1973; a senior Bangladesh engineer was assigned to the Agency for this purpose. The draft report resulting from this review has been approved by the BAEC and the Agency and the final report is expected to be published during the current month.

19. A number of BAEC scientists and engineers are participating in the Bangladesh Energy Study, sponsored by the Planning Commission and being conducted with UNDP assistance.

TRAINING

20. The BAEC has been taking special care to provide its scientists, engineers and technicians with training in nuclear science and technology both at home and abroad. The training provided at home consists mainly of basic orientation courses and of specialized courses in solid-state physics, nuclear physics, nuclear medicine, geology and instrumentation.

21. Under different technical assistance programmes, several members of the BAEC's staff were sent for training abroad during the past year, the Agency playing a major part in the provision of fellowships. In the year under review, the Agency awarded the BAEC nine research contracts involving a total cash amount of about US \$25 000. Equipment to a value of about US \$35 000 was also received by the BAEC.

INTERNATIONAL RELATIONS

22. The BAEC is keenly interested in developing international co-operation in the peaceful uses of atomic energy with Member States in general and with Member States in the Middle East and South and South-East Asia in particular. Bangladesh is ready to co-operate with those who wish to benefit from its knowledge and experience in the peaceful uses of atomic energy and would welcome help from and co-operation with advanced countries in enhancing that knowledge and experience.

23. Bangladesh has been taking an active part in the Asian Regional Project on Radiation Preservation of Fish and Fishery Products under the Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology. Bangladesh also participated in the Agency's Panel on Power Reactors of Interest to Developing Countries, held in Vienna in November 1974, in the First Asian Regional Congress on Radiation Protection, held in Bombay in December 1974, and in the Agency's Symposium on Ionizing Radiation for Sterilization of Medical Products and Biological Tissues, held in Bombay in December 1974.

24. Bangladesh has been participating in the Agency's International Nuclear Information System through the national network of scientific information sources which is being organized within the country.

CANADA

1. In 1974, the Ontario Hydro Pickering Generating Station produced 13 377 000 megawatt hours despite the fact that one unit had to be shut down for an extended period of repairs. The net capacity factor of the station during 1974 was 74%. Pickering Unit 4 produced 4 462 110 megawatt hours, while Unit 2 in 1974-75 operated continuously for 217 days at full capacity.
2. Construction of the 3000 MW Bruce Generating Station by Ontario Hydro on Lake Huron is well advanced, and it is expected that the first 750 MW unit will produce first steam to turbine early in 1976.
3. Construction work started on four more units at Pickering, and approval of the Bruce "B" station, comprising 3000 MW, is expected shortly. Hydro-Quebec is proceeding with the construction of Gentilly 2, a 600 MW unit scheduled to be on line in 1979. It is being built on a site adjacent to the Gentilly 1 station, near Trois Rivières in Quebec, and with Gentilly 1 will be capable of supplying steam to the La Prade Heavy Water Plant, which is being built nearby by Atomic Energy of Canada Limited (AECL).
4. The New Brunswick Electric Power Commission is proceeding with the construction of a 600 MW unit similar to Gentilly 2. The unit is expected to come on line in 1981.
5. The rehabilitation of the Glace Bay Heavy Water Plant is virtually completed, and the present commissioning schedule indicates first production before the end of 1975. The capacity of the plant is 360 metric tons per year. AECL has purchased from Canadian General Electric Company Limited the Port Hawkesbury Heavy Water Plant, which in 1974-75 produced at 70% of its design capacity (360 metric tons per year). The Bruce Heavy Water Plant, owned by Ontario Hydro, produced at 73% of its design capacity (720 metric tons per year). Between them the Bruce and Port Hawkesbury plants produced 361 megagrams of reactor-grade heavy water in the twelve-month period ending 31 March 1975 -- a 38% increase over the previous year. The output of these plants is expected to increase in the coming year and will be augmented by the first production from Glace Bay.
6. Ontario Hydro has been authorized to proceed at Bruce with the construction of an additional two heavy water production plants similar in size to the one that is now in operation.

PAKISTAN

INTRODUCTION

1. The Pakistan Atomic Energy Commission (PAEC) continued to expand its broad based programme for peaceful uses of atomic energy. During the year new projects were initiated. Emphasis has been given to the generation of nuclear power to meet the growing energy shortage and to the search for uranium. The application of nuclear techniques in agriculture, with particular emphasis on the evolution of improved varieties of food and cash crops and preservation of food-grains, and the use of radio-isotopes in the medical application of atomic energy continued to receive particular attention.

NUCLEAR POWER GENERATION

2. Since its achievement of full power in October 1972, the Karachi Nuclear Power Plant (KANUPP) has produced 1.6 billion kWh of electric power with an average availability factor of 77%. The plant continued to be run and maintained by Pakistan engineers.

3. The detailed documents for inviting bids for a 600 MW nuclear power plant have been completed. Site investigation and geological studies are under way. It is expected that the bids will be invited shortly.

AGRICULTURE

4. The two atomic energy centres for agriculture, namely the Nuclear Institute of Agriculture and Biology (NIAB) at Lyallpur and the Atomic Energy Agricultural Research Centre, Tandojam have been doing work for the development of high yielding, early maturing and disease resistant varieties of wheat, rice, cotton, legumes and sugar-cane. Work is also being done to improve protein quality and quantity in cereals and legumes. Two mutants of Basmati rice which mature about three weeks earlier and give the same yield as the parent have been evolved at NIAB, Lyallpur.

5. A proposal has been formulated for the Atomic Energy Centre for Marine Products to be set up at Karachi, where research on various aspects of radiation preservation of fishes would be carried out.

6. A pilot scale project on the eradication of fruit flies through the sterile male technique is being taken in hand with the active collaboration of the Federal Plant Protection Department.

7. Land for construction of another atomic energy agricultural research centre at Tarnab in North West Frontier Province has been acquired. Construction of the main building is to commence soon. The centre would specialize in the radiation preservation of fresh and dried fruit. However, it would also have facilities for conducting research in the improvement of two of the most important crops in the region, namely tobacco and sugar-cane, and for work in such fields as entomology, soil science and plant physiology.

MEDICAL

8. During 1974-75, about 20 000 patients were treated in the Radiotherapy and Nuclear Medicine Departments of the PAEC Medical Centres at Karachi, Jamshoro, Multan and Lahore.

9. The Institute of Radiotherapy and Nuclear Medicine (IRNUM) at Peshawar, with the provision of 42 beds for indoor patients, has started functioning. It is the most modern and well equipped of its kind in Pakistan. Construction of the sixth nuclear medical centre of PAEC at Larkana in Sind Province has commenced and is expected to be completed by the end of next year.

PROSPECTING FOR URANIUM

10. Keeping in view the uranium requirements for the projected nuclear power plants in the country and world-wide demand for uranium, PAEC has stepped up its programme for prospecting and exploitation of uranium in the country, by using aerial, airborne and geo-chemical survey techniques.

11. Besides discovering uranium in the sandstone rocks of Dera Ghazi Khan, where a project sponsored by the United Nations Development Programme is under way, an extension of these rock formations has been located over wide areas in the country in the south and the north. In addition, uranium showings in other geological formations have been located and some deposits of thorium and zirconium and other heavy elements have also been found.

TRAINING

12. Special emphasis is being placed on the training of scientists, engineers and technicians. The Reactor School at the Pakistan Institute of Nuclear Science and Technology (PINSTECH) can accommodate about 100 students every year for studies leading to a master's degree in nuclear technology. In addition a Nuclear Power Training Centre has been established to meet the growing demand for nuclear power engineers, operators and technicians.

