

Current Status of Education and Training in Nuclear Technology in Bangladesh

*International Affairs Division
Bangladesh Atomic Energy Commission
P.O. Box 158, Ramna, Dhaka1000, Bangladesh*

1. Introduction

Bangladesh Atomic Energy Commission (BAEC) is the national authority for the introduction, promotion and safety issues of nuclear science and technology in the country. During the last four decades, a significant development has been achieved in the field of food and agriculture, medicine, industries and environment using nuclear technology. Education and training in science and technology played a vital role to achieve the significant development in these fields. Some local public universities and BAEC training facilities at home and abroad have played mainly a key role to develop the human resource in the field of nuclear science and technology.

Over the last four decades, BAEC with its various specialized establishments has played a focused role in the advancement, understanding and usage of nuclear science and technologies in the country. Through years of cumulative efforts, BAEC has developed a pool of research infrastructure, capacity and human resources having been trained extensively at home and abroad in their respective fields.

The trained manpower in the different fields of science and technology are working in the country to solve some national problems like arsenic contamination in drinking water, iodine deficiency disease goitre, cancer and many others.

2. Training Facility in Nuclear Technology

To build up skilled man power in the field of nuclear science and technology BAEC has the program of local training as well as of foreign training.

2.1. Local Training

BAEC usually arrange nuclear orientation course for the newly recruited scientists in different disciplines. This program is conducted by its own resource persons. The basic knowledge in nuclear technology is usually imparted through this training. BAEC usually provide it's newly scientists with some specialized advanced training course on nuclear engineering, reactor physics, nuclear physics etc. BAEC arranges training courses on computer science at different levels. Engineers and technicians working at different government organization and NGOs are provided with training courses on NDT at different levels. BAEC regularly train up radiation workers working at different radiation

installations in the country. BAEC every year arranges several national training courses on specialized topics like QA/QC on different analytical measurements, advanced electronics, nuclear safety and radiation control etc.

2.2. Training Abroad

BAEC regularly trains up its scientists in different fields at different advanced laboratories in abroad under the technical support of Technical Cooperation (TC) and RCA Programs of International Atomic Energy Agency, Vienna, Austria. BAEC scientists are also regularly trained up under the scientists exchange program between Bangladesh and Japan i.e. MEXT program of Japan. About 100 scientists are availing the opportunity of getting short, medium and long term foreign training in every year

3. Education

Public universities namely University of Dhaka, Jahangirnagar University, Rajshahi University, Chittagong University, Shahjalal University of Science & Technology and Bangladesh University of Engineering offer several courses on nuclear physics, reactor physics, and medical physics in Masters, M. Phil and Ph. D. programs. Scientists of BAEC also have the privilege to carry out on-the-job higher studies like M.S. Ph. D. in nuclear technology at different universities at home and abroad. In some cases government bears the expenses of higher studies under the scope of national projects. Institute of Nuclear Medicine and Ultrasound (INMU) of BAEC is affiliated with the University of Dhaka for awarding M. Phil degree in nuclear medicine. BAEC scientists are providing the medical students of Bangladesh College of Physicians and Surgeons (BCPS) with advanced radiological courses in FCPS program. Every year about 400 students complete their university education having nuclear backgrounds.

4. Nuclear Development in the Country

Bangladesh Atomic Energy Commission (BAEC) is the pioneer research organization in the country. It is using nuclear technology for the socio-economic development of the country since 1962. Different institutes, centers and laboratories with modern facilities are developed sequentially which includes 3 MW TRIGA Mark II research reactor, 3 MV Van de Graff accelerator, 50 kCi Co-60 gamma irradiator, neutron generator and modern sophisticated medical equipment etc. The areas in which BAEC and other organization in the country is working during the last three decades are medicine, food and agriculture, industries and environment. BAEC is concerned with the safety issues of the nuclear and other ionizing radiations. It has already established the legal framework for the control of all nuclear installation in the country. There is nuclear safety and radiation control act and nuclear safety and radiation control rules, which covers all the necessary safety measures to handle the all sorts of radiation protections. Different important nuclear activities of the country in different areas are listed below:

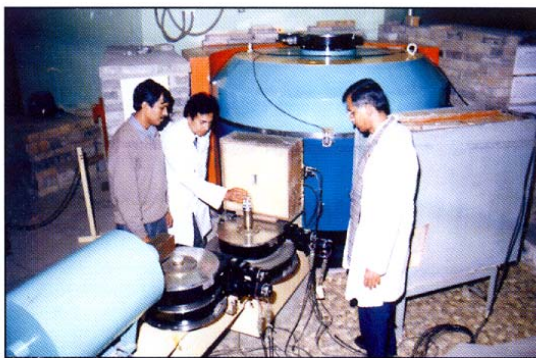
4.1. TRIGA Mark II (3 MW) Research Reactor

TRIGA Mark II research reactor of BAEC is the only nuclear reactor of the country. It is a tank type research reactor and is used for training, research and isotope production.. Since its

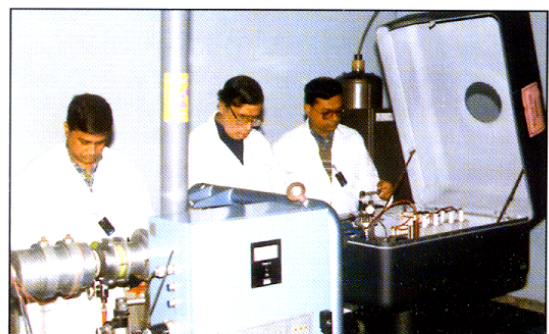


TRIGA Mark II Reactor at AERE, Savar, Bangladesh

commissioning the reactor has been used in various fields of research and utilization, such as, neutron activation analysis, neutron scattering, neutron radiography, radiation shielding experiments, production of isotopes, training of manpower, education etc.



TAS at TRIGA reactor



Neutron generator

4.2. 3 MV Van de Graaff Generator

The accelerator is capable of producing proton, deuteron, and alpha particle beam with acceleration potential up to 3 MV. It is also capable of producing neutron or X-ray beam using suitable target. The accelerator is extensively used for elemental analysis of environmental, biomedical and industrial samples in the range of parts per million or even at lower concentrations. The experimental tools utilized are: Proton Induced X-ray Emission (PIXE), Proton Induced γ -ray Emission (PIGE), Rutherford Backscattering Spectrometry (RBS) and Nuclear Reaction Analysis (NRA)



Radiographic testing of aircraft



3 MV Van de Graaff Generator

4.3. Non-Destructive Testing (NDT)

The NDT facility of BAEC has been working to develop and promote the science and practice on NDT as well as its applications in industries with the objective to make the country self-reliant on this technology. This facility includes:

- a. 200kV and 300kV unidirectional portable X-ray machines.
- b. Ir-192 gamma projectors with remote controls.
- c. Portable digital ultrasonic flaw detectors and thickness gauges.
- d. Portable electromagnetic yoke and current generator.
- e. Magnetizing and demagnetizing coils.
- f. Single frequency multipurpose eddy current tester.
- g. Fluorescent and non-fluorescent liquid penetrant testing kits.
- h. Schmidt hammer and Electro-magnetic rebar locator.

4.4. Central Radioactive Waste processing and Storage Facility:

A Central Radioactive Waste Processing and Storage Facility is near completion at AERE, Savar campus of BAEC. On completion, radioactive wastes and spent radiation sources (generated from nuclear application in the country) would be safely processed and stored in this facility.

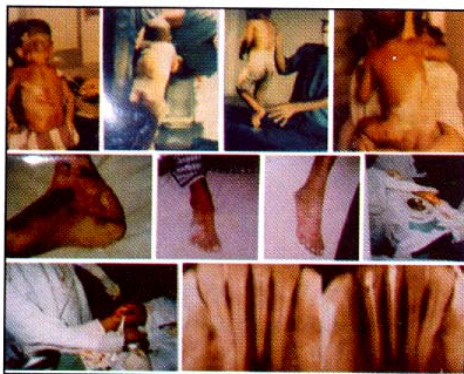
4.5. Gamma irradiators

In Bangladesh there are three number of gamma irradiator facilities, they are used for variety of purposes in research, industry, and other fields.

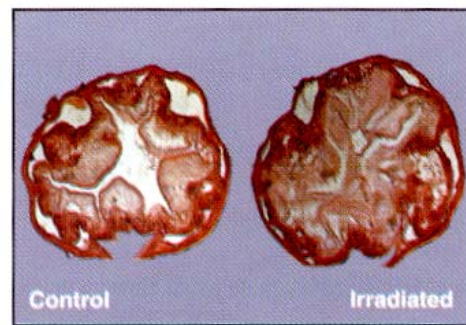
BAEC has been carrying out research activities using a 50000-Curie gamma radiation source facility at the Institute of Food and Radiation Biology (IFRB) at Savar on food preservation and sterilization of medical products. Irradiation services are rendered using this source to more than 20 organizations including Jayson Pharmaceuticals Ltd, Acme Pharmaceutical Ltd, Padma Cans and Closures Ltd, Gaco Pharmaceuticals, Renata Ltd, City Hospitals, etc.

4.6. Tissue Banking

More than 500 amnion membranes were collected, sterilized using a 50000-Curie gamma radiation source and supplied to the doctors for treatment of different diseases.



Clinical application of tissue allografts



Gamma ray treated insect tissues

Besides, 100 bones have been collected, sterilized and supplied for treatment of orthopedic patients. In addition to this, bone grafts were also supplied for ordinary surgery.

4.7 Pest control and management:

Nuclear and biotechnological approaches have been developed in the country, and are being used for the protection and preservation of stored as well as field crops through integrated pest management. About one million sterile blowfly have been released for the first time in Sonadia island of Cox's Bazar to control its population in the island using Sterile Insect Technique (SIT). Blowfly is a detrimental pest of dried fish in Bangladesh.

4.8 Biotechnology and genetic engineering:

Plant Biotechnology is one of the pioneer laboratories in developing tissue culture research. The Co^{60} source at AERE, Savar is being used for this purpose. This work has

been initiated in the early eighties with the micro propagation of fast growing forest trees. In course of time, fruit, medicinal and ornamental plants have been included in the program. *Agro bacterium* mediated genetic transformation has also been initiated with fiber crop jute in Bangladesh.

5. Nuclear medicine centers

There is one Nuclear Medicine Institute at Dhaka and 13 Nuclear Medicine Centers (NMCs) located in different parts in the country. In addition to that three private clinics are rendering services nuclear medicine. In these NMC establishments investigations are conducted for the disorders in organs like thyroid, brain, liver, kidney, bone, spleen, etc. Malnutrition, anemia, functions of kidney and heart are also investigated. Tc-99, I-131 etc isotopes are being used for diagnosis and therapeutic purposes in the Nuclear Medicine Centers. Treatment services for more than a hundred thousand patients are being provided from all these 14 stations per year.



Gamma Camera Imaging



Treadmill Stress for Cardiac Scan

6. Diagnostic X-ray and Therapeutic Services

There is a wide network in diagnostic and therapeutic services facilities in the country. There are about 3000 diagnostic X-ray installations present mostly in urban area of the country. In addition to that about one dozen computed tomography devices are present in diagnostic area. The radiotherapy units available mostly in teaching hospitals. There are about 12 Co-60 units and 2 LINAC along with therapeutic brachytherapy present in the country.

7. Nuclear Power and Energy

Nuclear energy issues of Bangladesh, as well as, planning and implementation of nuclear power project is the main concern of Bangladesh Atomic Energy Commission. Several past studies have established the technical, economic and financial viability of the Rooppur nuclear power project. The need for nuclear power was also established in the National Energy Policy of Bangladesh. The priority of the project is further evident from the fact that a Cabinet Committee, chaired by the Head of the Government, is in

existence to identify problems of implementation of the project and to provide policy guidelines in solving such problems.

Some progress had made during the period in preparation of the Site Safety Report for the proposed 600 MW (e) Rooppur Nuclear Power Project. The scientist/engineers of the respective division of BAEC have carried out investigations as suggested by the IAEA for the Rooppur site mainly in the areas of seismic studies, radiological dispersion studies and the draft of the site safety report is completed.

8. Safety Issues

In Bangladesh, the activities involving nuclear and radiation techniques and practices are diversified and used in a variety of fields and address the needs of a number of sectors of national economy, such as healthcare, industry, agriculture, construction, water resources, isotope production, food preservation, oil and gas exploration, etc. This trend is likely to grow significantly in the future in keeping with overall goals of socio-economic advancement. Issues of nuclear safety and radiation control have, therefore, assumed overwhelming importance. This necessitated introduction of laws and rules on regulatory control over radiation practices. For the nuclear safety and radiation control in the different areas, government has passed an act known as the Nuclear Safety & Radiation Control Act¹ No. 21 of 1993 followed by Nuclear Safety & Radiation Control rules² 1997.

9. Future Plan for Education and Training in Nuclear Technology

BAEC is going to establish a “Nuclear Training Institute” which will also have residential facilities. Government has already assured to fund to establish the Nuclear Training Centre in the campus of AERE, Savar. BAEC placed a formal proposal for Affiliation with Jahangirnagar University for Awarding Post Graduate Degrees in different specialized fields of nuclear science and technology. As this might take some time for implementation; therefore, BAEC has decided to start the academic program immediately under the present set-up of the organization.

With this view, BAEC proposes to affiliate its Nuclear Training Institute with the Jahangirnagar University for pursuing academic degree programmes i.e. post graduate diploma, M. S., M.Phil. and Ph.D. in the following specialized fields of nuclear science and technology :

1. Reactor Science and Technology
2. Nuclear and related Analytical Science
3. Nuclear safety and radiation control
4. Nuclear Instrumentation and Control
5. Nuclear Power and Energy
6. Materials Science
7. Radiation Medicine
8. Nuclear Geology
9. Radiological Science
10. Radiation Biology
11. Environmental and Molecular Biology

10. Needs for Regional Cooperation in Nuclear Education and Training

For a sustainable nuclear technology, regional cooperation is necessary to promote, manage and preserve nuclear knowledge. Regional cooperation is needed to ensure the continued availability of talented and qualified manpower in the nuclear field in the Asian region. It is necessary to enhance the quality of the human resources for the sustainability of nuclear technology. To uphold the nuclear technology in the Asian region, collaboration among the universities, research centres and training institutions is very much essential.

11. Conclusion

Bangladesh has been started to use nuclear technology four decades ago. At present its activities increased by many folds and its successful applications in different sectors have played a vital role for the socio-economic development of the country. During this period many activities have been transferred from laboratories to hospitals, agriculture or industries. Radiation is used successfully in the country for medical kit sterilization, tissue banking, food preservation, nondestructive testing, production of more crops, disease diagnosis and treatment. Collaboration among the universities, research centres and training institutions is very much essential to uphold the nuclear technology in the Asian region.

References

1. NSRC Act No. 21 of 1993.
2. NSRC Rules-97 (SRO No. 205-Law/97).