

NATIONAL NUCLEAR RESEARCH INSTITUTE (NNRI)



At A Glance



*nuclear science
for national development*

BRIEF HISTORY

The National Nuclear Research Institute (NNRI) of the Ghana Atomic Energy Commission (GAEC) was originally established by an Act of Parliament, **Act 204 of 1963** as the sole institute of the Commission responsible for all matters relating to peaceful uses of atomic energy. The founding Act 204 was amended in 1993 by PNDC Law 308 mainly to enable it to create other institutes under the Commission. This amendment resulted in the creation of two other Institutes in addition to NNRI.

MANDATE

NNRI derives its goals and objectives from the functions prescribed in Act 588 of 2000. It is also responsible for the operation of all high-level government-owned nuclear facilities in the country.

VISION

Excellence in development and peaceful application of nuclear science and technology.

MISSION

NNRI exists to promote and strengthen nuclear science and technology research, training and development for the socio-economic development of Ghana.

STRATEGIC OBJECTIVES

The main objectives of the Institute are:

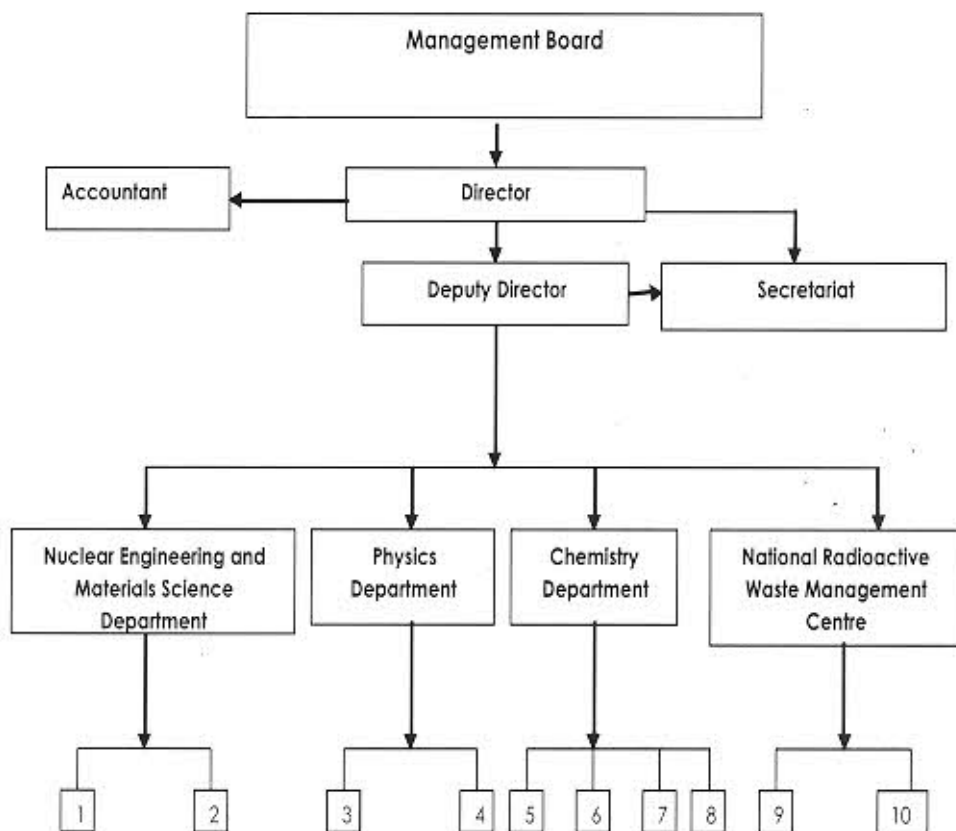
- To engage in research and development activities using nuclear techniques in the area of environment, industry, health and other related sectors;
- To encourage and promote commercialization of research and development results;
- To build national capacity in nuclear science and technology;
- To assess and manage radioactive waste in a sustainable manner;
- To promote and maintain relations with relevant national and international institutions for mutual exchange and dissemination of information and results.

ORGANISATION AND MANAGEMENT

At the policy level, the Institute is managed by the NNRI Management Board which reports to the GAEC Board. Fig. 1 shows the detailed organogram.

The day to day management of the Institute is undertaken by the Director and the Administration Committee, comprising of the Director, Deputy Director, Heads of Departments, Managers of Centers, Scientific Secretary/Head of Administration and Finance Officer.

Fig 1. - ORGANISATION STRUCTURE



1. Non-Destructive Evaluation Services (NDES) Section
2. Ghana Research Reactor-1 Centre (GHARR-1)
3. X-Ray Fluorescence
4. Solid State Nuclear Track Detection
5. Geochemistry and Applied Isotope
6. Radiochemistry
7. Environmental Analytical Chemistry
8. Pesticide Residues
9. Health Physics
10. Waste Management

PROGRAMMES

The research and development activities of NNRI are undertaken by a number of facilities and laboratories including the 30kW Ghana Research Reactor (GHARR-1) which provides neutrons for activation analysis (NAA). Generally research work involves the following:

- Environmental monitoring and quality control of various particulate matters in air, water, soil and food items using X-Ray fluorescence analysis;
- Monitoring of bovine tuberculosis in selected kraals in the Greater Accra region;
- Multi-elemental analysis of biological, environmental, geochemical and geological, medicinal and health, food and nutrition samples using thermal and epithermal neutron activation analysis;
- Groundwater hydrochemistry, pollution of surface water bodies and isotope applications in water resources assessment;
- Determination of residence time distribution measurements and flow rates in process plants using sealed radioactive sources and radiotracers;

- Radon gas monitoring in various mine sites and linkages between radon gas emissions and seismic activities in southern Ghana;
- Studies in criticality safety analysis and shielding.

On-going Research Activities

1. Nutrition and health-related studies using GHARR-1
2. Radioisotope applications for troubleshooting and optimizing industrial processes.
3. Non-destructive evaluation of concrete structures.
4. Isotope applications for groundwater resources assessment in the Densu River Basin.
5. Geochemical, stable isotope and hydraulic relationships in some selected coastal wetland systems in Ghana.
6. Air quality monitoring and studies.
7. Developing urban zone air pollution monitoring.
8. Identification and assessment of hazards from technically enhanced naturally occurring radioactive materials (TENORM).
9. Geochemical and geophysical investigation of GAEC site to determine its suitability for implementation of the Borehole Disposal Concept.

The Institute also provides services in the areas of:

- Non-destructive testing and radiotracer applications in determining anomalies in industrial plants;
- Elemental analysis provided to various clients in the mining, petroleum and chemical industries.
- Management of radioactive waste

The Institute's facilities are also available for the training of students from the School of Nuclear and Allied Sciences and other tertiary institutions.

DEPARTMENTS/CENTRES

The Departments and Centres undertake research and development programmes which are financed by government subvention and financial/technical support from the International Atomic Energy Agency and other development partners.

1. Nuclear Engineering and Materials Science Department (NEMS)

Sections / Units and Activities

a. Non - Destructive Evaluation Services (NDES) Section

This section provides technical consultancy and inspection services for all types of engineering materials, components, assemblies and installations. The non-destructive examination services can be performed in-house or at remote field locations. A mobile dark room is available to facilitate field work. The services provided are:

1. Radiographic Testing (RT); Iridium and X-Ray
2. Ultrasonic Testing (UT); Ultrasonic Flaw Detection and Ultrasonic Thickness Gauging
3. Magnetic Particle Testing; (MT)
4. Liquid Penetrant Testing (PT)
5. Radio Isotope Based Technology- Scanning of distillation columns in the petrochemical industries.

These methods are used to test welds in pressure vessels, storage tanks, pipelines etc to ensure that there are no defects. Personnel involved in the performance, evaluation and the supervision of inspection are fully qualified to the various levels of capability in accordance with SNT-TC-1A, of the American Society for Non Destructive Testing and the South African Qualification and Certification Committee-NDT, (SAQCC-NDT).



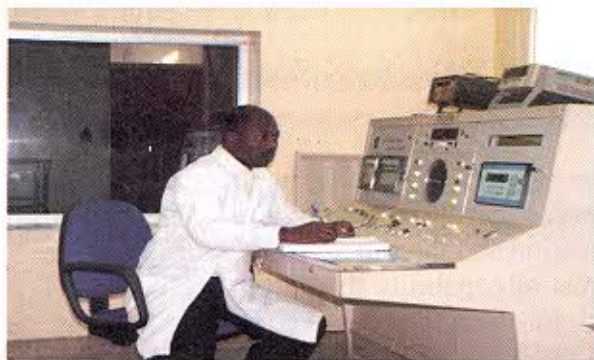
NDES staff carrying out radiographic inspection on the West Africa Gas Pipeline at the Takoradi Thermal Power Plant.

b. Ghana Research Reactor-1 (GHARR-1) Centre

The Ghana Research Reactor-1 (GHARR-1) Facility has a Miniature Neutron Source Reactor which provides neutrons for activation analysis (NAA) for both research and commercial purposes. NAA is used to provide services to the mining, industrial, medical, agricultural, geological and environmental sectors. Services include:

- Measurements of relative amounts of trace elements or contaminants.
- Multi-elemental analysis.

The reactor is also used for training nuclear scientists and engineers and for various research work by universities and other research institutions. The reactor can be used to produce short lived radioisotopes for tracer technology.



Major facilities in the department are:

- Ghana Research Reactor-1
- Ir-192 Gamma projectors
- 300kv X-ray machines
- Ultrasonic flaw detectors
- Ultrasonic thickness gauges
- Elcometer for concrete testing
- Soil nuclear density gauge
- Mobile dark room

2. Department of Chemistry

Sections / Units and Activities

Research activities at the department are focused mainly on health, environment, analytical chemistry and radiochemistry. They are all targeted towards solving pertinent national problems which affect a vast number of both rural and urban populace.

a. Nuclear Chemistry and Radiochemistry Research

This unit is involved mainly in radiochemistry research and their application to health, analytical chemistry and environmental studies. One of the key projects is the use of radionuclide neutron activation analysis of the essential and some trace elements in food. Multi-elemental analysis are carried out on biological, environmental, geochemical, geological, medicinal and health, food and nutrition samples using thermal and epithermal neutron activation analysis. This technique is also applied in the preparation of in-house reference materials.

b. Environmental Research

i. Geochemistry and Applied Isotope Research

The main research activities in this unit involve the application of hydrogeological and hydrochemical techniques in understanding the water cycle and the parameters that influence its chemical dynamics. Both conventional and isotope techniques are used to better understand the dynamics of the water cycle. Recharge studies and water quality assessment are also major activities of the laboratory. These techniques are being used to determine the hydrochemical status of the Densu delta and Sakumo coastal wetlands.



Atomic Absorption Spectrometer

ii. Pesticide Residue

The section undertakes research activities in residue problems associated with the use of pesticides on food and cash crops, soil and water to boost Ghana's agricultural production and protect human health. Use of pesticides has increased drastically due to numerous pest problems facing the Ghanaian farmer. The pesticide residue profile of the Densu River Basin is being undertaken. The quality of pesticide products imported, as well as those formulated locally are determined to ascertain manufacturer's claim of quality. The section also trains both under and postgraduate students on the techniques involved in pesticide residues studies. Chromatographic techniques such as Gas Chromatography and Thin Layer Chromatography are employed.

The following is the list of major equipment available in the department:

Instrumental Inorganic Analysis:

- Fast sequential Atomic Absorption Spectrometer (AAS) fitted with an auto sampler and a sample injection pump system (SIPS)
- Flame Photometer
- Ion Chromatograph (IC)
- Ion selective electrode analyzer

Instrumental Organic Analysis:

- Gas Chromatograph (GC) fitted with an auto sample injection system
- High Pressure Liquid Chromatograph (HPLC) fitted with an auto sampler
- Fourier Transform Infra Red Spectrometer (FTIR)

Isotope Analysis:

- Liquid Scintillation Counter

3. Department of Physics Sections/ Units and Activities

a. X-ray Fluorescence Analysis

X-ray fluorescence analysis is a non-destructive technique used for elemental analysis of solid and liquid samples. The specimen is irradiated by an intense x-ray beam and the sample in turn emits fluorescence x-rays that characterize the elements contained in the sample. Using the peak energies of the x-ray spectrum produced, the elemental composition of the sample can be identified and quantified. Samples analyzed include:

- Mineral ores and industrial raw materials;
- Environmental samples (air, water, soil and vegetation Monitoring).



X-ray Fluorescence Spectrometer

b. Solid State Nuclear Track Detection (SSNTD)

The SSNTD laboratory offers services to Estate Developers, mining industry and individuals in:

- Radon gas measurement. Radon is a radioactive gas which can cause lung cancer after a long exposure.
- Uranium Prospecting and geophysics.
- Monitoring of naturally occurring radioactive materials (NORM).



Analysis of Radon Concentration Levels

Facilities in the department include

- X-Ray Fluorescence Spectrometer.
- Solid State Nuclear Tract Detector.
- Accelerator facility (under construction).
- Air particulate monitors.
- Smoke stain reflectometer or black carbon analyser.

4. National Radioactive Waste Management Centre (NRWMC)

Activities

The Centre undertakes radioactive waste safety operation at GAEC and in Ghana, which is a Class C country by IAEA classification. This is because radioactive waste is generated from medical, industrial and research applications from radioactive materials as well as from research reactor utilization. Radioactive materials such as radiation sources used in medicine, industries (e.g. brewing, mining and road construction industries) and research pose health risk and must be safely and securely managed at the end of their useful life. The Centre operates a centralised radioactive waste processing and storage facility that help waste generators to manage their waste, treat, store and transport the waste to the centralised Waste Management facility at Ghana Atomic Energy Commission for treatment, conditioning and storage awaiting disposal. The Centre operates a computerised radioactive waste management registry for all radioactive waste generated and collected.

Facilities in the Centre include

- Hand Foot monitor
- Alpha Beta Particulate Air Monitor Model 333-2
- Ludlum Model 375-30RWM Waste Monitor
- Multi Purpose Radiation Meter

CLIENTS

Some of the clients served by the departments and centres are listed below.

NEMS

Both the NDES Section and GHARR-1 Centre of the Department rendered scientific, technical, and commercial activities to organisations, companies and individuals.

- Environmental Protection Agency (EPA)
- Geological Survey
- Sungold
- Xara Equipment Ghana Ltd.
- UN Millennium Villages Project Prestige
- Gevdita Resources

