

# THE 30kW RESEARCH REACTOR FACILITY IN GHANA: PAST, PRESENT AND FUTURE PROGRAMMES

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# PRESENTATION OUTLINE



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# INTRODUCTION

**Miniature Neutron Source Reactor (MNSR) is used as a source of neutrons for neutron activation analysis at research institutions, universities and hospitals.**

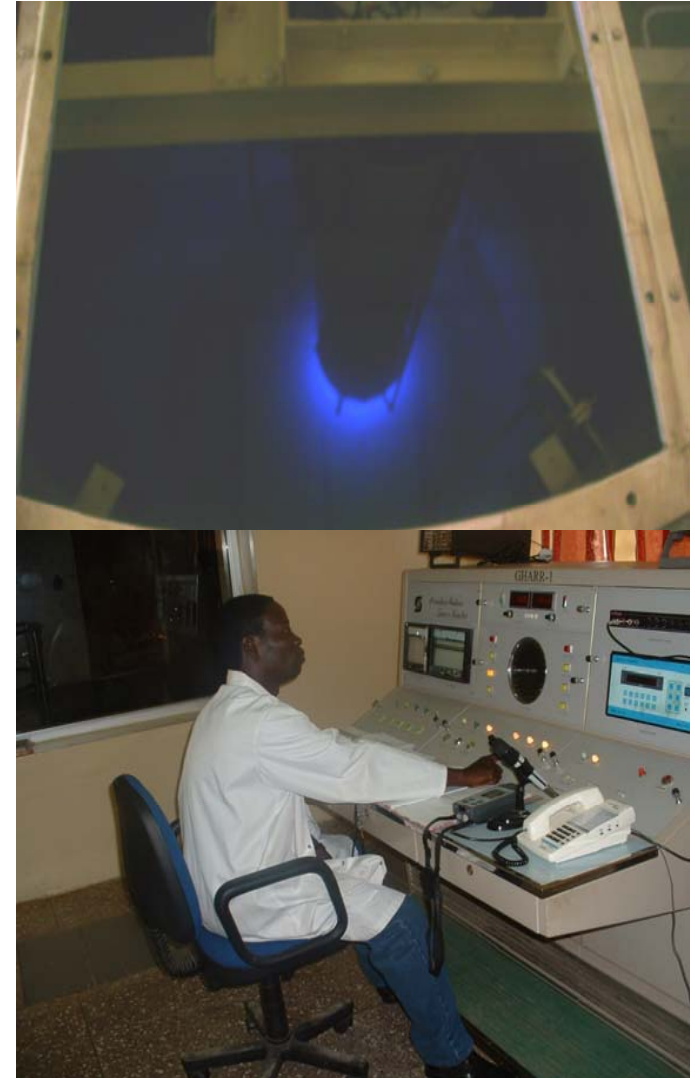
**Ghana Research Reactor-1, (GHARR-1) was commissioned in March 1995 and has since been operational.**

**The GHARR-1 is used mainly for neutron activation analysis, and for research.**

**It can also be used to prepare radioisotopes with medium and short-lived half-lives and it is a good tool for training and education.**

# INTRODUCTION

- The reactor complex contains 5 major components. These are the reactor assembly, control console, auxiliary systems, irradiation system and the pool
- . For the past twelve years, the reactor has been used in determination of major, minor and trace elements in samples of archaeological, Environmental, geological and biological origin.



# INTRODUCTION

- In the near future, GHARR-1 shall be used to support forensic studies. GHARR-1's applicability in Large sample neutron activation analysis (LS-NAA) is being investigated.



# PAST ACTIVITIES

- During the past twelve years, Ghana's MNSR has been used mainly for neutron activation analysis (NAA) and for education and training in the fields of:
- Method development and elemental analysis in various sample matrices (Documented in over 100 published papers in international and national peer-review Journals).
- It has also been used in teaching and learning in
  - Nuclear Engineering,
  - Applied Nuclear Physics and
  - Nuclear and Radiochemistry for students from the universities and Polytechnics among others.

# PAST ACTIVITIES

- **The neutron activation analysis laboratory at the Centre has been engaged in many innovative research and development in NAA. Notable among them are:**
- **Development and validation of analytical procedures and methods: These included; k<sub>0</sub>-NAA standardization method; the relative method; and neutron flux mapping**
- **Radioanalytical, method in place at the Centre involves Preconcentration NAA and speciation methods using cloud point extraction for (As, Hg, Cd, Cr etc).**

# PAST ACTIVITIES

- ⌘ **Analytical services:** The Centre offers analytical services to clients and researchers in the following areas; Geochemistry including Hydrochemistry, soil fertility studies and mineral exploitation among others.
- ⌘ **Research has also been carried out in environmental and health related studies.**
- ⌘ **Commercialization**
- ⌘ **The centre has rendered services to many industries, research institutions, universities, and individuals. Some of the services carried out included:**
  - ⌘ **Analysis of borehole water, sediments and water from streams and rivers in mining areas, petroleum product analysis, foodstuffs *etc.***



# PAST ACTIVITIES

- ☒ We have also worked for many companies and industries
- ☒ Major partner is Environmental Protection Agency (EPA), in routine monitoring of drinking water, food stuffs and mine waste from mining towns and villages
- ☒ These commercial activities generated modest funds, which help to sustain the running of the facility.

## ⌘ Education and Training

- ⌘ The reactor has been used to train students from various universities in Ghana and the West African sub-region.
- ⌘ In all, more than 30 B. Sc dissertations have been produced, 20 M. Phil. and 5 Ph.D. theses in the past ten years.

# PRESENT PROGRAMMES

## Human Resource Development

- ⌘ The decline in nuclear professionals worldwide has become a concern to all especially, Ghana and Africa.
- ⌘ This is because, there is lack of specialized people to manage, operate and utilize existing facilities.
- ⌘ To help solve this problem in Ghana and Africa, Ghana Atomic Energy Commission through the International Atomic Energy Agency and the Faculty of Science, University of Ghana has established the postgraduate School of Nuclear and Allied Sciences (SNAS).
- ⌘ The GHARR-1 is the central equipment for teaching and learning at SNAS

# PRESENT PROGRAMMES

- ⌘ Presently about 15 M. Phil. and 4 Ph.D. students from the School of Nuclear and Allied Sciences (SNAS), University of Ghana are using the reactor for their theses work.
- ⌘ The Research reactor in Ghana is used for training nuclear scientist in reactor operation, core convention, reactor physics calculations *etc.* which will enable the country obtain the required manpower for its future nuclear power programmes.

## PRESENT PROGRAMMES

⌘ Environmental pollution studies using environmental samples such as sediments, soil, water and biological indicators like lichens are some of the past and on-going research projects being carried out at GHARR-1 Centre.



⌘ The most interesting environmental studies being carried out presently at the Centre is the use of lichen transplants for monitoring of vehicular traffic emissions in the country.



# EDUCATION AND TRAINING

⌘ The Ghana Research Reactor is the central pivot equipment on which the postgraduate school of Nuclear and Allied Sciences rest

⌘ The major users being

- ⊞ Applied Nuclear Physics
- ⊞ Nuclear Engineering
- ⊞ Nuclear and Radiochemistry
- ⊞ Nuclear & Environmental Protection



# EDUCATION AND TRAINING

- ⌘ **Some Work carried out by the students included:**
- ⌘ **Determination of essential, non-essential and toxic elements in Ghanaian foods using low power research reactor & XRF**
- ⌘ **Multielemental analysis of various medicinal plants used in Ghana**
- ⌘ **Pollution studies in Ghana using biological indicators**
- ⌘ **Reactor Physics calculations**
- ⌘ **Core convention**



# EDUCATION AND TRAINING

- ⌘ Epidemiological studies: Correlation of toxic element with diseases
- ⌘ Preconcentration NAA for trace elements in foods and medicine (e.g. Cloud Point Extraction)
- ⌘ Speciation of some toxic and essential elements such as As, Cd, Cr, Hg, I, etc.



# FUTURE PLANS

- ☒ **The Ghana Research Reactor-1 facility is being resourced to enable the Centre provide services to support forensic investigation in the country.**
- ☒ **The Centre is planning to install low background detectors and Compton suppression gamma-ray counting system to enable the facility engage in low level detection.**
- ☒ **GHARR-1 facility for bulk INAA and its subsequent use for archaeological studies are being carried out.**



## FUTURE PLANS

- ⌘ GHARR-1 is used in analysis of archaeological pottery samples.
- ⌘ Large Sample Neutron Activation Analysis (LS-NAA) is one of programmes planned for the near future
- ⌘ The limitation of the size of the analytical portion becomes a problem when the amount of material collected for the analysis is larger, for example, soils, rocks, plant materials and food. Large portion of these materials (a few grams to a few kg) can easily be collected and analyzed using the Large Sample Instrumental Neutron Activation Analysis (LS-INAA) technique and are more closely representing the entity for which analytical data are required.

# FUTURE PLANS

- ⌘ The sizes of samples that can be analyzed depend on the size of the irradiation sites.
- ⌘ The GHARR-1 has two larger irradiation sites outside the beryllium annulus which can take a sample with a maximum diameter of 2.8 cm.
- ⌘ The slanting tube in the irradiation facility can also take a sample whose diameter is not more than 4.0 cm (approx). Sample mass can range between a few grams to few kilograms depending upon sample type.
- ⌘ The MNSR irradiation facility can be modified to suit LS-INAA technique

## **FUTURE PLANS**

**A new irradiation site can be created to accommodate desired sample size for the purpose of LS-INAA.**

**This can be done by means of introducing a new slanting tube with its irradiation site located close to the reactor core.**

**The tube can be made of aluminum or stainless steel. The large sample – surrounded by flux monitors – can be packed in a polyethylene container.**

**The transfer of sample to the irradiation site will be done manually by lowering the sample to the irradiation site by means of a strong string attached to the sample.**

# CONCLUSIONS

- ⌘ In conclusion, we would like to say that the Ghana research reactor-1, installed and commissioned in Ghana in 1995, has been used extensively to support the socioeconomic development of the country.
- ⌘ Plans have been put in place recently to use the reactor for human resource development in Nuclear Science and Technology.
- ⌘ The GHARR-1 Centre has received enormous support and financial assistance from the IAEA/AFRA.
- ⌘ This has greatly enhanced our performance in the area of research and commercialization, and capacity building. It is our cherished hope that these activities will be enhanced in the years to come to meet the expectations of local and international standards.

# ACKNOWLEDGEMENT

- ⌘ Our sincere thanks go to the IAEA/AFRA for the supply of almost all the equipment at the Centre and provision of standards.
- ⌘ We also thank the IAEA for human resource development put in place to train the staff, which has made the utilization of the GHARR-1 a success.
- ⌘ Acknowledged with thanks is the IAEA's sponsorship for this conference .

***Thanks for your  
attention***