

REPUBLIC OF GHANA



7TH REVIEW MEETING OF THE CONVENTION ON NUCLEAR SAFETY

**NATIONAL REPORT PRESENTED BY THE REPUBLIC OF GHANA
IN COMPLIANCE WITH THE CONVENTION ON NUCLEAR SAFETY
OBLIGATIONS**

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LIST OF ABBREVIATIONS

ASME NQA 1	American Society of Mechanical Engineers Nuclear Quality Assurance-
CIAE	China Institute of Atomic Energy
CNS	Convention on Nuclear Safety
DOE	Department of Energy
GHARR-1	Ghana Research Reactor -1
GNPPO	Ghana Nuclear Power Programme Organization
GOG	Government of Ghana
HRD	Human Resource Development
IAEA	International Atomic Energy Agency
INSAG	International Nuclear Safety Group
INSEP	International Nuclear Safeguards Engagement Programme
NADMO	National Disaster Management Organization
NNSA	National Nuclear Safety Administration
NPID	Nuclear Power Infrastructure Development
NRA	Nuclear Regulatory Authority
RDC	Regional Designated Centre
RWMC	Radioactive Waste Management Centre
SNAS	School of Nuclear and Allied Sciences
SSC	Structures, Systems, and Components
USIE	Unified System for Information Exchange in Incidents and Emergencies
USNRC	United States Nuclear Regulatory Commission

INTRODUCTION

Ghana seeks to derive maximum benefits from nuclear science and technology while ensuring the safe, secured and peaceful utilization of these nuclear technologies. The Republic of Ghana acceded to the Convention on Nuclear Safety (CNS) in 2011.

A comprehensive legislation, Nuclear Regulatory Authority Act, 2015 (Act 895), covering the three thematic areas of safety, security and safeguards is in enforce. The Act established an independent body, the Nuclear Regulatory Authority (NRA). The powers of the NRA enshrined in the Act, include development of regulations, issuance of authorisation by registration and licensing, inspection, and enforcement.

Ghana's nuclear power programme and the needed infrastructure is still under development. A national roadmap for the Ghana's nuclear programme has been developed based on the IAEA Milestone Approach for Nuclear Power Development. Actions have been identified for each of the 19 infrastructural issues spanning across the three Phases.

Ghana Nuclear Power Programme Organization (GNPPO) formed as part of the recommendation of the IAEA, has been mandated to coordinate the activities of all stakeholder institutions involved in the planning and implementation of Ghana's nuclear power programme.

Ghana's National Science Technology and Innovation Policy document identifies education, energy, nuclear science and technology sectors as key pillars for the country's development plan. In view of this, the country attaches great importance to nuclear science education and training at the Graduate School of Nuclear and Allied Sciences of the University of Ghana. The school is an IAEA African Regional Designated Centre (RDC) for professional Training and Higher Education in Nuclear Science and Technology.

This national report describes measures taken by the Government of Ghana for implementing its obligations under the Convention of Nuclear Safety (CNS). Its structure complies with the recommendations of the Guidelines of the CNS regarding the form and structure of national reports. Ghana is embarking on nuclear power programme, therefore reports on Articles 6-19.

SUMMARY

Ghana has since the promulgation of the Nuclear Regulatory Authority Act, 2015 (Act 895), established an independent Nuclear Regulatory Authority (NRA) with its functions and responsibilities defined. The law provides for the regulation and management of activities and practices for the peaceful uses of nuclear material or energy, radioactive material or radiation; the protection of persons and the environment against the harmful effects of radiation hazards and to ensure the implementation of the country's international obligations and for related matters. The NRA has set out to develop regulations and guidelines to ensure implementation of the provisions of Nuclear Regulatory Authority Act, 2015 (Act 895).

The country's nuclear power programme is being developed in line with the IAEA recommended internationally accepted comprehensive framework for developing infrastructure for nuclear power. The GNPPPO has an advisory body and a technical wing composed of the Nuclear Power Institute (NPI) of Ghana Atomic Energy Commission, Directorate of Nuclear Installations (DNI) of the Nuclear Regulatory Authority, Ghana and other stakeholders. The GNPPPO recognises the need to establish mechanisms for developing and sustaining a human resource base through a systematic approach to education and training for implementation of Ghana's nuclear power programme.

The government of Ghana has also signed a Memorandum of Understanding (MOU) and a Memorandum of Agreement (MOA) with Russia and MOU with China on Cooperation on Ghana Nuclear Power Programme.

ARTICLE 6: - EXISTING NUCLEAR INSTALLATIONS

Ghana has no nuclear installation by the definition of Convention of Nuclear Safety (CNS) but operates a 30kW tank-in-pool research reactor, which uses Highly Enriched Uranium (HEU) as fuel. The Nuclear Reactors Research Centre (NRRC) of National Nuclear Research Institute (NNRI) which operates Ghana Research Reactor-1 (GHARR-1) is undertaking steps to convert the reactor core from High Enriched Uranium (HEU) to Low Enriched Uranium (LEU).

As part of efforts aimed at converting the GHARR-1 from the use of HEU to LEU, Ghana Atomic Energy Commission has collaborated with NRA, IAEA, the Government of the Republic of China, the United States Department of Energy, and other vendors in the nuclear industry. The NRA is collaborating with regulatory bodies in the regulatory control of activities related to the core conversion.

ARTICLE 7: - LEGISLATIVE AND REGULATORY FRAMEWORK

In 2015, the NRA Act 895, was promulgated by the Government to establish and maintain a comprehensive legislative and regulatory framework to among other things govern the safety of nuclear installations, provide for a system of licensing, regulatory inspection and assessment of nuclear installations and to ascertain compliance and enforcement of safety related regulations.

Ghana has been a member of the IAEA since September 1960 and a party to the following International Legal Instruments of the IAEA; Comprehensive Safeguards agreement in connection with the Treaty on Non-Proliferation of Nuclear Weapons (1973); Additional Protocol to the Agreement on Safeguards in connection with the Treaty on Non-Proliferation of Nuclear Weapons (2002);the Convention on Nuclear Safety (1995);the Comprehensive Nuclear Test Ban Treaty (CBTB);the African Nuclear

Weapon Free Zone Treaty (Pelindaba); Amendment to the Convention on Physical Protection of Nuclear Material (2005); The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (the Joint Convention); the Convention on Assistance in the Case of Nuclear Accident or Radiological Emergency (1987), the Convention on Early Notification of a Nuclear Accident (1987) and the Convention on Supplementary Compensation for Nuclear Damage (CSC) (1997).

National Safety Requirements and Regulations

The Nuclear Regulatory Authority has set out to develop regulations and guidelines to ensure implementation of the provisions of NRA Act 895. The following regulations and associated guidelines are under development:

1. Nuclear Safeguards
2. Siting of Nuclear Installations
3. Licensing of Nuclear Installations
4. Nuclear Power Generation in Ghana
5. Emergency Preparedness of Nuclear Installations
6. Safety and Security of nuclear installations
7. Operation of a Nuclear and Radioactive Waste Management Facility
8. Compensations and Limitation on Right of Compensation, Exceptions to Liability
9. Provision of Radiation Monitoring Services, Calibration of Radiation Monitoring Instruments and Consultancy to Authorised Practices and Activities
10. Nuclear and Radioactive Waste Management Programme for Authorised Persons
11. Management System including Quality Assurance and Quality Control of Authorised Activities

12. Design, Re-Design and Modification of a Nuclear Installation and Performance Criteria
13. Decommissioning and Decommissioning Plan of a Nuclear Installation
14. Construction of a Nuclear Installation
15. Radiation Protection Programme of a Nuclear Installation
16. Periodic Testing, Maintenance, Inspection and Control of Modifications and Surveillance of a Nuclear Installation
17. Operational Limits and Conditions of a Nuclear Installation
18. Commissioning of a Nuclear Installation
19. Education, Training, Qualification and Certification of Personnel of a Nuclear Installation
20. Establishing and Operating a Training Institution for Personnel of a Nuclear Installation

System of licensing, Regulatory Assessments and Inspections

An applicant shall not engage in an activity or a practice which involves the use of nuclear material or any radiation source, unless that person is authorised by the Nuclear Regulatory Authority.

Enforcement of Applicable Regulations

The NRA may issue an order for a temporary cessation of activities, in the case of an imminent or actual hazard to the public or the environment and immediate cessation when a situation for which the operator is responsible poses a safety or security hazard to humans and the environment, and shall ensure that the operator resolves the safety and security concerns.

The NRA may also modify, suspend or revoke the authorisation or issue a warning notice to an authorised person who contravenes a minor safety or security requirement or procedure.

ARTICLE 8: - REGULATORY BODY

On the establishment of the Nuclear Regulatory Authority, regulation of nuclear and radioactive material and substances have been assigned entirely to the regulatory body. It also has established an organogram and has its own budget line approved by parliament, making it completely independent of any other user and promoter of nuclear and radioactive material. It also establishes a regulatory control system including authorisation, inspection and enforcement

Organisational Structure

The governing body of the NRA consists of a chairperson and six other members. The NRA has three Directorates and ten Departments. The Nuclear Safety, Security and Safeguards, Emergency Preparedness and Response Departments of the NRA have the oversight responsibility of developing regulations related to nuclear power.

Human Resource Development

A Human Resource Department has been established at NRA to ensure the continual development and sustenance of the competence of staff. Staff of the regulatory authority continually participate in IAEA workshops, technical meeting, training and fellowship programs to build their competence. In-house seminars are organised for staff returning from such international programs to share knowledge and skills acquired with colleagues. Key amongst the training programmes is the IAEA Post Graduate Education Course on Radiation, Transport and Waste Safety organised by the IAEA in cooperation with the Government of Ghana through the School of Nuclear and Allied Sciences, University of Ghana.

For the purposes of monitoring the GHARR-1 core conversion activities, some staff of the NRA have received training in security in the transport of radioactive materials, validation of package design certification and safeguards of nuclear materials.

Management System of NRA

The NRA management seeks to ensure that licensees operate their facilities at all times in a safe, secured and safeguarded manner. The NRA is dedicated to have good leadership that shall transform strategic direction into operational programmes and has public safety as her primary focus. The NRA has independence in regulatory decision making from any undue influence on the part of the nuclear industry and those sectors of government that sponsor this industry. The NRA has technical competence at its core, with other competencies built upon this fundamental and essential requirement. The NRA seeks to be open and transparent in its development of regulations and decisions. The NRA in collaboration with other regulatory bodies and IAEA is currently developing requirements, guidelines and code of practices that shall be clear and easily understood by all stakeholders. The NRA continues to make clear, balanced and unbiased decisions, and is accountable for those decisions; and is building a strong organisational capability in terms of adequate resources, strong leadership and robust management systems. The NRA is performing her regulatory functions in a timely and efficient manner; has and encourages a continuous self-improvement and learning culture; including the willingness to subject herself to independent peer reviews. The Board of NRA initiates policies for the development of the Authority; ensures the proper management of resources and the implementation of the functions conferred on the Authority under Act 895 and any other enactments. The Board of the NRA meets at least once every three months. The Technical Committee of NRA reviews policies, criteria, guidelines, procedures and other related matters of the Authority, reviews the licensing and certification requirements for technical

support services and consultancies, reviews and recommends for the NRA Board's approval reports to be sent to International Atomic Energy Agency. The Committee holds regular meetings in order to discharge all of its duties. The Finance Committee of NRA looks at the financial position of the Authority at each time and suggest avenues of improving upon income generating activities of the Authority, reviews the financial statement of the Authority for each year and submits its comments and recommendations to the Authority for the necessary action to be taken, reviews investment instruments for financial sustainability of the operations of the Authority for approval by the NRA Board. The Executive Committee assists the Director-General in the day to day administration of the affairs of the Authority as set out in Act 895, recommends policy criteria, guidelines, procedures and other related matters of the Authority for review by the Technical Committee, recommends the licensing and certification requirements for technical support services and consultancies, recommends for approval reports to be sent to the International Atomic Energy Agency, including reports on Ghana's obligations under the Joint Convention, Convention on Nuclear Safety, among others. The Committee holds regular meetings in order to discharge all of its duties. Resource Management section of the Management System addresses, Recruitment, Selection and Appointment of Personnel; Performance, Assessment and Training; and Employing Temporary Workers and Outsourcing. Process Implementation section of the Management System Addresses Documents control; Control of records; Purchasing; Communications; Managing organizational changes; Project Management; Preparation of Technical Reports; Regulatory Technical Support; Incoming and Outgoing Correspondence; Numerical Calculations; Archiving; Software Administration & ICT. Measuring, Assessing and Improving section of the Management System addresses Self-Assessment; Independent

Assessment; Management System Review; Non-Conformances, Corrective and Preventive Actions; Improvement Proposals.

The NRA has three Directorates and ten Departments. Regulations are drafted at the Directorates, reviewed by an Inter-Directorate Committee, followed by review from Executive Committee, Technical Committee and the Board. Stakeholders are consulted and involved in the development of the regulations through Workshops, Public Meetings and involvement in Committees. The regulations developed are forwarded to Parliament of Ghana for Gazetting.

Financial Resource and Technical Development

The Nuclear Regulatory Authority is financed through the following:

1. Moneys appropriated by Parliament
2. Loans, loan guarantees and grants
3. Fees and charges due the NRA from services rendered by or through the NRA etc.

The regulatory authority continues to collaborate with external agencies including the IAEA, DOE, USNRC, NNSA and CIAE in the area of technical support for its activities and staff.

ARTICLE 9: - RESPONSIBILITY OF THE LICENCE HOLDER

The Nuclear Regulatory Authority Act, 2015 (Act 895) sets out the general obligations on the part of the licensee. The Act states that the licensee is responsible for the safety of the installation and its operation. To ensure that the licensee discharges its prime responsibility for safety, the Nuclear Regulatory Authority is mandated to establish the safety requirements. The Act also requires all operators to provide training, information and guidance on nuclear safety, and radiation protection to the public and also to maintain a management and human resource development system within the organisation.

ARTICLE 10: - PRIORITY TO SAFETY

The Nuclear Regulatory Authority is mandated to facilitate the development of national policies on the regulation and management of activities and practices with respect to nuclear safety. The responsibility to ensure the safety of any activity or practice associated with the design, construction and operation of nuclear installations however, rests with the licensee.

The NRA is in the process of developing regulations that shall provide for the safety of nuclear material and facilities; the types of authorisation and their duration, renewal, suspension, modification and revocation; the programme and procedure of inspection; education, training, qualification and certification requirements for personnel to manage and operate facilities; the hold points in deploying nuclear power plant, assessment and verification and the implementation of other international conventions which relate to nuclear technology to which Ghana is signatory and has ratified.

ARTICLE 11: - FINANCIAL AND HUMAN RESOURCE

Ghana currently does not have a nuclear power plant but at present developing the necessary infrastructure in order to build one in the near future. To this end the financial resource detailed here is grouped under two main areas; funding for the programme and regulations regarding financial provisions for decommissioning and management of spent fuel and radioactive waste from future nuclear installations.

Regarding funding for the construction of the nuclear power plant, the government of Ghana is looking at different financial sources - including export credits, commercial loans, bonds, equity and modern instruments. With the support of IAEA, GNPPO staffs are being trained to use the Agency's FINPLAN tool in assessing other financial options.

In addition, the government of Ghana has signed an MOU and MOA with Russia and an MOU with China on cooperation on Ghana Nuclear Power Programme.

Financial Provisions for Decommissioning

The Nuclear Regulatory Authority Act, (Act 895) mandates the NRA to ensure that the operator of any nuclear facility shall provide adequate financial resources needed to cover the cost associated with safe decommissioning, including the management of the resulting waste during the operation of the facility. The NRA is to develop mechanisms to enforce this obligation by the time the first nuclear power plant is ready to be commissioned.

Human Resource Development

The introduction of nuclear power as part of the national energy mix requires developing the human resource base with competent workforce for the sustainability and continued success of the program. The strategy therefore is to plan how competence will be built and sustained through an effective combination of education, training, working experience, re-training and performance improvement initiatives.

The Human Resource Development Strategy Document outlines the human resource needs of the NRA and the owner/operator organisation. In addition, the document has also given consideration on workforce planning, education, training, recruitment and retention of staff.

Considering the importance of a well-trained personnel with relevant competencies and skills, Ghana Atomic Energy Commission (GAEC) in collaboration with the University of Ghana and with the support of the IAEA has established the School of Nuclear and Allied Sciences (SNAS). The School runs nuclear-oriented academic programmes which are organised under five departments at the post graduate level. SNAS is an IAEA Regional Designated Centre for professional and higher education in nuclear science and technology, and education and training in radiation protection. The school is also an

IAEA regional hub for the African region's AFRA Network for Education in Nuclear Science and Technology (AFRA-NEST).

ARTICLE 12: - HUMAN FACTORS

The safe and reliable operation of nuclear installations depend not only on technical excellence but also on individuals and the organization. To prevent, detect, and correct human errors, the licensee of the nuclear installation is required among other things to employ personnel with technical capabilities, ensure their training, and also adopt relevant quality assurance and operation management programmes.

The operators of any nuclear installation would be required to establish and implement a management system which would be assessed and improved continually. The management system would enhance safety by bringing together in a coherent manner all the requirement for managing the nuclear installation.

The management system would define the responsibilities of personnel for each process and of the managers and functions in the organizational structure, so that there are clear lines of authority and accountability.

ARTICLE 13: - QUALITY ASSURANCE

In order to achieve GNPPO objective of promoting the development and advancement of a national nuclear infrastructure that can adequately support nuclear energy generation, there is need for a management system outlining the safety and quality assurance requirements necessary for all nuclear facilities and activities.

The GNPPO has therefore developed a management system document that encompasses established integrated management system approach to ensure safe, reliable, and efficient management of radioactive material and their application for nuclear power. The document was developed based on IAEA safety standards; the management systems for

nuclear facilities and activities (GS-R-3), Fundamental safety principles (SF-1), and ASME NQA-1 publications.

ARTICLE 14: - ASSESSMENT AND VERIFICATION OF SAFETY

For the quality of the assessment and verification of safety process, Article 14 of the Convention on Nuclear Safety has stipulated that the assessment should depend on the professional competence, independence and integrity of the regulatory body. The Nuclear Regulatory Authority Act has provisions to implement the provisions of Article 14 of the Convention on Nuclear Safety. The legislation specifies that any person intending to establish a nuclear installation shall obtain a license from the NRA before embarking on such undertaking.

Another aspect of the safety requirements of nuclear installations is an effective ageing management programme during the operational life of any nuclear facility. GHARR-1 for example, has a comprehensive ageing management plan. Under the CNS and the current regulatory order, the NRA is to ensure safety assessment and review functions with respect to ageing management.

The method for conducting the assessment at each stage of the nuclear installation lifetime is the sole preserve of the NRA. The assessment and verification of information requirements at each stage are met and documented for future reference.

As part of efforts to enhance assessment and verification of safety, Ghana has requested the IAEA to conduct an INIR mission for Phase 1 of the development of the nuclear power program.

ARTICLE 15: - RADIATION PROTECTION

The NRA is mandated by law (Act 895) to adopt the principles of protecting humans from harmful effects arising from radiation exposure. Additionally, it prescribes measures aimed at preventing undue radiation exposure of humans through regulations, guidelines and standards.

The NRA is to develop radiation protection policy aimed at ensuring that during all operational states of the nuclear installation, radiation exposures to site personnel and the public remains as low as reasonable achievable (ALARA). In order to ensure that releases of radioactive waste and effluents to the environment are kept ALARA, the operator shall ensure that measurements are performed to determine contamination levels.

The NRA shall review and assess nuclear installations from the pre-construction stage, construction, pre-commissioning, commissioning and to operations stage for radiation safety.

ARTICLE 16: - EMERGENCY PREPAREDNESS

The law requires that the licensee puts in place an Emergency Preparedness and Response Plan (EPR). The NRA in collaboration with the National Disaster Management Organization (NADMO) and other stakeholders have developed a National Nuclear and Radiological Emergency Response Plan. The National Emergency Plan ensures comprehensive allocation of responsibilities and actions among the stakeholders.

The Facility Emergency Response Plan should be consistent with that of the National Plan. Procedure for communicating and information dissemination to the public during an emergency event is detailed in the National Emergency Response Plan.

ARTICLE 17: - SITING

The Act 895 outlines regulatory requirements for national site evaluation process and criteria for nuclear installations. The regulatory body also ensures that an application for authorization to construct and operate a nuclear installation comes with a Site Evaluation Report for assessment and review.

Siting assessment studies are currently ongoing to select a preferred site for Ghana's first nuclear power plant. The strategies being adopted in the site assessment studies are: identification of applicable siting evaluation criteria and development of a suitable site identification methodology which will lead to the selection of preferred site; establishment of a profound and corresponding relationship with all stakeholders; and detailed evaluation of selected sites to develop engineering site data for nuclear power plant design purposes.

The selection of a suitable site for Ghana's nuclear power plant includes various studies on the following thematic areas, geology and seismology, water availability and quality, meteorology and atmospheric dispersion, population and exclusion, human induced event, emergency planning, flooding, wildlife, archaeology and cultural preservation, Land use, and community impact.

A Siting Charter has been developed by GNPPO to serve as a comprehensive activity guide in addressing the criteria identified. Among others, the document provides detailed activities required to adequately assess the geological, seismological and geotechnical characteristics of proposed sites. Information required for addressing meteorological and atmospheric dispersion concerns in the site selection procedure for the NRA's acceptability of a candidate site has been highlighted.

ARTICLE 18: - DESIGN AND CONSTRUCTION

The NRA is to establish a process for the evaluation and approval of proposed sites for the development of a nuclear installation and associated facilities before detailed evaluation of the site and pre-construction review and assessment of the facility are commenced.

ARTICLE 19: - OPERATION

To ensure the safe and secure management of radioactive waste, the NRA is mandated by Act 895 to develop regulations for the protection of the public and the environment from adverse impacts of radioactive waste management activities. The NRA has drafted a National Radioactive Waste Management Regulations which is undergoing review. A National Radioactive Waste Management Policy and Strategy Document has also been drafted. The Radioactive Waste Management Centre (RWMC) of Ghana Atomic Energy Commission is responsible for the safe and secure management of “disused” radioactive sources generated in Ghana to safeguard human lives and the environment. The RWMC has managed radioactive waste generated in Ghana including historic/legacy and orphaned sources safely since its establishment through the support of stakeholder institutions. The Centre operates a medium Centralized radioactive waste facility where radioactive waste is characterized and stored awaiting further management. Over the years, the Centre has developed its technical capability through the provision of technical services to clients, collaboration in technical cooperation (TC) projects with stakeholder organizations, and human resources training and management. The Centre has acquired the technical capacity to play pioneering roles in radioactive waste management in the Africa. The Centre has had collaborative workings and partnerships with regional and international organizations namely: The Africa Regional Co-operative Agreement for Research Development and Training related to Nuclear Science and Technology (AFRA),

The International Atomic Energy Agency (IAEA) and the United States of America Department of Energy (DOE).

The Government of Ghana as part of its long term management strategy for stored disused sealed radioactive sources (DSRS) has opted for the IAEA developed Borehole Disposal System (BDS) as an end-point management option. The BDS is being implemented as a project with the Ghana Atomic Energy Commission (GAEC) as the implementing institution. The project has traversed three IAEA TC cycles. An initial site investigation and characterization as well as initial Safety Assessment (SA) for the BDS have been performed. Detailed site characterization activities involving geological, hydrogeological and hydrochemical investigation a second iteration safety assessment are currently on-going.

ANNEXES

1. Nuclear Regulatory Authority Act, 2015 (Act 895).
2. National Nuclear and Radiological Emergency Response Plan, Prepared by NADMO and GAEC with support from UNDP, January 2010.
3. Preparedness and Response for a Nuclear or Radiological Emergency, General Safety Requirement-Part 2, IAEA, 2002.
4. Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirement- Part 3, IAEA, 2014.
5. Preparedness and Response for a Nuclear or Radiological Emergency. General Safety Requirement Part 7, IAEA, 2015.
6. Siting Charter, Nuclear Power Institute, GAEC.
7. HRD Strategy, Nuclear Power Institute, GAEC.

8. Draft on Waste Management Regulations, NRA.