



An assessment of the operations of the Nuclear Regulatory Authority since the enactment of the nuclear regulatory authority act (2015-2024)

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Abstract

This piece provides an in-depth assessment of the activities of the Ghana Nuclear Regulatory Authority (NRA) since the promulgation of the Nuclear Regulatory Authority Act, 2015 (Act 895). This paper further proposes suggestions for enhancement after assessing the mission, efficacy, difficulties, and conformity to global norms of the activities of the Nuclear Regulatory Authority of Ghana. This paper has five main sections. The introductory section provides an overview of nuclear technology globally as well as the objectives of this research. It also provides a background on the research processes that were used in this project. The second section discusses provisions of the Nuclear Regulatory Authority Act, which are salient to this research paper. The main primary research work and findings, which were respectively done and gathered through the interviewing of officials at the NRA about the Regulatory Authority's operations from 2015 to 2024, are presented in the third part. By contrasting the NRA's mandate with its actual performance, the fourth section examines and assesses these findings and makes conclusions, suggestions, and recommendations for improving the effectiveness and strengths of NRA's operations. The final section summarises the main conclusions and highlights the need to consolidate the strengths of NRA operations to guarantee strong regulatory governance and nuclear safety.

Keywords: Nuclear Regulatory Act, Nuclear Regulatory Authority, International Standards

Introduction

General overview of international nuclear technology operations (peaceful use of nuclear energy)

Nuclear technology is oft described as a low-carbon and eco-friendly means of energy production with immense benefits ^[1]. Nuclear technology saw global expansion, especially in the 1950s and 1960s by technologically advanced countries such as the Soviet Union, Britain, America, and Canada ^[2]. Nuclear technology has made significant contributions to energy security, healthcare, agriculture, and various industrial processes worldwide. By 2022, nuclear energy accounted for approximately 10% of global electricity generation, highlighting its importance in providing a stable, large-scale energy supply with minimal carbon emissions, thus supporting global climate goals ^[3]. A number of countries across the world have adopted nuclear technology for its safe uses such as the production of electricity and the contribution of nuclear technology to the health sector. Regardless of the apparent benefits of nuclear technology, some countries are adamant about the adoption of nuclear technology for reasons such as high cost of production and safety concerns ^[4].

Beyond electricity generation, nuclear technology offers a wide range of peaceful applications. In the medical field, it is used for radiotherapy in cancer treatment and diagnostic imaging. In agriculture, nuclear techniques help in improving crop yields and food preservation through irradiation. Industrial applications include material testing and quality control, demonstrating the versatility and importance of nuclear technology in advancing various sectors.

Due to the negative reactions associated with Nuclear Technology and the fear amongst some nations about the impact of Nuclear Technology especially after the Hiroshima and Nagasaki atomic bombing catastrophes in

August 1945, as well as the prospects of the peaceful uses of the technology for national development, the United Nations established the International Energy Atomic Agency (IAEA) in 1957 ^[5]. The IAEA promotes adherence to safety measures through technical assistance, standardization of protocols, and regular peer reviews among member states. Furthermore, the Nuclear Non-Proliferation Treaty (NPT) was passed in 1968 with the aim of promoting worldwide cooperation in the peaceful use of nuclear energy. This treaty has also played an essential role in halting the spread of nuclear weapons ^[6]. Several other conventions on Nuclear Safety, Nuclear Security, Nuclear Transport, and Nuclear Liability among other areas have been put in place under the auspices of the IAEA to regulate nuclear energy operations, activities, and facilities, and also impose obligations on States.

In a memo prepared by researchers focusing on nuclear advancement in Africa, six countries, namely South Africa, Ghana, Nigeria, Morocco, Uganda, and Egypt have been described as making notable progress towards the reliance on nuclear power ^[7]. These developments underscore the need for, and importance of effective regulatory oversight to ensure that nuclear technology contributes to sustainable development while mitigating potential risks.

This paper intends to critically assess the operations of Ghana's Nuclear Regulatory Authority (NRA) since the enactment of the Nuclear Regulatory Authority Act, 2015 (Act 895). The assessment is grounded on several specific objectives:

Objectives of the Paper

A thorough assessment of the operations of the NRA should cover a list of more than twenty (20) areas. However, this research is in phases, as such it will cover only six areas as indicated below. Subsequent research papers will focus on

the other areas of nuclear energy operations. The six areas assessed in this research include measures implemented by the Nuclear Regulatory Authority (NRA):

1. to ensure that radiation and nuclear energy are used exclusively by authorized personnel for peaceful purposes;
2. to protect workers, the public, and the environment from harmful radiation effects;
3. in terms of licensing, inspection, and enforcement of nuclear and radiological installations;
4. to support, guide, and secure its mandate;
5. to collaborate with agencies, entities, and institutions; and
6. to deal with challenges in performing its mandate.

Conceptual Approach to the Research

The six operational areas of the NRA mentioned above will be researched and assessed in this paper by evaluating the NRA's mandate, regulatory effectiveness, adherence to established standards, and its challenges before providing recommendations.

1. **Evaluating the mandate of the NRA:** This section will provide a comprehensive analysis of the legal and regulatory responsibilities assigned to the NRA as delineated in the Nuclear Regulatory Authority Act. By examining the scope of its mandate, we aim to understand the foundational principles guiding the NRA's operations and its obligations toward ensuring nuclear safety and regulatory compliance within Ghana.
2. **Examining Regulatory Effectiveness:** The focus here is to evaluate how effectively the NRA has enforced standards related to safety, security, and environmental protection in nuclear activities. This involves assessing the practical implementation of regulatory measures, reviewing compliance levels, and analyzing the outcomes of enforcement actions taken by the NRA to safeguard public health and the environment.
3. **Comparing Practice with Standards:** This objective aims to benchmark Ghana's regulatory framework against international best practices in nuclear regulation. By comparing the NRA's practices with those adopted in leading nuclear-regulated countries, we can identify gaps and areas for improvement. This comparison will highlight strengths and weaknesses, offering insights into how Ghana's regulatory framework can evolve to meet global standards.
4. **Identifying Challenges:** Here, we will discuss the key challenges that the NRA faces in executing its mandate. These may include resource constraints, technical and operational difficulties, and institutional hurdles. Understanding these challenges is crucial for appreciating the complexities of nuclear regulation in Ghana and the impact of these obstacles on the NRA's regulatory efficiency.
5. **Recommending Improvements:** Based on the findings from the previous sections, this part will propose actionable recommendations for enhancing the NRA's operations. By drawing on international benchmarks and considering Ghana's unique domestic needs, we will suggest strategic initiatives and reforms aimed at

strengthening the NRA's capacity to effectively oversee nuclear activities and ensure robust regulatory governance.

These objectives collectively aim to provide a thorough critique of the NRA's performance and offer a roadmap for enhancing the safety, security, and environmental integrity of Ghana's nuclear sector. The insights gleaned from this assessment will be instrumental in aligning Ghana's nuclear regulatory practices with international standards, thereby bolstering public confidence and fostering sustainable development in the nuclear industry.

This paper is meticulously structured into five comprehensive sections, each serving a distinct purpose in the critical assessment of Ghana's Nuclear Regulatory Authority (NRA) since the enactment of the Nuclear Regulatory Authority Act, 2015 (Act 895).

Organization of the Paper

1. **Introduction:** This section provides a broad overview of nuclear technology on a global scale, emphasizing its peaceful applications and the international regulatory framework that governs its use. It sets the stage by outlining the objectives of the paper, aiming to explore the operational dynamics and regulatory effectiveness of Ghana's NRA in the context of established international norms. It also provides insights into the research processes and methods used in this project.
2. **The Nuclear Regulatory Authority under the Act:** This section examines the functions, powers, and regulatory activities mandated by Act 895. It reviews the NRA's authorization processes, regulatory oversight mechanisms, and enforcement actions. The aim is to provide a detailed understanding of how the NRA is expected to operate under the legal framework established by Act 895.
3. **Actual Operations of the Authority since the Act:** This segment presents an empirical analysis of the NRA's operations from 2015 to 2024. It evaluates how effectively the NRA has implemented its duties as specified under Act 895, using data and real-world examples to illustrate its regulatory performance.
4. **Discussion and Analysis of Findings:** In this section, we compare the NRA's mandated functions with its actual operations. This comparative analysis identifies areas where the NRA has excelled and highlights gaps where improvements are needed. The discussion also explores the challenges faced by the NRA, providing a nuanced understanding of its regulatory environment.
5. **Conclusion:** The final section recapitulates the key findings from the paper. It synthesizes the insights gained from the evaluation and analysis and provides strategic recommendations for enhancing the operations of the NRA. The recommendations aim to align Ghana's nuclear regulatory practices with international standards, ensuring robust oversight and effective management of nuclear activities.

This structured approach ensures a thorough and systematic evaluation of Ghana's NRA, offering insights and

actionable recommendations for strengthening nuclear regulatory oversight and enhancing environmental and public health protections.

Research Methods

This paper combined a number of research methods to arrive at the findings, analyses, and conclusions. These methods include:

Literature Review: "A literature review is an account of what has been published on a topic by accredited scholars and researchers ... and what their strengths and weaknesses are ... It is not just a descriptive list of the material available or a set of summaries" [8]. The information provided in the first part of this section was gathered through extensive reading and review of the literature. The second section, which discusses some selected provisions of the Nuclear Regulatory Act, Act 895 is also based on an extensive perusal of the Nuclear Regulatory Act.

This method was chosen for a variety of reasons which include;

1. **Existing Knowledge Base:** Literature studies aid in comprehending the state of knowledge on a certain topic at the moment. In this instance, it gave a basic grasp of the Act 895 mandate, the NRA's regulatory framework, and global best practices for nuclear control.
2. **Identification of Gaps:** It was feasible to find gaps and comprehend areas where the NRA's operations may be examined more closely by looking through previously published publications, research papers, and official records.

Interviews with NRA Officials: Interviews are a powerful qualitative research method, providing firsthand insights that are not always available in written documents. The interview is defined as the method of asking questions to gain both qualitative and quantitative data [9]. In this study, interviews with officials from the NRA were conducted to gain a deeper understanding of the actual operations of the authority juxtaposing it with the mandate of the authority as provided in the Act.

Data Analysis: Using qualitative approaches, the information obtained from the interviews and literature review was examined. Thematic analysis [10] revealed important themes pertaining to the roles, authority, and efficacy of the NRA. Findings for improvement were brought to light by a comparison with international norms and best practices. The findings' validity and dependability were crosschecked by the triangulation of data from several sources [11].

The Nuclear Regulatory Authority under the Act

The establishment of the Nuclear Regulatory Authority (NRA) in Ghana through the enactment of the Nuclear Regulatory Authority Act, 2015 (Act 895), marks a significant milestone in the country's nuclear regulatory landscape. This essay explores the functions, powers, and regulatory activities of the NRA as stipulated under the Act, highlighting its critical role in ensuring the safe and secure use of nuclear technology in Ghana.

The NRA is endowed with a broad mandate to oversee nuclear and radiological safety in Ghana. Sections 5 and 6 of Act 895 outline its core functions and powers, which include regulating and supervising the use of nuclear

materials and radiation sources, ensuring the protection of people and the environment, and fostering a culture of safety and security in the nuclear sector. The NRA's authority extends to setting regulatory standards, issuing licenses, conducting inspections, and enforcing compliance with regulatory requirements.

Section 21 of Act 895 grants the NRA the power to authorize the use of nuclear materials and radiation sources. This involves a rigorous assessment process to ensure that applicants meet all safety, security, and environmental protection criteria. Authorization is a critical regulatory activity, as it ensures that only qualified and compliant entities are permitted to handle nuclear materials.

The NRA is responsible for regulating the export and import of controlled nuclear items under Section 29 of the Act. This includes issuing permits and monitoring the transfer of these materials to prevent unauthorized access and ensure compliance with international obligations. Effective regulation of controlled items is essential for maintaining national and global security.

Section 27 mandates the NRA to establish and maintain a national register of radiation sources. This register provides a comprehensive inventory of all radiation sources in the country, enabling effective monitoring and control. The register is crucial for ensuring traceability and accountability, thereby enhancing radiation protection and security.

In addition to the register of radiation sources, Section 38 requires the NRA to maintain a national register of export, import, trans-shipment, and transport of radioactive sources. This register facilitates the tracking of radioactive materials throughout their lifecycle, ensuring that they are handled and transported in accordance with regulatory requirements. The NRA is tasked with the recovery of orphan sources under Section 30. Orphan sources are radioactive materials that are not under regulatory control, often due to loss, theft, or abandonment. The recovery and secure management of these sources are vital for preventing radiation hazards and ensuring public safety.

Section 31 of Act 895 emphasizes the importance of emergency preparedness. The NRA is responsible for developing and implementing emergency response plans to address potential nuclear or radiological incidents. Effective emergency preparedness involves coordination with other agencies, regular drills, and public awareness campaigns to ensure a swift and effective response to emergencies.

The NRA's regulatory oversight extends to nuclear installations, as outlined in Sections 34 to 42. This includes licensing, inspection, and enforcement activities to ensure that nuclear facilities operate safely and securely. The NRA sets stringent standards for the design, construction, operation, and decommissioning of nuclear installations.

Effective management of radioactive waste is critical for environmental protection and public health. Sections 43 to 50 of Act 895 assign the NRA the responsibility for regulating the management of radioactive waste, including its collection, storage, treatment, and disposal. The NRA ensures that waste management practices comply with national and international standards.

Section 51 addresses the regulation of the transportation of radioactive materials. The NRA sets safety requirements for the packaging, handling, and transportation of these materials to prevent accidents and unauthorized access during transit.

The decommissioning of nuclear facilities is a complex process that requires careful planning and oversight. Sections 51 to 55 mandate the NRA to regulate the decommissioning process to ensure that it is conducted safely and that any residual radioactive materials are appropriately managed.

Sections 57 to 59 give the NRA the authority to regulate the extraction, mining, and processing of radioactive materials. This includes setting standards for occupational safety, environmental protection, and radiation monitoring in mining operations.

Inspection and enforcement are key functions of the NRA, as detailed in Sections 71 to 85. The NRA conducts regular inspections of nuclear and radiological activities to ensure compliance with regulatory requirements. Enforcement actions, including penalties and sanctions, are taken against entities that violate regulations.

Under Section 91, the NRA contributes to the development and enactment of regulations governing nuclear and radiological activities. This involves drafting regulations, conducting stakeholder consultations, and ensuring that the regulatory framework remains up-to-date and effective.

Section 92 empowers the NRA to develop and adopt guidelines, procedures, and standards for nuclear and radiological safety. These guidelines provide detailed instructions on best practices and regulatory compliance, helping to ensure consistent and effective regulation.

Presentation of Findings

The Nuclear Regulatory Authority (NRA) has implemented several measures to ensure that radiation and nuclear energy are used exclusively by authorized personnel for peaceful purposes. The authority's Safety and Security Sections oversee the importation, monitoring, and handling of nuclear materials, working closely with national security agencies to intercept unauthorized sources. Strict guidelines have been established, requiring entities involved in the importation of nuclear materials to provide documentation such as permits, transport routes, and other safety measures. Additionally, the NRA employs advanced surveillance systems, including access controls, CCTV cameras, and radiation monitors, to track and monitor these materials. Non-compliance with these regulations results in enforcement actions, such as penalties and confiscations, to maintain public safety.

The NRA actively protects workers, the public, and the environment from harmful radiation effects by enforcing comprehensive health, safety, and environmental standards. These include building specifications for facilities storing radioactive materials, such as requirements for walls, windows, and doors. The NRA conducts both routine and unannounced inspections of health facilities and other institutions handling radioactive materials. Violators face penalties, including temporary shutdowns and fines, until corrective measures are implemented.

In terms of licensing, inspection, and enforcement of nuclear and radiological installations, the NRA follows detailed processes as outlined in the Nuclear Regulatory Authority Act, 2015 (Act 895). Interested parties must notify the NRA and apply for licenses before importing or operating nuclear materials. The authority issues construction permits after confirming compliance with mandated safety specifications and inspects facilities to ensure proper storage of radioactive materials. Import

permits, valid for six months, are issued to regulate the transportation and entry of nuclear materials. Modifications to licensed facilities require NRA approval to maintain compliance with safety standards.

The NRA has developed key regulations to support its mandate, including the Basic Ionising Radiation Control Regulation and the Non-Ionising Radiation Regulation. These documents provide guidelines for managing ionizing and non-ionizing radiation sources, addressing aspects such as exposure management, accident response, and quality control. Together, these regulations complement the provisions of Act 895 and ensure the safe use of nuclear technology.

The authority also collaborates with governmental agencies, private companies, and international organizations to enhance its regulatory effectiveness. The NRA has signed Memoranda of Understanding (MoUs) with institutions such as the Health Facilities Regulatory Authority (HEFRA) and the Customs Excise and Preventive Services (CEPS), which assist in intercepting unauthorized nuclear imports. Partnerships with the Ghana Standards Authority (GSA) and the Food and Drugs Authority (FDA) further ensure that safety and monitoring standards are upheld.

Analysis of Findings

The Nuclear Regulatory Authority (NRA) of Ghana has demonstrated commendable progress in fulfilling its mandate under the Nuclear Regulatory Authority Act, 2015 (Act 895). Its efforts to establish a regulatory framework for nuclear and radiological safety reflect a strong commitment to ensuring public health and environmental protection. Among its achievements, the NRA has implemented strict licensing protocols and conducted routine and unannounced inspections to enforce compliance with safety standards. These measures are vital for preventing unsafe practices and ensuring that operators of nuclear and radiological facilities adhere to established guidelines. The authority's collaboration with domestic agencies such as the Ghana Standards Authority (GSA), Health Facilities Regulatory Authority (HEFRA), and Customs Excise and Preventive Services (CEPS) further strengthens its capacity to monitor nuclear activities across diverse sectors.

The NRA's focus on enforcement is evident in its ability to impose penalties, suspend operations, and shut down facilities that fail to comply with regulations. This approach underlines its role as a firm regulator dedicated to maintaining high safety standards. Additionally, the authority has established sector-specific guidelines for managing ionizing and non-ionizing radiation, providing a foundation for safe practices in industries such as healthcare, mining, and manufacturing. These achievements underscore the NRA's commitment to its mandate and its significant contribution to nuclear safety in Ghana.

However, despite these accomplishments, gaps in the NRA's operations emerge when its activities are assessed against international frameworks for nuclear regulation. One critical area where the NRA appears to fall short is environmental protection. While the authority enforces compliance with building specifications and conducts inspections, there is no indication of long-term environmental monitoring programs to track radiation levels in air, water, and soil. International best practices emphasize the need for continuous surveillance to detect and mitigate the impacts of radiation on ecosystems. This lack of

proactive environmental monitoring could leave communities vulnerable to contamination, particularly in areas where radiation exposure risks are higher.

Another important aspect missing from the NRA's operations is robust public engagement. The international framework highlights the importance of educating the public about radiation safety and involving stakeholders in regulatory processes to build trust and promote compliance. However, the NRA's reliance on enforcement measures, such as penalties and shutdowns, does not extend to proactive education initiatives or transparent communication strategies. Public awareness campaigns and stakeholder consultations are critical for fostering a culture of safety and ensuring that communities are adequately informed about potential risks and protective measures. The NRA also faces challenges in the areas of licensing, inspection, and emergency preparedness. Although the authority enforces technical and infrastructure compliance, there is limited evidence of inclusive stakeholder consultations during licensing processes. Transparency in decision-making, particularly when licensing new nuclear facilities, is essential for addressing public concerns and ensuring broad support for regulatory actions. Furthermore, the NRA's emergency preparedness efforts lack detailed plans, inter-agency coordination exercises, and community-focused evacuation strategies. These elements are crucial for responding effectively to potential radiological incidents, as they ensure readiness and minimize the impact on public health and safety.

Capacity building within the NRA is another area that requires attention. The authority's personnel play a critical role in enforcing regulations and maintaining safety, yet there is no indication of structured training programs to enhance their technical skills and knowledge. Regular training and professional development are essential for keeping regulatory staff abreast of evolving global best practices, particularly in a field as dynamic as nuclear regulation. Additionally, the NRA's reliance on manual systems for monitoring and inspections highlights the need for technological investments to improve efficiency and accuracy. Advanced digital tools can streamline operations, enhance data collection, and support more effective decision-making.

The NRA's collaboration efforts are commendable at the domestic level, and though they do not fully extend to the international sphere, the NRA has made significant efforts in the international sphere as well. Participation in global peer review mechanisms, such as the International Atomic Energy Agency (IAEA) and the Integrated Regulatory Review Service (IRRS), is vital for benchmarking national practices against international standards and identifying areas for improvement. The available references to such reviews or technical assistance programs in the interview responses suggest the utilization of opportunities for learning and capacity building. However, more room exists for such collaborations. Furthermore, the NRA does not appear to engage in cross-border collaborations for emergency preparedness or transboundary radiation monitoring, both of which are crucial for addressing risks that transcend national borders.

Addressing these gaps would require strategic interventions that align the NRA's activities more closely with international frameworks. For instance, establishing long-term environmental monitoring programs would enable the

authority to proactively manage radiation risks and protect ecosystems. Public awareness campaigns and stakeholder consultations could foster trust and enhance compliance, while detailed emergency response plans and inter-agency drills would improve preparedness for radiological incidents. Investing in advanced technologies and implementing structured training programs for regulatory personnel would further strengthen the NRA's operational capacity. In addition to these measures, the NRA should prioritize active participation in international collaborations and peer review mechanisms. Deepening engagement with the IAEA and other global bodies could provide more technical assistance, facilitate knowledge exchange, and enhance the authority's alignment with global best practices. Regional and international partnerships should be deepened and strengthened to augment the capacity of the NRA to access resources and expertise needed to address complex challenges and strengthen its regulatory framework.

Conclusion

The Nuclear Regulatory Authority (NRA) of Ghana has made commendable efforts to regulate the use of nuclear and radiological materials in accordance with its mandate under Act 895. Through its licensing, inspection, and enforcement activities, as well as collaborations with domestic, regional, and international agencies, the NRA has laid a solid foundation for ensuring safety and compliance. However, when benchmarked against international frameworks, several critical gaps emerge. These include insufficient environmental monitoring programs, limited public engagement, inadequate emergency preparedness measures, and a lack of structured capacity-building initiatives. Additionally, the NRA's limited integration into global peer review mechanisms and insufficient alignment of its guidelines with international standards underscore areas requiring urgent attention.

Addressing these shortcomings is imperative for enhancing the NRA's operational capacity and ensuring the comprehensive safety of workers, the public, and the environment. Strengthening international collaborations, adopting advanced technologies, and expanding public outreach will not only align the NRA with global best practices but also foster greater public trust and resilience in Ghana's nuclear safety framework. By closing these gaps and advancing its regulatory mandate, the NRA can position itself as a model for effective nuclear regulation in Africa, ensuring the peaceful and safe use of nuclear technology for national development.

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