**IAEA-NS-IRRS-2024/7**
**ORIGINAL: English**

# INTEGRATED REGULATORY REVIEW SERVICE (IRRS)

## MISSION

**TO**

# Ghana

Accra, Ghana

*25 November to 4 December 2024*

DEPARTMENT OF NUCLEAR SAFETY AND SECURITY

IAEA

Integrated Regulatory Review Service

IRRS

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Regulatory
Review Service

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# REPORT OF THE
# INTEGRATED REGULATORY REVIEW SERVICE (IRRS) MISSION
# TO
# GHANA

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| **Mission dates:** | *25 November – 4 December 2024* |
| **Regulatory body visited:** | *Nuclear Regulatory Authority* |
| **Location:** | *Accra, Ghana* |
| **Regulated facilities, activities, and exposure situations in the mission scope:** | *radiation sources facilities and activities, research reactor, waste management facilities, decommissioning activities, transport, emergency preparedness and response, medical exposure, occupational exposure, public exposure, interface with nuclear security* |
| **Organized by:** | *IAEA* |

| IRRS TEAM | |
|---|---|
| Thiagan Pather (South Africa) | Team Leader |
| Geraldine Pina (France) | Deputy Team Leader |
| Paul Brejza (Malta) | Reviewer |
| Pedro Rosario (Portugal) | Reviewer |
| Justice Chipuru (Zimbabwe) | Reviewer |
| Richard Elek (Hungary) | Reviewer |
| Alan Muller (South Africa) | Reviewer |
| Serhat Alten (Turkiye) | Reviewer |
| Wilma Tolud (Netherlands) | Reviewer |
| Agnese Aizpuriete (Latvia) | Reviewer |
| Mahammad Ayub (Pakistan) | Reviewer |
| Delwende Nabayaogo (Burkina Faso) | Reviewer |
| Houda Idihia (Morocco) | Reviewer |
| Haraldur Hannesson (Denmark) | Reviewer |
| Teodros Hailu (IAEA/NSRW) | Team Coordinator |
| Sonal Gandhi (IAEA/NSNI) | Deputy Team Coordinator |
| Baan Fischer (IAEA/NSRW) | Administrative Assistant |

**The number of recommendations, suggestions and good practices is in no way a measure of the status of the national infrastructure for nuclear and radiation safety. Comparisons of such numbers between IRRS reports from different countries should not be attempted.**

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## EXECUTIVE SUMMARY

At the request of the Government of Ghana, an international team of senior nuclear and radiation safety experts met with representatives of the Nuclear Regulatory Authority (NRA) from 25 November to 4 December 2024 to conduct an Integrated Regulatory Review Service (IRRS) initial mission. The mission was conducted at NRA's Headquarters in Accra.

The primary purpose of the mission was to perform a peer review of Ghana's legal and regulatory framework for nuclear, radiation, radioactive waste, and transport safety as well as emergency preparedness and response, the interface between safety and nuclear security. The IAEA safety standards and the Code of Conduct on the Safety and Security of Radioactive Sources as well as the Code of Conduct on the Safety of Research Reactors were used as the international benchmark for safety. The mission provided opportunities for the exchange of information and experience between the IRRS team members and their Ghanaian counterparts in the areas covered by the IRRS mission.

The IRRS team consisted of 14 experts from 13 IAEA Member States and 3 IAEA staff members. The Ghanaian counterparts for the mission were primarily the management and staff of NRA. Representatives from the Ministry of Environment, Science, Technology, and Innovation (MESTI), and the Ministry of Energy participated in the opening meeting.

The IRRS team reviewed the core modules representing: responsibilities and functions of the government; the global nuclear safety regime; responsibilities and functions of the regulatory body (NRA); management system of NRA; activities of NRA including authorization, review and assessment, inspection, enforcement; development and content of regulations and guides; and emergency preparedness and response. The scope of authorized facilities and activities included a research reactor; radiation source facilities and activities; occupational radiation protection; control of medical and public exposure; transport of radioactive material; radioactive waste management facilities; decommissioning of facilities; and interfaces with nuclear security. Moreover, as Ghana is embarking on a nuclear power programme and is currently conducting preparatory work for development of the safety infrastructure for a nuclear power plant, the IRRS mission included a review against the IAEA tailored Module for countries embarking on nuclear power programme.

In preparation for the IRRS mission, Ghana conducted self-assessment and prepared a preliminary action plan to address areas identified for improvement. The results of the self-assessment and supporting documentation were provided to the IRRS team as Advance Reference Material (ARM) prior to the mission. During the mission, the IRRS team performed a systematic review of all the topics presented in the ARM. The IRRS team recognised the extensive preparation and assessment work undertaken by NRA and the dedication of NRA staff.

The IRRS team conducted interviews and discussions with NRA staff. Members of the IRRS team also undertook site visits and observed regulatory inspection activities at the GHARR-1 Research Reactor facility, the Radioactive Waste Management Centre, an industrial facility using radiation sources, and a hospital. During the site visits, the IRRS team members held discussions with management and staff of the operating organisations.

The IRRS mission also included discussions on two policy issues: budgeting and funding of the regulatory body and staff compensation, and establishing decommissioning and radioactive waste management funds. During the discussion of the policy issues, members of the IRRS team and representatives from Ghana shared views and regulatory experiences.

The efforts and constructive engagement of NRA staff in the peer review process enabled the IRRS team to develop a broad understanding of Ghana's regulatory framework.

As a country with a stated intention of pursuing a nuclear power programme, the Government of Ghana has updated its National Energy Policy in 2021 and developed draft national policies for nuclear and radiation safety as well as radioactive waste management. Ghana has affirmed its commitment to nuclear and radiation safety, in line with international best practices through:

- establishing NRA as an independent nuclear regulatory authority, following promulgation of the Nuclear Regulatory Authority Act, Act 895 of 2015 (the Act);
- delivering on its national obligations under the various international instruments for nuclear and radiation safety;
- initiating the strengthening of the regulatory framework for nuclear and radiation safety through the development of regulations and guides, which are currently all in draft; and
- providing support and advocacy for NRA, through the provision of financial and human resources commensurate with the current national nuclear and radiation programme and commitment to further enhance the regulatory capacity in line with the expanding nuclear power programme, thereby enabling NRA to grow its capability and capacity to maintain effective regulatory control of all nuclear and radiation facilities and activities in Ghana.

However, the effective independence of NRA's regulatory decision-making on matters of safety is paramount and the Government needs to ensure that this is supported and protected.

The IRRS team recognized that NRA is committed to ensuring continuous improvement of safety and the protection of people and the environment and demonstrated by initiating the development of its management system and development of regulatory guidance, mostly in draft, to guide and support the consistent implementation of the regulatory functions and activities; and by inviting an initial IRRS peer-review mission.

In the spirit of continuous improvement, the IRRS mission report includes recommendations and suggestions intended to help improve Ghana's regulatory infrastructure and practices related to nuclear and radiation safety.

The IRRS team considers that Ghana's primary challenge is the completion and issuance of regulations and guides to support the consistent and predictable implementation of the Act, considering both the existing nuclear and radiation programme in the country and the envisaged nuclear power programme.

In addition, the IRRS team concluded that the following actions, if addressed by the Government and NRA, would further enhance the overall effectiveness of the regulatory system.

The Government should:

- establish and implement a national policy and strategy for safety, and national policy and strategy for radioactive waste management;
- facilitate the establishment of internal dosimetry, neutron monitoring as well as calibration of neutron and radon measuring instruments;
- ensure that all the elements for safety, consistent with the IAEA Safety Standards, are established through legislation.

NRA should:

- expedite the development and approval of the management system;
- formalize the implementation of graded approach in the regulatory decision making process;
- establish and implement an enforcement policy and process, including criteria for corrective actions;
- develop an emergency plan and procedures for the functions assigned to NRA regarding preparedness and response to nuclear or radiological emergencies.

The IRRS team acknowledges that some of the issues have already been identified in the action plan for improving the national regulatory infrastructure, developed by NRA during the self-assessment performed in preparation for the IRRS mission.

The IRRS team appreciates the full support and cooperation of NRA and all other parties participating in the IRRS mission to Ghana. The peer review of the regulatory, technical, and policy issues were conducted in a constructive, open and transparent manner throughout the mission.

The IAEA issued a press release upon conclusion of the mission.

# I. INTRODUCTION

At the request of the Government of Ghana, an international team of senior safety experts met representatives of the Nuclear Regulatory Authority (NRA) from 25 November to 4 December 2024 to conduct an Integrated Regulatory Review Service (IRRS) mission. The purpose of this peer review was to review Ghana's governmental, legal and regulatory framework for nuclear and radiation safety. The review mission was formally requested by the Government of Ghana in June 2020. A preparatory meeting was conducted on 24 to 25 April 2024 at NRA Headquarters in Accra to discuss the purpose, objectives, and detailed preparations of the review of the regulated facilities and activities in Ghana and their related safety aspects and to agree on the scope of the IRRS mission.

The IRRS team consisted of 14 senior regulatory experts from 13 IAEA Member States, and 3 IAEA staff members. The IRRS team carried out the review in the following areas: responsibilities and functions of the government; the global nuclear safety regime; responsibilities and functions of the regulatory body; the management system of the regulatory body; the activities of the regulatory body including the authorization, review and assessment, inspection and enforcement processes; development and content of regulations and guides; emergency preparedness and response; occupational radiation protection, control of medical exposure and public exposure control; transport of radioactive material; waste management and decommissioning; and interface with nuclear security. The IRRS mission also included Module 12, Tailored Module for countries embarking on nuclear power programme since Ghana is conducting preparatory work for the safety infrastructure development for the construction of a nuclear power plant. In addition, policy issues were discussed, including budgeting and funding of the regulatory body and staff compensation; and establishing decommissioning and radioactive waste management fund.

NRA conducted self-assessment in preparation for the mission and prepared a preliminary action plan. The results of NRA's self-assessment and supporting documentation were provided to the IRRS team as advance reference material for the mission. During the mission, the IRRS team performed a systematic review of all topics within the agreed scope through review of Ghana's advance reference material, conduct of interviews with management and staff of NRA and direct observation of NRA's regulatory activities at regulated facilities. Meetings were also organized with the Ministry of Environment, Science, Technology and Innovation.

All through the mission the IRRS team received excellent support and cooperation from NRA.

## II. OBJECTIVE AND SCOPE

The purpose of this IRRS mission was to review Ghana's governmental, legal and regulatory framework and activities for nuclear and radiation safety against the relevant IAEA safety standards; to report on the effectiveness of the regulatory system; and to exchange information and experience in the areas covered by the IRRS. The agreed scope of this IRRS review included all facilities and activities regulated in Ghana. It is expected that this IRRS mission will facilitate regulatory improvements in Ghana and other Member States, utilizing the knowledge gained and experiences shared between NRA and IRRS reviewers and the evaluation of Ghana's regulatory framework for nuclear and radiation safety.

The key objectives of this mission were to enhance the national legal, governmental and regulatory framework for nuclear and radiation safety, and national arrangements for emergency preparedness and response through:

a) providing an opportunity for continuous improvement of the national regulatory body through an integrated process of self-assessment and review;

b) providing the host country (regulatory body and governmental authorities) with a review of its regulatory technical and policy issues;

c) providing the host country (regulatory body and governmental authorities) with an objective evaluation of its regulatory infrastructure with respect to IAEA safety standards;

d) promoting the sharing of experience and exchange of lessons learned among senior regulators;

e) providing key staff in the host country with an opportunity to discuss regulatory practices with IRRS team members who have experience of other regulatory practices in the same field;

f) providing the host country with recommendations and suggestions for improvement;

g) providing other states with information regarding good practices identified in the course of the review;

h) providing reviewers from Member States and IAEA staff with opportunities to observe different approaches to regulatory oversight and to broaden knowledge in their own field (mutual learning process);

i) contributing to the harmonization of regulatory approaches among States;

j) promoting the application of IAEA safety requirements; and

k) providing feedback on the use and application IAEA safety standards.

# III. BASIS FOR THE REVIEW

## A) PREPARATORY WORK AND IRRS TEAM

At the request of the Government of Ghana, a preparatory meeting for the Integrated Regulatory Review Service (IRRS) was conducted from 24 to 25 April 2024. The preparatory meeting was carried out by the appointed Team Leader Mr Thiagan Pather, Deputy Team Leader Ms Geraldine Pina and the IRRS IAEA Team coordinators, Mr Teodros Hailu and Ms Sonal Gandhi.

The IRRS mission preparatory team had discussions regarding regulatory programmes and policy issues with the senior management of NRA represented by Mr Nii Kwashie Allotey, Director General of NRA, other senior management and staff. It was agreed that the regulatory framework with respect to the following facilities and activities would be reviewed during the IRRS mission in terms of compliance with the applicable IAEA safety requirements and compatibility with the respective safety guides:

- Research Reactors,
- Waste management facilities;
- Radiation sources facilities and activities;
- Decommissioning;
- Transport of radioactive material;
- Control of medical exposure;
- Occupational radiation protection;
- Public exposure control;
- Emergency Preparedness and Response;
- Interface with nuclear security; and
- Selected policy issues.

In relation to the current preparatory work for the safety infrastructure development for the construction of a nuclear power plant conducted by Ghana, it was also agreed that the IRRS mission will cover Module 12 – Tailored Module for countries embarking on a nuclear power programme.

Mr Emmanuel Ampomah-Amoako from NRA made presentations on the national context, the current status of NRA and the self-assessment results to date.

IAEA staff presented the IRRS principles, process and methodology. This was followed by a discussion on the tentative work plan for the implementation of the IRRS in Ghana.

The proposed composition of the IRRS team was discussed. Logistics including meeting and workplaces, counterparts and Liaison Officer identification, proposed site visits, lodging and transportation arrangements were also addressed.

NRA's Liaison Officers for the IRRS mission were confirmed as Mr Nii Kwashie Allotey as Liaison Officer, and Mr Emmanuel Ampomah-Amoako as Deputy Liaison Officer.

NRA provided IAEA with the advance reference material for the review at the end of September 2024. In preparation for the mission, the IRRS review team members reviewed the ARM and provided their initial impressions to the IAEA Team Coordinator prior to the commencement of the mission.

## B) REFERENCES FOR THE REVIEW

The relevant IAEA safety standards, the Code of Conduct on the Safety and Security of Radioactive Sources as well as the Code of Conduct on the Safety of Research Reactors were used as review criteria.

The complete list of IAEA publications used as the references for this mission is provided in Appendix VII.

## C) CONDUCT OF THE REVIEW

The initial IRRS team meeting took place on Sunday 24 November 2024 at Fiesta Royale Hotel in Accra, directed by the IRRS Team Leader and the IAEA Team Coordinators. Discussions encompassed the general overview, the scope and specific issues of the mission, clarified the bases for the review and the background, context and objectives of the IRRS programme. The understanding of the methodology for review was reinforced. The agenda for the mission was presented to the team. As required by the IRRS Guidelines, the reviewers presented their initial impressions of the ARM and highlighted significant issues to be addressed during the mission.

The host Liaison Officer was present at the initial IRRS team meeting, in accordance with the IRRS Guidelines, and presented logistical arrangements planned for the mission.

The IRRS entrance meeting was held on Monday 25 November 2024 with the participation of NRA Senior management and staff. Opening remarks were made by Ms Aba Bentil Andam, NRA Board Chairperson, Mr Patrick Nomo, Chief Director, Ministry of Environment, Science, Technology and Innovation, Mr Collins Adomako-Mensah, Deputy Minister of Energy and Mr Thiagan Pather, IRRS Team Leader. Mr Emmanuel Ampomah-Amoako gave an overview of the Ghana context, NRA activities and the action plan prepared as a result of the pre-mission self-assessment.

During the IRRS mission, a review was conducted for all review areas within the agreed scope with the objective of providing Ghana and NRA with recommendations and suggestions for improvement and, where appropriate, identifying good practices. The review was conducted through meetings, interviews and discussions, visits to facilities and direct observations of regulatory practices.

In addition to the review, discussions were made to share views, experience and lessons learned between Ghana and the IRRS team on selected policy issues.

The IRRS team performed its review according to the mission programme given in Appendix II.

The IRRS exit meeting was held on Wednesday 04 December 2024. Opening remarks were made at the exit meeting by Mr Nii Kwashie Allotey, Director General of NRA and were followed by the presentation of the results of the mission by the IRRS Team Leader Mr Thiagan Pather. Closing remarks were made by Ms Hildegarde Vandenhove, IAEA Director, Division of Radiation, Transport and Waste Safety.

An IAEA press release was issued at the end of the mission.

Ghana is encouraged to report to the next review meeting of the Convention on Nuclear Safety, the results of the mission as well as the progress made against the recommendations and suggestions identified in this report.

# 1. RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMENT

## 1.1. NATIONAL POLICY AND STRATEGY FOR SAFETY

The Nuclear Regulatory Authority (NRA) is established by the NRA Act, Act 895 in 2015 (hereinafter referred to as "the Act") as an independent regulatory body and became operational in January 2016. NRA has a statutory responsibility for regulating the civilian use of nuclear and other radioactive materials in medicine, industry, agriculture, education and research. NRA reports to the Government through the Ministry of Environment, Science, Technology, and Innovation (MESTI).

The Nuclear Energy Policy issued by the Ministry of Energy in 2021, affirms the Government's intention to diversify the current energy mix with the inclusion of civilian use of nuclear power and maintain the implementation of long-term power sector plans. This includes developing and implementing an effective mechanism for funding and financing the nuclear power programme, establishing strategic bilateral partnerships with nuclear power countries and international institutions, and educating and sensitizing the public (including policymakers, legislators, media, educational institutions, local chiefs, and opinion leaders) to address their concerns about including nuclear power in the energy mix. Additionally, it includes continuous development of regulatory framework to address issues of safety, security, and safeguards in line with international best practices.

A draft national policy and strategy for safety entitled "National Policy for Nuclear and Radiation Safety" was developed by NRA in 2023. The IRRS team was informed that this draft policy is currently with the Minister of MESTI awaiting submission to Cabinet for approval. The draft policy confirms the Government's commitment to:

- adhere to binding international conventions and relevant instruments related to safety;
- apply a graded approach commensurate with national circumstances and radiation risks associated with facilities and activities;
- the provision of adequate resources aligned with responsibilities for the management of safety and demonstration of effective leadership for safety;
- the provision of a framework for research to support nuclear and radiation safety; and
- the need to take into account social and economic developments.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *The national safety policy and strategy document is in draft form and has not received its final approval from the Cabinet* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 1 states that** *"The government shall establish a national policy and strategy for safety, the implementation of which shall be subject to a graded approach in accordance with national circumstances and with the radiation risks associated with facilities and activities, to achieve the fundamental safety objective and to apply the fundamental safety principles established in the Safety Fundamentals."* |
| **(2)** | **BASIS: SSG 16 Action 5 states that** *"the government should establish a clear national policy and strategy for meeting safety requirements in order to achieve the fundamental safety objective and to apply the fundamental safety principles established in SF-1* |

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| **R1** | **Recommendation: The Government should issue the comprehensive national safety policy and strategy for all facilities and activities, which is consistent with IAEA Safety Standards.** |

## 1.2 ESTABLISHMENT OF A FRAMEWORK FOR SAFETY

Ghana is still developing its regulatory framework for safety and several documents are in draft form. These include:

- National policy for nuclear and radiation safety
- The radioactive waste management policy and strategy
- Regulations to be issued under the Act
- Training programme for technical staff of NRA
- NRA integrated management system
- Working arrangements with other governmental agencies with responsibilities for safety.

The Act provides for the regulation and management of activities and practices for the peaceful use of nuclear material or energy, radioactive material or radiation. The Act in part implements the draft national policy and strategy but requires that draft regulations are promulgated.

The Act repealed sections of Ghana Atomic Energy Commission (GAEC) Act 588 of 2000 as well as the Radiation Protection Instrument 1993 Regulation (LI 1559).

Not all elements of GSR Part 1 (Rev. 1) Requirement 2, paragraphs 2.5 are addressed in the Act, although some elements are included in the draft regulations. The missing elements include:

- The conduct of activities, in accordance with a graded approach.
- Provision for the involvement of interested parties and for their input to decision making.
- Provision for an interface with nuclear security,
- Provision for acquiring and maintaining the necessary competence nationally for ensuring safety.

In addition, the Act does not make reference to prime responsibility for protection and safety to the person or organization responsible for any facility or activity.

| **RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES** | |
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| *Observation: The Act does not contain all the required elements of an appropriate legal and regulatory framework for safety. Examples of some missing elements include: the need to apply a graded approach; assignment of prime responsibility for protection and safety; and that compliance with regulations does not relieve the authorized party from its prime responsibility for safety.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 2 states that** *"The government shall establish and maintain an appropriate governmental, legal and regulatory framework for safety within which responsibilities are clearly allocated.* |
| **(2)** | **BASIS: SSG 16 (Rev. 1) Action 149 states that** *"The operating organization should be formed, if it has not already been formed, and it should be expressly assigned its prime responsibility for safety."* |

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| **R2** | **Recommendation: The Government should ensure that all the elements for safety are established through legislation including the application of the graded approach, assignment of prime responsibility for protection and safety and stipulation that compliance with regulations does not relieve the authorized party from its prime responsibility for safety.** |

The Act has provisions that the Minister may, on the advice of the Board, make regulations for the efficient and effective implementation of the Act by legislative instrument. The IRRS team was informed that regulations are issued by parliament in accordance with the national legal system of developing regulations.

NRA has developed several draft regulations. These drafts which are at different stages of development include, among others, the Basic Ionising Control Radiation Regulations (BIRCR), Licensing for Nuclear Installations, Site Evaluation, Nuclear Security, Integrated Management System, Design, Construction Commissioning and Operation of nuclear installations, Emergency Preparedness and Response, Radioactive Waste Management, Decommissioning, and Transport Safety.

The IRRS team was informed that some regulations, such as the BIRCR, are at the final stages of legal review by the Attorney General's office and major change in the technical content of the regulations is not expected. Some of the draft regulations are being reviewed internally by NRA while others are being reviewed externally by relevant stakeholders.

In the absence of regulations, NRA applies and enforces regulatory requirements based on provisions of the Act and through license conditions imposed on authorized parties by NRA.

| **RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES** | |
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| **Observation:** *Several Regulations have been drafted for the implementation of the Act 895. Elements of the regulatory framework for safety are absent as regulations have not been issued under the Act 895. The issue was already included by NRA in the initial action plan prepared for the mission.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 2 states that** *"The government shall establish and maintain an appropriate governmental, legal and regulatory framework for safety within which responsibilities are clearly allocated.* |
| **(2)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 32 states that** *"The regulatory body shall establish or adopt regulations and guides to specify the principles, requirements and associated criteria for safety upon which its regulatory judgements, decisions and actions are based.***"** |
| **(3)** | **BASIS: GSR Part 1 (Rev. 1) para. 4.61 states that** *"The government or the regulatory body shall establish, within the legal framework, processes for establishing or adopting, promoting, and amending regulations and guides. [...]"* |
| **(4)** | **BASIS: SSG-16 (Rev.1) Action 31 states that** *"The regulatory body should develop and issue those safety regulations that are needed for the bidding process or contract negotiations"* |
| **R3** | **Recommendation: The Government should expedite the promulgation of the regulations.** |

## 1.3 ESTABLISHMENT OF A REGULATORY BODY AND ITS INDEPENDENCE

NRA has been established as the independent regulatory body for nuclear and radiation safety in Ghana. NRA is governed by a seven-member Board appointed by the President. The mandate of the Board is to formulate and initiate policies for the development of NRA; to ensure the proper management of the resources of NRA; and to ensure that NRA implements all functions conferred on it by the Act, and any other enactment.

The NRA Board may advise the Minister on issuing regulations under the Act. The process to issue regulations requires that consultations are performed, and the approval of the Board prior to final legal drafting/review by the Attorney General before promulgation by parliament.

The Presidential (Transition) Act, Act 845, stipulates that the term of all persons, appointed to a Board by the President or State Ministers, ends automatically when new government is formed, which may affect the ability of NRA to carry out its duties until a new Board is appointed. Since the Act came into force, the Board has been constituted three times, and the IRRS team was informed that there have been extended periods with no constituted Board.

The IRRS team was informed that NRA currently has sufficient funds provided by the annual budget of the State for the activities of NRA. It is noted from the Annual report for 2022 that the total budget was GH¢13,085,059 and that the internally generated revenue contributed nearly 20% of this total.

NRA plans to construct new offices and has included in its budget request for 2025 an allocation for the concept and design for these offices. Construction of the new offices is planned to commence towards the end of 2026.

The IRRS team was informed that there are enough staff within NRA to meet its current regulatory workload, but it can experience delays in getting the clearance to replace employees leaving due to retirement etc. The IRRS team was informed that the retention of existing staff may in future become an issue if staff should opt to work in the nuclear power programme.

The Act has provisions for appointment of staff of NRA. The level of competencies is specified in the draft "Scheme of Service" for the various positions within NRA. NRA also has a draft "Training Programme for Technical Staff of NRA, 2017".

The Act states that the prerequisites for the Director-General are "*a person of proven integrity"* and "*has qualification and practical experience in the relevant field"*. The Act makes no mention of leadership for safety although this is noted in the draft national policy for nuclear and radiation safety.

NRA has the power to take enforcement actions by virtue of the Act; NRA inspectors can order the cessation of activities. Further, authorized persons, who commit an offence under the Act are liable upon conviction to penalty points, which correspond to fines or periods of imprisonment in accordance with the Fines (penalty units) Act, Act 572 Schedule I.

Although the Act establishes NRA as an independent regulatory authority, its effective independence is hindered by several aspects, as follows: NRA is supervised by the MESTI, which is separate from the main promoter of the country's nuclear power programme, but still supervises the operating organization of GHARR-1 research reactor and other radiation sources used in research activities. Furthermore, the Act gives a person aggrieved by a decision or action of NRA the ability to submit a complaint in writing to the Minister, which will then convene a panel to review the regulatory decision. The Minister may accept or reject the recommendation of the panel and proceed to take a decision which is in the interest of the nation, which may lead to reversing a safety-related decision by NRA.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *MESTI has responsibilities for promotion for nuclear technology. Additionally, the appeal of decisions from the NRA are directed to the Minister, who has the power to revoke them.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 4 states that** *"The government shall ensure that the regulatory body is effectively independent in its safety related decision making and that it has functional separation from entities having responsibilities or interests that could unduly influence its decision making"* |
| **(2)** | **BASIS: SSG-16 (Rev. 1) Action 27 states that** *"The government should establish an effectively independent regulatory body and should empower it with adequate legal authority and ensure it has the technical and managerial competence, and the human and financial resources, to discharge its responsibilities in the nuclear power programme."* |
| **R4** | **Recommendation: The Government should ensure that the NRA is effectively independent, so that regulatory judgements and decisions follow a process free from any undue influence that might compromise safety.** |

## 1.4 RESPONSIBILITY FOR SAFETY AND COMPLIANCE WITH REGULATIONS

The use of different terminology between the Act, the draft national policy and the regulations introduces potential confusion as to who has the prime responsibility for safety.

The Act does not use the term prime responsibility, however the Act states that the authorised person is *"responsible for the safe and secure conduct of the activity or practice in compliance with this Act.*" However, the draft national policy states that prime responsibility for safety lies with the operator. Furthermore, draft BIRCR assigns prime responsibility to the person or organisation that generates radiation risk.

The draft National Policy for Nuclear and Radiation Safety requires that protection should be optimised throughout the lifetime of facilities and activities, but this is not a requirement under the Act. Furthermore, the Act does not include the requirement that compliance with regulations should not relieve the authorized party from its prime responsibility for safety. **Recommendation R2 in section 1.2. addresses the issue**.

## 1.5 COORDINATION OF AUTHORITIES WITH RESPONSIBILITIES FOR SAFETY WITHIN THE REGULATORY FRAMEWORK

NRA has signed some memoranda of understanding (MoU) with other authorities. However, the IRRS team was informed that in some cases there is a lack of coordinated implementation. NRA entered into an MoU with Environmental Protection Agency in August 2022 as well as with Ghana Civil Aviation Authority in August 2024. The IRRS Team was informed that working arrangements are in place with these entities; however, are not documented.

The Act states that NRA shall collaborate with the Environmental Protection Agency (EPA), Ministry responsible for National Security and agencies responsible for emergency and disaster management. NRA collaborates with the National Disaster Management Organisation (NADMO) and their working relationship at the national level is based on the National Nuclear and Radiological Emergency Response

Plan, which should be approved by the National Security Council. The IRRS team noted that the Draft Emergency Preparedness and Response for Authorized Persons Regulations do not include provisions for collaboration between NRA and any other Ghanian emergency response organizations. At the operator's level, the sole EPR regulating organization is the NRA.

There are also no agreements in place with border control agencies or the Health Facilities Regulatory Authority. The interface among authorities is discussed further in section 10.3. The IRRS team was informed, that NRA has experienced challenges in formalizing working arrangements with some national authorities. The intervention of the Government to mitigate these challenges will be beneficial.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *NRA has working arrangements with several authorities but formal processes have not been developed, in some instances.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 7 states that** *"Where several authorities have responsibilities for safety within the regulatory framework for safety, the responsibilities and functions of each authority shall be clearly specified in the relevant legislation. The government shall ensure that there is appropriate coordination of and liaison between the various authorities.* |
| **(2)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 12 states that** "*The government shall ensure that, within the governmental and legal framework, adequate infrastructural arrangements are established for interfaces of safety with arrangements for nuclear security and with the State system of accounting for, and control of, nuclear material."* |
| **R5** | **Recommendation: The Government should support the NRA to ensure that there is effective coordination between NRA and all relevant authorities that have responsibilities for safety and security.** |

## 1.6 SYSTEM FOR PROTECTIVE ACTIONS TO REDUCE EXISTING OR UNREGULATED RADIATION RISKS

The Draft National Policy for Nuclear and Radiation Safety requires that "*Protective actions to reduce existing or unregulated radiation risks must be justified and optimized. This shall be achieved by establishing appropriate protective measures to minimise the radiation exposure and to remediate adverse conditions, if radiation risks are high.*"

The Act requires an authorised person to inform NRA in case of loss of control of the source and for NRA to ensure the safe management of any orphan source. NRA collaborates with the Ministry responsible for National Security and other agencies responsible for emergency such as the National Disaster Management Organisation (NADMO). NRA acts as the lead technical agency under the National Nuclear and Radiological Emergency Response Plan. The IRRS team was informed that NRA conducted a search and secure activity for orphan sources in 2016.

NRA serves as the main point of contact for the Convention on Early Notification of a Nuclear Accident and Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

Radon requirements are included in the draft Basic Ionising Radiation Control Regulations.

The IRRS Team was informed that NRA is working with stakeholders to conduct studies of NORM including radon and this will form the basis for the strategy to protect people from radon and other NORM, although a formal strategy has not been established with regard to unregulated radiation risks.

## 1.7. PROVISIONS FOR THE DECOMMISSIONING OF FACILITIES AND THE MANAGEMENT OF RADIOACTIVE WASTE AND OF SPENT FUEL

The management of radioactive waste is covered in several sections of the Act and radioactive waste management regulations have been drafted.

NRA has developed a draft policy and strategy for radioactive waste management entitled "Radioactive Waste Management Policy and Strategy for the Republic of Ghana" dated July 2020. This Policy and Strategy document elaborates on the preferred options for radioactive waste management and the strategy for outlining the arrangements for the implementation of the stated national policy for radioactive waste management. The draft policy provides that the Government will develop a financial plan for management of radioactive waste but lacks detail regarding interim target dates for waste disposal. This policy document is still undergoing review by a committee which includes NRA and the Radioactive Waste Management Centre. The IRRS team was informed that once reviewed, it will go out for consultation to stakeholders.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *The draft Radioactive Waste Management Policy and Strategy requires further considerations and discussion with appropriate stakeholders.* | |
| **(1)** | **BASIS: GSR Part 5 Requirement 1 states that** *"The government shall provide for an appropriate national legal and regulatory framework within which radioactive waste management activities can be planned and safely carried out. This shall include the clear and unequivocal allocation of responsibilities, the securing of financial and other resources, and the provision of independent regulatory functions....."* |
| **(2)** | **BASIS: GSR Part 5 Requirement 2 states that "***To ensure the effective management and control of radioactive waste, the government shall ensure that a national policy and a strategy for radioactive waste management are established. The policy and strategy shall be appropriate for the nature and the amount of the radioactive waste in the State, shall indicate the regulatory control required, and shall consider relevant societal factors. The policy and strategy shall be compatible with the fundamental safety principles [2] and with international instruments, conventions and codes that have been ratified by the State. The national policy and strategy shall form the basis for decision making with respect to the management of radioactive waste."* |
| **R6** | **Recommendation: The Government should establish, issue and implement a comprehensive national policy and strategy on radioactive waste and spent nuclear fuel management.** |

The Government has established a Radioactive Waste Management Centre (RWMC) under GAEC to cater for the storage of radioactive waste, which is licenced by NRA. Disused Sealed Radioactive Sources (DSRS) are to be stored centrally by GAEC on payment of a fee by the users. The RWMC is currently exploring the borehole disposal option as the final disposal facility for the various medium and low-level waste generated in the country.

The IRRS Team was informed that the Government intends to establish an independent radioactive waste management organisation to be called "National Radioactive Waste Management Authority" (NRWMA) for future management of radioactive waste and spent nuclear fuel . The IRRS Team was further informed that the Government intends to establish a Radioactive Waste Management Executive Committee (RWMEC), which will oversee the implementation of this policy and strategy.

**Policy Discussion: Establishing decomissioning and radioactive waste management fund**

NRA is mandated the Act to establish the necessary mechanisms to enforce the obligations on financing decommissioning and radioactive waste management of an authorised person. To meet this mandate, NRA is seeking to establish a Decommissioning Fund and a Radioactive Waste Management Fund to provide for the assured disposal and safe management of spent fuel and other radioactive waste. The elements being considered include identification of decommissioning costs, estimation of decommissioning costs, collection of Decommissioning Fund and Radioactive Waste Management Fund, control and oversight of decommissioning and radioactive waste management funds, uncertainties in funding and best practices in management of decommissioning funds. NRA would like to share the experience of other regulators on whether it is necessary to establish two different funds, management of the funds: private or government, challenges in instituting and implementing these funds, and mechanisms of release of funds to the authorized party.

The IRRS team members who participated in the discussions shared their similar challenges and experiences on establishing and implementing decommissioning and radioactive waste management fund in their respective countries. In all the countries, such fund(s) were created and managed by the operators/licensees. The role of the regulatory body was ensuring the adequacy of such funds. The IRRS team emphasised that this was a challenging issue for many regulators and that it was encouraging to note that Ghana has started to think about this in the early stages of the development of its nuclear power programme.

The discussions confirmed that there was no general rule about having one or two funds, but the important conclusion from the discussion was that both aspects related to decommissioning and radioactive waste management and their interdependency should be taken into consideration when deciding on such fund(s). In some cases, the operator covers the cost estimates in the decommissioning plan which are submitted as part of the authorisation process and then these estimates are re-assessed periodically.

The IRRS team explained that the nuclear power operator, while deciding on the electricity prices, factors in the costs related to the decommissioning and radioactive waste management. It was also discussed that generally the fund is expected to be accumulated over the design life of the plant with the assumption that the power plant will operate until then; however, it might be prudent to factor in contingencies.

The IRRS team also provided their perspective from the radioactive sources point of view and informed that the issue related to radioactive waste management from industrial and medical practices is a also challenge and they are undertaking feasibility studies to come up with the final solution for disposal. In some countries, regarding the sealed sources which are imported, the authorized party is required to make a bank deposit that is refunded when the radioactive sources is returned to supplier. Where the sources are not returned to the supplier then the money is utilized to fund the required management of the source.

## 1.8. COMPETENCE FOR SAFETY

The draft National Policy for Nuclear and Radiation Safety states "*The Government of Ghana will also promote research and development in science and technology and ensure nuclear science education and training are provided at the academic level, and within all nuclear-related organisations*".

The IRRS team noted efforts by the Government to develop strategies for training experts to meet the needs of organizations in the field of the nuclear and radiation safety.

In relation to developing competence of NRA staff there is a draft document "Training Programme for Technical Staff of NRA" dated 2017, which incorporates four levels of competence.

GAEC in collaboration with the University of Ghana, and with support from the IAEA, established the School of Nuclear and Allied Sciences (SNAS) in September 2006 to provide education in nuclear science and technology at the graduate level. The school is providing a pool of educated personnel in nuclear and radiation safety for Ghana.

The draft BIRCR requires the authorised person or employer to ensure that there is sufficient training provided but the level of training required is not stipulated.

NRA has developed criteria for qualification of radiation experts and radiation protection officers. Currently, NRA has authorized three individuals as qualified experts and the Radiation Protection Institute as a consulting organisation that can give qualified expert advice.

The IRRS team was informed that NRA is considering further actions to promote the increase in the number of qualified experts.

## 1.9. PROVISION OF TECHNICAL SERVICES

In accordance with the draft BIRCR, technical services for calibration of equipment, personal dosimetry, environmental monitoring and other services require authorization from NRA.

NRA is drafting requirements prescribing the technical support services that require authorization and relevant criteria. The IRRS team noted that environmental monitoring services were not included in the draft requirements and NRA has not authorized any technical support services for environmental monitoring.

NRA has authorised the following services:

- Consulting Organization
- Training Services
- Dosimetry Services
- Performance and Calibration Services
- Leakage Testing Services
- NORM Decontamination Services as well as
- Services related to import, export, installation, maintenance of radiation emitting devices.

## 1.10. SUMMARY

The Government of Ghana has initiated a legal framework for safety. Several elements of this framework require finalization and approval. Notably the Government needs to finalize the draft policies and

expedite promulgation of the regulations under the Act and ensure effective independence of NRA. Furthermore, the Act needs to be amended to align with the requirements of the IAEA safety standards.

# 2. THE GLOBAL SAFETY REGIME

## 2.1. INTERNATIONAL OBLIGATIONS AND ARRANGEMENTS FOR INTERNATIONAL COOPERATION

The Act assigns to the NRA a function to exchange information and co-operate with regulatory authorities of other countries and relevant international organisations on matters of nuclear safety, nuclear security and safeguards.

Ghana is a contracting party to relevant international conventions and international agreements for ensuring nuclear safety, security, safeguards and the management of radioactive waste. In particular, Ghana is a Contracting Party to the Convention on Nuclear Safety, the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, the Convention on Early Notification of a Nuclear Accident, the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, as well as the Convention on the Physical Protection of Nuclear Materials and its Amendment.

Ghana has made a political commitment to the Code of Conduct on the Safety of Research Reactors.

Additionally, Ghana has made a political commitment to the Code of Conduct on the Safety and Security of Radioactive Sources. However, Ghana has not made a political commitment to the Supplementary Guidance on the Management of Disused Radioactive Sources and Supplementary Guidance on the Import and Export of Radioactive Sources. Furthermore, Ghana has not updated the designated contact point under the Code of Conduct on Safety and Security of Radioactive Sources.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *Ghana has made a political commitment to the Code of Conduct on the Safety and Security of Radioactive Sources, but it has not yet expressed its political commitment to the Supplementary Guidance on the Import and Export of Radioactive Sources and Guidance on the Management of Disused Radioactive Sources.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) para. 3.2 states that** *"The government shall fulfil its respective international obligations, participate in the relevant international arrangements, including international peer reviews, and promote international cooperation and assistance to enhance safety globally 3.2. The features of the global safety regime include: …*<br>*(b) Codes of conduct that promote the adoption of good practices in the relevant facilities and activities…".* |
| **(2)** | **BASIS: Code of Conduct on Safety and Security of Radioactive Sources para. 31 states that** *"Every State should, as appropriate, inform persons involved in the management of radioactive sources, such as industry, health professionals, and government bodies, and the public of the measures it has taken to implement this Code, and should take steps to disseminate that information."* |

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| **S1** | **Suggestion: The Government should consider expressing its political commitment to the Supplementary Guidance on the Import and Export of Radioactive Sources and Supplementary Guidance on the Management of Disused Radioactive Sources.** |

## 2.2. SHARING OF OPERATING EXPERIENCE AND REGULATORY EXPERIENCE

The IRRS team was informed that the Government of Ghana, through bilateral cooperation, has signed Memoranda of Understanding as well as Inter-Governmental Agreements with China and the Russian Federation. Similar agreements are under discussion and review with the USA.

Ghana participates in the following international activities:

- IAEA member state and served on the Board of Governors on numerous occasions.
- Serving on IAEA Nuclear Safety Standards Committee
- Member of Incident Reporting System for Research Reactors
- Member of the International Framework for Nuclear Energy Cooperation
- Member of the Regulatory Cooperation Forum

Ghana participates in the following African regional activities:

- African Commission on Nuclear Energy (AFCONE)
- Forum of Nuclear Regulatory Bodies in Africa (FNRBA)
- African Regional Cooperation Agreement for Research, Development and Training related to Nuclear Science and Technology (AFRA).

NRA has also established Memoranda of Understanding with the USNRC, CNSC and PNRA.

Ghana is a regional designated centre, recognised by the IAEA, for training in nuclear science and technology, as well as safety and security.

The IRRS team was informed that Ghana wishes to expand the international cooperation by reaching out to countries that need help in developing their regulatory infrastructure.

## 2.3. SUMMARY

Ghana is committed to its international obligations and promotes international cooperation and assistance to enhance safety globally.

The Government should consider expressing its political commitment to the Supplementary Guidance on the Import and Export of Radioactive Sources and Supplementary Guidance on the Management of Disused Radioactive Sources.

NRA has a proactive approach and is committed to support international cooperation at all levels.

# 3. RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY

## 3.1. ORGANIZATIONAL STRUCTURE OF THE REGULATORY BODY AND ALLOCATION OF RESOURCES

The NRA was established with the enactment of the Act to provide for the regulation of facilities and activities for the peaceful use of nuclear and radiation technology; to provide for the protection of persons and the environment against the harmful effects of radiation hazards; and to ensure effective implementation of Ghana's international obligations and related matters.

The NRA is governed by a seven-member Board appointed directly by the President of the Republic of Ghana with two institutional representatives having a rank not below that of a Director from:

- the secretariat of the National Security Council; and
- the Environmental Protection Agency (EPA).

The role of the board is oversight of activities of the NRA and includes:

- initiating policies for the development of the NRA;
- ensuring the proper management of the resources of the NRA; and
- ensuring the implementation of the functions conferred on the NRA.

The Director General of NRA is appointed by the President of the Republic of Ghana and is a member of the Board. The Director General handles the day-to-day administration of affairs and is assisted by a Deputy Director General. The Director General approves the authorizations and other documents issued by NRA.

NRA comprises three directorates namely:

- Radiological and Non-Ionising Installations Directorate;
- Nuclear Installations Directorate; and
- Finance and Administration Directorate.

The Radiological and Non-Ionising Installations Directorate has four departments:

- Emergency Preparedness and Response Department: Mainly responsible for ensuring that appropriate preparedness and response arrangements are in place at both the national and facility level;
- Radiological Applications Department: Mainly responsible for regulating radiological facilities and activities;
- Non-Ionising Installations Department: Mainly responsible for regulating non-ionising radiation facilities and activities; and,
- Instrumentation and ICT Department: Mainly responsible for maintaining equipment used for regulatory activities, and also handles all ICT related matters for the Authority.

The Nuclear Installations Directorate has three departments and regulates nuclear installations which currently comprise the research reactor and the radioactive waste management facility:

- Nuclear Safety Department: Mainly responsible for ensuring the regulatory oversight of the safety of nuclear installations;

- Nuclear Security Department: Mainly responsible for regulation of the security of nuclear and radiological facilities and activities; and,
- Nuclear Safeguards and Non-Proliferation Department: Mainly responsible for ensuring compliance with the international safeguards and non-proliferation obligations of the country.

The Finance and Administration Directorate has three departments:

- Finance Department: Mainly responsible for managing finances;
- General Services and Procurement: Mainly responsible for the general maintenance works and procurement; and,
- Human Resources Department: Mainly responsible for of the management of human resources and human capacity building.

Internal Audit, International Relations and Public Affairs, as well as Legal Affairs report directly to the Director-General. Additionally support departments comprising Monitoring and Evaluation, as well as Education and Training report to the Deputy Director-General.

This structure is outlined in the organizational chart of NRA in Annex VIII.

NRA has drafted a Scheme of Service that details the organisational structure which NRA seeks to grow to, with a new internal structure comprising nine directorates including a regional office, reflecting the additional workload that will be required once the country's nuclear power programme commences. This draft document also identifies the human resources that will be required to allow NRA to fulfil its duties and perform its functions as specified in the Act, in a manner commensurate with the radiation risks associated with facilities and activities.

## 3.2. EFFECTIVE INDEPENDENCE IN THE PERFORMANCE OF REGULATORY FUNCTIONS

The position of NRA within MESTI, which is responsible for GAEC and the fact that appeals of NRA decisions are referred to the Minister of MESTI raises potential impacts to the independence of the regulatory decisions of the NRA. **Recommendation R4 in section 1.3. addresses the issue**.

NRA has drafted a comprehensive human resources plan that includes provisions to address potential conflict of interest of its staff. However, in its current form, the draft document focuses mainly on preventing situations resulting in personal gain by employees and does not include provisions to give special consideration to staff members that may be recruited from authorized parties in the future, aiming at ensuring their effective independence when carrying out their regulatory duties. NRA recognizes that this could be achieved by establishing provisions in the draft human resources plan, e.g. establishing an appropriate cool down period for new staff members recruited from authorized parties, where they are recused from regulatory activities relating to their former employer.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation**: *The draft NRA human resources plan does not address special consideration regarding staff members that may be recruited directly from authorized parties in the future, with regards to ensuring their effective independence.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) para. 4.8 states that** *"To maintain the effective independence of the regulatory body, special consideration shall be given when new staff* |

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| | *members are recruited from authorized parties, and the independence of the regulatory body, regulatory aspects and safety considerations shall be emphasized in their training. (…)"* |
| **S2** | **Suggestion: NRA should consider including in its human resources plan provisions to ensure new staff members that may be recruited directly from authorized parties remain effectively independent when carrying out their regulatory duties.** |

### 3.3. STAFFING AND COMPETENCE OF THE REGULATORY BODY

NRA presently has fifty-eight technical staff with various educational backgrounds, including nuclear engineering, mechanical engineering, civil engineering, nuclear and environmental science, nuclear physics, radiation protection, physics and related areas.

To meet the expected demand of human resources associated with the nuclear power programme, NRA has identified the need for sixty-one additional staff members and approval was sought from the Government. The IRRS team was informed that NRA has received approval to appoint an additional twenty-five staff members. Recruitment for these positions has commenced and NRA believes there is sufficient pool of human resources within Ghana to fill these posts.

The IRRS team was informed that the NRA is projecting to reach a combined staff strength of around two hundred-fifty by the early 2030s when the facilities under the nuclear power programme are expected to be operational and that this is considered as sufficient for its needs according to the draft competence needs assessment.

The IRRS team noted that establishing and maintaining a nuclear power programme is a major undertaking requiring careful planning, preparation and investment in time, money, infrastructure and human resources, as well as strict attention to nuclear safety, nuclear security, and the control and accounting of nuclear and radiological materials.

In 2017, the NRA drafted a four-level training programme based on the IAEA SARCON model. Despite still being in draft form, the IRRS team was informed that the document is already being used in training of the regulatory staff. The training programme covers:

- Level I: Nuclear Safety, Regulatory Control, Radiation Safety, Nuclear Security, Safeguards and Non-Proliferation;
- Level II: Radiation Protection and Waste Management, Power Reactors, Nuclear Security, Safeguards and Non-Proliferation;
- Level III: Review and Assessment, Inspection and Enforcement, Simulator and Development of Regulatory Tools;
- Level IV: Leadership and Management.

The training programme allows NRA staff to acquire both technical and managerial competences with an emphasis placed on safety and security considerations in the performance of regulatory functions.

NRA staff members that have completed Level III training programme on Inspection and Enforcement are qualified to be inspectors.

NRA has drafted an extensive internal process dealing with knowledge retention. Through this document, NRA intends to have an effective knowledge management system and, among other

provisions, the process requires that all staff that go for any form of training provide a training report, which is shared with other staff. Staff who are trained are required to give presentations at the directorate level to other staff so that the knowledge gained is shared within the NRA.

A draft NRA Governance Manual includes provisions that require the Director-General to prepare a formal management succession plan, but this is limited to key senior officers and does not encompass all the staff. Therefore, NRA does not currently have in place a strategy to compensate for the departure of qualified staff, including for turnover that might potentially increase once the nuclear power programme is at an advanced level of development.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *The draft NRA Governance Manual includes provisions that require the Director-General to prepare a formal management succession plan, but this is limited to key senior officers and does not encompass all the staff.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) para. 4.12 states that** *"The human resources plan for the regulatory body shall cover recruitment and, where relevant, rotation of staff in order to obtain staff with appropriate competence and skills, and shall include a strategy to compensate for the departure of qualified staff."* |
| **(2)** | **BASIS: SSG-16 (Rev. 1) Action 92 states that** *"The regulatory body […] should actively recruit staff so as to ensure capability in areas relevant to safety in a timely manner."* |
| **S3** | **Suggestion: NRA should consider expanding its strategy for succession of qualified staff to all levels, in order to allow it to timely replace staff that may decide to leave.** |

**Policy Issue: Budgeting and funding of the Regulatory Body and staff compensation**

NRA is funding resources are mainly from the government, loans and grants, and fees and charges that the regulatory body collects from regulatory activities. NRA is required by the Act to prepare a Financial Sustainability Plan and is also developing a Conditions of Service and Scheme of Service to provide basis for recruiting and maintaining staff to support the implementation of the Authority's mandate. The two documents are to form the basis for negotiating staff remuneration and compensation packages. NRA's Regulatory Strategy Document is focused on ensuring sufficient financial resources for meeting all functions of the regulatory body including for regulatory research. NRA would like to share experiences of the IRRS team on development of financial sustainability plan, development of fees and charges for regulatory services, and strategies for staff remuneration and motivation to ensure retention of staff.

The IRRS team who participated in the discussions provided their perspectives and shared experiences on the issue. The budget of regulatory bodies in different countries was funded in a variety of ways, from being completely funded by the government in some countries to be funded 80% from the fees charged to the operators and 20% from the government budget.

The team shared experience on how the remuneration of staff is compared with operating organizations. The salary structure in their regulatory bodies was not generally the highest compared to other industries, but it was reasonably above average. Some countries had the common government pay structure with some additional incentives and allowances for the nuclear regulators.

The team shared approaches used in their respective regulatory bodies to ensure the retention of staff including strategies used to motivate and maintain skilled staff. Career development through well-established training programmes, promotions, job stability and security, opportunities to gain international experiences and good working conditions were the common approaches mentioned. The experts emphasised that competent staff is the core asset of a regulator.

Further, as an embarking country, developing the expertise early on is important for Ghana, as training of staff takes time and outsourcing the tasks would be costly. Attritions happen in many countries due to various reasons including developing nuclear power programmes in the neighbouring countries and adequate planning is needed to address this issue. Experts advised that NRA should reflect this aspect in its sustainability plan.

### 3.4. LIAISON WITH ADVISORY BODIES AND SUPPORT ORGANIZATIONS

Under the Act, NRA may engage the services of experts and consultants as it considers necessary. At the Board level, there is a Technical Committee that identifies areas needed for technical support. This Technical Committee has the role of providing additional advice for cases where critical regulatory decisions need to be made.

NRA aims to maintain an adequate core competence through training and dissemination programmes. The competence needs assessment that NRA has drafted seeks to maintain core competences, including for competences needed as the country's energy programme expands to include nuclear power generation.

The Act sets conditions in which NRA may consult with advisory bodies and technical support organizations (TSOs). However, the established provisions either in the Act, in draft regulations or in NRA's current management system, do not establish that such consultation does not relieve NRA of its assigned responsibilities. The IRRS team was informed that NRA is already taking this into account in its liaison with advisory bodies and TSOs, even though it is not formalized.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *The Act sets conditions for NRA to consult with advisory bodies and technical support organizations. However, NRA's management system does not have provisions confirming NRA's accountability and responsibility in such situations.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 20 states that** *"The regulatory body shall obtain technical or other expert professional advice or services as necessary in support of its regulatory functions, but this shall not relieve the regulatory body of its assigned responsibilities."* |
| **S4** | **Suggestion: NRA should consider formalizing provisions to ensure that consultation of advisory bodies and technical support organizations does not relieve it of its assigned responsibilities.** |

### 3.5. LIAISON BETWEEN THE REGULATORY BODY AND AUTHORIZED PARTIES

NRA communicates with authorized parties through several formal and informal channels, including official letters and its own website.

When receiving applications for authorization, NRA issues Requests for Additional Information (RAIs) as necessary to seek clarification from an applicant or authorized party which enables them to address any issues or expand on the subject concerned.

When issuing authorizations, NRA includes specific conditions in the license or registration to substantiate and clarify its decisions to authorized parties.

During inspections, NRA staff make exit meetings to brief authorized parties and highlight the main findings. This allows the authorized parties to better understand the related regulatory requirements and immediately clarify any outstanding issues.

For situations where an authorized party disagrees with a regulatory decision, a process is in place for its appeal. The authorized party can first appeal to the Board, who will then conduct a review of the situation. If the decision is maintained by the Board, the authorized party may still appeal to MESTI. While the process for appeals is in place, its implementation could potentially affect the effective independence of NRA. **Recommendation R4 in section 1.3. addresses the issue**.

## 3.6. STABILITY AND CONSISTENCY OF REGULATORY CONTROL

Although the NRA has drafted several regulations for establishing regulatory requirements, they have not yet been approved. The IRRS team was informed that NRA is already using the draft regulations in its decision-making and uses the mechanism of establishment of license conditions to ensure they become binding for authorized parties. **Recommendation R3 in section 1.2. addresses the issue.**

NRA has drafted some guidance documents for authorized parties, but these have not yet been approved. Some additional guidance documents are yet to be developed. **Recommendation R21 in section 9.1. addresses the issue.**

Additionally, there are several draft regulatory documents which establish the processes, criteria and procedures but are not yet approved since NRA's management system is not yet in place. **Recommendation R9 in section 4.1. addresses the issue.**

The IRRS team is of the view that expediting the development, and expediating the finalization and approval of NRA's regulatory documents would enhance the stability and consistency of its regulatory functions and decision-making.

## 3.7. SAFETY RELATED RECORDS

NRA maintains records on safety-related matters, including:

- register of radiological facilities and waste management facilities,
- register of licenses/decisions,
- register of modifications,
- register of events,
- register of radiation practices,
- register of radiation sources,
- register of radioactive waste,
- register of personal doses of exposed workers,

- register of measurements of doses at workplaces,
- records of licensed personnel in nuclear facilities,
- database of inspection record, etc.

These safety related records are generally monitored and inspected by staff of NRA in preparation for planned or unplanned inspections, and in the authorization process.

The IRRS team was informed that NRA was using the IAEA Regulatory Authority Information System (RAIS) to maintain and retrieve these records. However, in 2022, there was a critical malfunction of the server that hosted RAIS, and the system has not been available since. NRA is still maintaining the same records but doing so manually in individual archives for each authorized party in a mix of digital and paper formats. While this process still ensures NRA maintains the required information, the IRRS team noted that it does not allow the records to be easily and quickly retrievable and these difficulties in retrieving information from the records could negatively impact the effectiveness of NRA.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *Due to malfunctioning of RAIS server, retrieval of recorded information needed for NRA`s efficient and effective conduct of core regulatory processes is negatively impacted.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 35 states that** *"The regulatory body shall make provision for establishing, maintaining and retrieving adequate records relating to the safety of facilities and activities."* |
| **(2)** | **BASIS: GSG-12 para. II.17. states that** *"Records should be readily retrievable to support and justify decision making."* |
| **S5** | **Suggestion: NRA should consider ensuring efficient retrievability of safety related records.** |

The draft BIRCR includes provisions for authorized parties to maintain their own records, which should also be accessible to NRA in support of its regulatory functions. The draft regulations require authorized parties to maintain records of:

- the tests and calibrations carried out;
- radiation dose records;
- cases of overexposure;
- medical records of workers;
- cases of contamination of skin, hair and clothing;
- results of area monitoring;
- list of all sealed radiation sources and their details;
- the radiation dose of any person undergoing medical exposure;
- stocks of unsealed radioactive material, with dates of receipt, issue and disposal and the supplier's or manufacturer's certificate;
- investigation of emergencies, accident and disposal of radioactive waste; and

- maintenance records of radiation sources.

### 3.8. COMMUNICATION AND CONSULTATION WITH INTERESTED PARTIES

NRA has established a list of interested parties that it engages in conducting consultations on draft regulations and guides. However, this list does not include the public. In the current practice, draft documents are opened to public comments only after they are submitted to the parliament. This practice does not apply to other aspects of regulatory decision-making by NRA.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *The processes in place for consultation regarding regulatory decisions and safety of facilities and activities do not include the public.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 36, states that** *"The regulatory body shall promote the establishment of appropriate means of informing and consulting interested parties and the public about the possible radiation risks associated with facilities and activities, and about the processes and decisions of the regulatory body."* |
| **(2)** | **BASIS: GSR Part 1 (Rev. 1) para. 4.69 states that** *"Public information activities shall reflect the radiation risks associated with facilities and activities, in accordance with a graded approach."* |
| **S6** | **Suggestion: NRA should consider establishing formal arrangements for consultation and communication with the public regarding regulatory judgements and decisions, following a graded approach.** |

The IRRS team noted that NRA has engaged in outreach activities, as part of its draft Communication Strategy, with several awareness promotion efforts already implemented such as:

- Public Education on radio – Technical staff of NRA joined a radio host to shed light on its role and to educate the public on radiation safety and nuclear matters.
- Media Training – A media training session was held for about twenty-two (22) journalists from TV, Radio, Print and Online media, to enhance their understanding on the operations of NRA, the regulation of radioactive materials, and the nuclear industry. This training served as an opportunity to better equip media personnel with the requisite knowledge to report on radiation, radioactive material and nuclear-related stories with higher accuracy, objectivity, and credibility; thereby contributing to the public's understanding.
- NRA Media Awards – During the media training, participating journalists were asked to prepare a news piece on the topics discussed, that were then reviewed by members of the NRA Media Corps and selected for granting an award.
- Media Training for Senior Management – A training session and tour of some media houses was held for senior management of NRA to ensure that senior staff who communicate with the public are well prepared to engage with the media, and to also provide them with first-hand experience of the operations of media houses.

The NRA's draft regulations on Site Evaluation and Licensing require the authorized party to have stakeholder and community engagement. Specifically, the authorized party is required to make arrangements to identify and make significant interactions and substantively engage with potentially

affected target audience, community groups, in the site evaluation process. The IRRS team was informed this process is being implemented, even though the regulations are in draft. **Recommendation R3 in section 1.2. addresses the issue**.

### 3.9. REGULATORY BODY'S ROLE IN A NUCLEAR OR RADIOLOGICAL EMERGENCY

The responsibilities of NRA in preparedness and response to a nuclear or radiological emergency have been provided in the Act. NRA is required to approve the emergency plan of the authorised person. In the event of a nuclear or radiological emergency that poses a risk of radioactive contamination spreading beyond the boundaries of Ghana, NRA is required to immediately notify the IAEA and the relevant authorities of any State that could be affected by the release. NRA is required to serve, in collaboration with the organisations responsible for disaster management, as the point of contact for providing any information or assistance regarding nuclear or radiological emergencies under the terms of relevant international instruments, including the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

The Act stipulates that the Authority is required to, in collaboration with agencies responsible for emergency and disaster management, develop and maintain a national emergency plan for responding to potential nuclear or radiological emergencies. The National Security Council is required to approve the plan, which is required to be reviewed and updated every two years.

In the updated draft National Nuclear and Radiological Emergency Response Plan (NNRERP), NRA has been assigned the role of advising the NADMO and to provide expert services in case of a nuclear or radiological emergency. The updated draft NNRERP covers nuclear power plants, safety and security events, and current international requirements, however the plan has not yet been finalised. NRA has identified in its Action Plan the need for stronger collaboration with NADMO for the exchange of information, performance of joint activities, capacity building, and enhancement of the safety and security culture.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *NRA has not finalised the review of the NNRERP. The issue was already included by NRA in the initial action plan prepared for the mission.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) para. 6.12 states that** *"Arrangements shall be developed, as appropriate, for the coordination of emergency preparedness and response and of protocols for operational interfaces between operating organizations and authorities at the local, regional and national levels."* |
| **(2)** | **BASIS: GSR Part 7 para. 6.16 states that** *"Plans, procedures and other arrangements for effective emergency response, including coordinating mechanisms, letters of agreement or legal instruments, shall be made for coordinating a national emergency response ..."* |
| **(3)** | **BASIS: GSR Part 7 para. 6.17 states that** *"Each response organization shall prepare an emergency plan or plans for coordinating and performing their assigned functions as specified in Section 5 and in accordance with the hazard assessment and the protection strategy. An emergency plan shall be developed at the national level that integrates all relevant plans for emergency response in a coordinated manner and consistently with an all-hazards approach...* |

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| **R7** | **Recommendation: NRA should expedite the review of the NNRERP and submit it for approval.** |

To fulfil its role during a nuclear or radiological emergency, NRA has acquired radiation instrumentation. An inventory has been compiled, and the instrumentation is being maintained by a dedicated unit in NRA. A mobile van equipped with relevant instrumentation is available to NRA to conduct radiation monitoring in the event of a nuclear or radiological emergency.

The IRRS team was informed that NRA staff have attended training offered by US NRC on computer codes applicable to a nuclear and radiological emergency. A communications plan for NRA's internal and external communication has been drafted which includes communication during a nuclear or radiological emergency. NRA participates in IAEA Convex exercises together with NADMO which is the National Warning Point for Ghana under the emergency conventions. NRA has participated in table-top drills conducted at the national level. A full-scale exercise is yet to be conducted in Ghana to test the preparedness and response to a nuclear or radiological emergency.

NRA has drafted a process for emergency preparedness and response as part of its management system, which covers all nuclear and radiological emergency preparedness and response activities of NRA. The process identifies the development of procedures for NRA to be prepared and to effectively respond to nuclear or radiological emergencies to mitigate adverse consequences. However, NRA's arrangements for training of its responders, conduct of exercises, means to coordinate radiation monitoring and to advise the Government as well as implementing obligations under the IAEA Conventions during a nuclear or radiological emergency have not been documented.

| **RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES** | |
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| **Observation:** *NRA has not developed an emergency plan and procedures for the functions assigned to NRA in preparedness and response to nuclear or radiological emergencies.* | |
| **(1)** | **BASIS: GSR Part 7 para. 6.17 states that** *"Each response organization shall prepare an emergency plan or plans for coordinating and performing their assigned functions as specified in Section 5 and in accordance with the hazard assessment and the protection strategy."* |
| **R8** | **Recommendation: NRA should develop an emergency plan and procedures for the functions assigned to NRA in preparedness and response to nuclear or radiological emergencies.** |

### 3.10. SUMMARY

Ghana has established NRA as the regulatory body for the regulatory control of facilities and activities. Overall, the responsibilities and functions of the NRA are in compliance with IAEA safety standards. However, the following areas have been identified for further improvement:

- Enhancing effective independence of the NRA;
- Human resource development and competence management;
- Approval of national nuclear and radiological emergency response plan and NRA's emergency response plan.

# 4. MANAGEMENT OF THE REGULATORY BODY

## 4.1. RESPONSIBILITY

NRA's management has established an organizational strategy for the period 2021-2025 that outlines its mission, vision, values, and goals. The strategy reflects management's commitment to safety and continuous improvement of its operations. The management/executive committee, chaired by the Director-General, coordinates the implementation of activities and provides updates to the Board.

NRA's strategy identifies goals and the applicable strategies for the planning period, which the executive committee translates into annual operational plans for the different directorates of the organization.

The IRRS team noted NRA management's commitment to the development and implementation of an effective management system covering all aspects of its operations and has initiated a project to develop its management system. The IRRS team was informed that management has set ambitions for NRA to obtain ISO 9001 certification for the management system when completed. Further, management has secured support for the development of the management system under the European Commission INSC project where expertise has been provided to the project team. The management system development is expected to be completed in 2025 with approval, training, and implementation thereafter. The IRRS team is of the view that NRA should continue the development of and implement its integrated management system in accordance with a graded approach taking into consideration the facilities and activities that already exist in the country, while preparing for the planned nuclear power programme.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *The management system is still under development and yet to be approved for implementation.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 19 states that** "The regulatory body shall establish, implement, and assess and improve a management system that is aligned with its safety goals and contributes to their achievement |
| **(2)** | **BASIS: GSR Part 2 Requirement 3 states that "**Senior management shall be responsible for establishing, applying, sustaining and continuously improving a management system to ensure safety |
| **R9** | **Recommendation: NRA should expedite the development and approval of the management system in a graded approach, prioritizing the completion of elements covering current activities.** |

## 4.2. THE MANAGEMENT SYSTEM

NRA has adopted a project approach to develop a management system covering all its operations. The Director General has appointed staff from the different departments of NRA to constitute the project team. Support for the project has been received from the European Commission INSC project. The project objective is ensuring the management system meets GSR Part 2 requirements and ISO 9001 certification. The IRRS team was informed that NRA had initiated the recruitment of a management system specialist to coordinate the further development and monitoring of the implementation of the management system.

A draft management system manual has been developed that identifies the overarching objectives, organizational structure, responsibilities, accountabilities and performance review. Further, a safety policy has been drafted and awaits approval among several other regulatory documents. The IRRS team noted that timely development and implementation of NRA's management system would be needed to address its operational requirements and meet its safety goals.

## 4.3. MANAGEMENT OF PROCESSES AND ACTIVITIES

The project team has identified several core, management, and support processes required in NRA's management system, and developed a work breakdown structure for the development and approval comprising eleven steps for each process. The IRRS team was informed that process documentation is led by expert users guided by an approved template for consistency. At the time of the IRRS mission, NRA had identified fifty-four processes and procedures that were at different stages of development.

The IRRS team was further informed that staff training and awareness were planned for the 1st quarter of 2025 to implement approved processes. Completion of the remaining processes is expected before the end of 2025. **Recommendation R9 in section 4.1 adresses this issue.**

## 4.4. MEASUREMENT, ASSESSMENT AND IMPROVEMENT

The IRRS team noted that NRA as a public institution follows Government systems for performance management. NRA strategic plan contains goals that are measured on a regular basis through an internal audit function. Each department is assigned annual goals that cascade downwards to individual employees. An annual performance review is conducted for all employees by the head of department, evaluating the extent to which set targets are met and forming the basis for incentives and potential promotion. Similarly, the Director General evaluates the performance of the departmental heads and compiles the organizational performance report to the Board and the Government. The management committee meets regularly to discuss the performance of NRA and agree on corrective actions to the identified deviations.

NRA has an internal auditor in line with the national laws who reports administratively to the Director General and functionally to the Internal Audit Agency of Government. The internal auditor evaluates the performance of NRA functions producing quarterly reports that are presented to the audit committee and the Internal Audit Agency. The work of the internal auditor is independent to enhance management accountability and has identified several performance deficiencies related to the management system, which management undertook to address. Further, the Internal Audit Agency and the Office of the Auditor General of Ghana conduct independent assessments of the work of NRA, making reports to the Government. The IRRS team is of the view that approval of processes and documentation related to measurement, assessment and improvement in the management system would enhance the operations of NRA. **Recommendation R9 in section 4.1. addresses the issue.**

## 4.5. LEADERSHIP AND CULTURE FOR SAFETY.

### *4.5.1. FOSTERING AND SUSTAINING LEADERSHIP AND CULTURE FOR SAFETY*

The IRRS team noted that NRA management is committed to fostering and sustaining leadership and culture for safety in the institution. The Director General appointed a safety and security culture committee comprising senior experts with a mandate of conducting assessments in the organization and advising management on how to implement corrective actions. The committee developed draft documents that are awaiting approval. **Recommendation R9 in section 4.1. addresses the issue.**

#### *4.5.2. MEASUREMENT, ASSESSMENT AND IMPROVEMENT OF LEADERSHIP AND CULTURE FOR SAFETY*

NRA has developed draft procedures for the assessment of its leadership and culture for safety. The draft documents are part of the management system documentation awaiting approval by the Director General. The IRRS team was informed that NRA plans to conduct the initial assessment before the end of June 2025 with the assistance of IAEA. The results of the assessment are expected to inform the corrective actions to improve its leadership and culture for safety.

### 4.6. SUMMARY

NRA is in the process of establishing its management system and a project team has been established for the work. Management has committed to the development of the management system and has secured technical assistance from the European Commission. It is expected that approvals for completed work and implementation would commence in early 2025. Following a graded approach in the development of the management system will assist the NRA in enhancing its efficiency and effectiveness in the delivery of its mandate.

## 5. AUTHORIZATION

### 5.1. GENERIC ISSUES

Authorizations for nuclear installations and radiation sources facilities and activities are issued by NRA through the provisions in the Act, including their renewal, suspension, modification and revocation. The Act also covers authorization of the transport and storage of nuclear and radioactive materials and radioactive waste. Penalties for non-compliance with requirements and authorisation conditions are provided for in the Act. NRA has draft regulations for implementation of the provisions of the Act. The draft internal process and procedure for notification and authorization covers all activities and facilities.

NRA has developed guides for applicants for authorization of Diagnostic Radiology Facilities, Industrial Radiation Applications, Nuclear Medicine Facilities, Radiotherapy Facilities and Activities and Nuclear Facilities and Activities; however, these guides are in draft. **Recommendation R21 in Section 9.1. addresses the issue.**

NRA issues licenses for high risk facilities and activities, and registrations for moderate to low risk facilities and activities. However, it is not formally specified, in any of NRA's regulatory documents related to authorization, which facilities and activities are high risk and which are moderate or low risk. The draft regulations for nuclear installations also do not take into account a graded approach, considering the current research reactor and waste management facilities, and the envisaged nuclear power programme.

The draft BIRCR provides that NRA may determine what facilities and activities are authorised by registration or licensing. NRA`s draft internal process and procedure for notification and authorization does not have provisions for graded approach in authorization. The IRRS team was informed that NRA has planned to draft internal guidance to address graded approach for all facilities and activities.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *NRA is developing internal guidance for application of graded approach for research reactors and waste management facilities and this issue is already included by NRA in the initial action plan prepared for the mission. Additionally, the Act and draft BIRCR, as well as NRA`s draft internal process and procedure for notification and authorization do not have provisions for graded approach in authorization of radiation sources facilities and activities.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) para. 2.5 states that** *"The government shall promulgate laws and statutes to make provision for an effective governmental, legal and regulatory framework for safety. This framework for safety shall set out the following:*<br>*(3) The type of authorization that is required for the operation of facilities and for the conduct of activities, in accordance with a graded approach"* |
| **(2)** | **BASIS: SSR-3 Requirement 12 state that** *"The use of the graded approach in application of the safety requirements for a research reactor shall be commensurate with the potential hazard of the facility and shall be based on safety analysis and regulatory requirements"* |
| **(3)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 22 states that** *"The regulatory body shall ensure that regulatory control is stable and consistent."* |
| **(4)** | **BASIS: GSG-13 para. 3.84 states that** *"The regulatory body should determine which facilities and activities require authorization by registration only and for which a licensing process is required."* |
| **R10** | **Recommendation: NRA should apply graded approach in the authorization of nuclear installations.** |
| **R11** | **Recommendation: NRA should document application of consistent graded approach in the authorization of radiation sources facilities and activities.** |

The draft BIRCR contains requirements that have to be fulfilled in order to obtain an authorization. This draft sets a requirement on the licensees to use dose constraints as described by guidance documents. However, NRA has not published any guidance documents on dose constraints and the IRRS team was informed that dose constrains are not applied by NRA or the licensees.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *The draft BIRCR sets the requirements for the use of dose constraints. However, dose constrains are not used.* | |
| **(1)** | **BASIS: GSR Part 3 para. 3.25 states that** "*For occupational exposure and public exposure, registrants and licensees shall ensure, as appropriate, that relevant constraints are used in the optimization of protection and safety for any particular source within a practice."* |
| **(2)** | **BASIS: GSR Part 3 para. 3.120 states that** "*The government or the regulatory body shall establish or approve constraints on dose and constraints on risk to be used in the optimization of protection and safety for members of the public…"* |
| **R12** | **Recommendation: NRA should ensure that dose constraints for occupational and public exposure are used in the optimization of protection and safety.** |

## 5.2. AUTHORIZATION OF RESEARCH REACTORS

The authorization of research reactors is governed by the Act, which outlines the steps of the authorization process, including design, construction, commissioning, operation, and decommissioning. Ghana's Research Reactor-1 (GHARR-1) is a low power research reactor (LPRR) of nominal power 34 kW with a low enriched uranium (LEU) core and is operated by GAEC.

NRA has renewed the authorization issued to GAEC for the research reactor in 2023. This license is valid for five years. The IRRS team was informed that a decommissioning plan was not submitted as a part of the renewal application and NRA had granted GAEC an extension to August 2026 for the submission of the decommissioning plan. The IRRS team was further informed that the extension for submission was to allow the operator time to finalize the financial details for decommissioning and the arrangements for the management of the spent fuel.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *No decommissioning plan was submitted with the application for authorization of the Research Reactor.* | |
| **(1)** | **BASIS: GSR Part 6 Requirement 10 states that** *"The licensee shall prepare a decommissioning plan and shall maintain it throughout the lifetime of the facility, in accordance with the requirements of the regulatory body, in order to show that decommissioning can be accomplished safely to meet the defined end state".* |
| **(2)** | **BASIS: GSR Part 6 para. 7.4 states that** *"The licensee shall prepare and submit to the regulatory body an initial decommissioning plan together with the application for authorization to operate the facility. This initial decommissioning plan shall be required in order to identify decommissioning options, to demonstrate the feasibility of decommissioning, to ensure that sufficient financial resources will be available for decommissioning, and to identify categories and estimate quantities of waste that will be generated during decommissioning".* |
| **R13** | **Recommendation: NRA should ensure that the decommissioning plan is submitted and reviewed prior to the renewal of the licence.** |

According to the Safety Analysis Report (SAR), GAEC has established a safety committee. However, while the SAR is mandatory under the Act, there is no regulatory requirement for a safety committee to provide advice to the operating organization on safety aspects of the research reactor.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *There is no regulatory requirement for establishing a safety committee for nuclear installations.* | |
| **(1)** | **BASIS: SSR-3 Requirement 6 states that** *"A safety committee (or an advisory group) that is independent from the reactor manager shall be established to advise the operating organization on all the safety aspects of the research reactor."* |

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| **S7** | **Suggestion: NRA should consider establishing a regulatory requirement for a safety committee for research reactors.** |

NRA requires the applicant to submit supporting documents as part of the application for authorization at any stage in the life of a nuclear installation. The scope and content of the Safety Analysis Report (SAR) is defined in the draft regulation on licensing of nuclear installations.

There are several draft regulations for nuclear installations. The IRRS team was of the view, the content of these regulations is more suited for Nuclear Power Plants (NPPs) and do not demonstrate application of the graded approach as required by the IAEA safety standards. The NRA recognizes the need to apply a graded approach to these regulations when applying to research reactors and waste management facilities. The IRRS team was informed that NRA is planning to develop a guide for applying a graded approach. **Recommendation R10 in section 5.1. addresses the issue.**

## 5.3. AUTHORIZATION OF RADIOACTIVE WASTE MANAGEMENT FACILITIES

Waste management facilities are authorized by NRA. The NRA draft regulations on radioactive waste management require authorisation for radioactive waste management facilities in all stages starting from siting to decommissioning/closure (as appropriate) of the facility. The IRRS team was informed that NRA issues authorizations only if the applicant can demonstrate the fulfilment of all relevant requirements of these regulations. The applicant of a radioactive waste management facility is required to submit a safety case documenting the results of the safety assessment, as part of the application for authorisation. The authorised party is required to carry out periodic safety reviews for the radioactive waste management facilities under their responsibility every ten years.

NRA has renewed the authorization issued to the GAEC waste management facility. This license is valid for ten years. The IRRS team was informed that a decommissioning plan was not submitted as a part of the renewal application and NRA had granted GAEC a time limit to 2025 for the submission of the decommissioning plan. (Section 5.2 addresses related issue)

## 5.4. AUTHORIZATION OF RADIATION SOURCES FACILITIES AND ACTIVITIES

Authorizations for radiation sources facilities and activities are issued by NRA in accordance with the Act. NRA issues licenses for high risk facilities and activities and registrations for moderate to low risk facilities and activities. Licenses are valid for 1 year and registrations are issued with a validity of 3 years. Authorizations are issued for each radiation source. In 2023, authorizations were issued for more than 100 radiation sources in medical applications and more than 200 sources in industrial applications. In addition, permits are required and issued for different stages in the lifetime of facility or during conduct of activities with radiation sources, including for import and export of radioactive sources.

The IRRS team was informed that since the draft BIRCR is not issued, NRA includes the regulatory requirements for licensees and registrants through conditions specified in authorizations. Exemption and clearance levels are included in the draft BIRCR. The draft BIRCR and authorization guidelines, as well as NRA`s draft internal process and procedure for notification and authorization requires that all activities and facilities involving radiation sources be notified to the NRA and initate the authorization process. Notification and authorization forms are provided for radiation source facilities and activities.

Separate authorization forms for use of radioactive sources and use of x-ray generators have been developed for applicants to provide detailed information about the source. Authorization forms require applicant`s information about organisation`s management system and human performance management,

RPO`s education and experience, authorized worker`s qualifications, radiation sources and equipment for protection, and arrangements for personal and area monitoring. Necessary documents to be attached to the application are listed in the form, providing also brief explanation on the content. The authorization forms also require certificates of compliance with applicable technical safety standards.

The scope of NRA`s draft authorization procedure defines the facilities and activities and responsible NRA departments and divisions. The draft procedure describes steps how applications are received and processed and includes detailed flowchart. The IRRS team was of the view that the development of the processes and procedures needs to be expanded to address all the different permits (e.g. for import, export, transfer, design and approval and construction) issued by NRA and should be impelemented comprehensively. **Recommendation R9 in section 4.1. addresses the issue.**

Furthermore, although different types of authorizations such as licenses and registrations are issued, the regulatory framework, including NRA's management system, does not have provisions for consistent implementation of a graded approach. **Recommendation R11 in section 5.1. addresses the issue.**

## 5.5. AUTHORIZATION OF DECOMMISSIONING OF FACILITIES

The Act outlines the requirements for decommissioning, including the submission of a decommissioning plan, strategy, and financing provisions. The draft Decommissioning Regulations specify the need for safety assessments, initial and final decommissioning plans, decommissioning strategy, conduct of decommissioning actions, and completion of decommissioning activities. The draft regulations also require that the decommissioning plan be updated by the authorized party and submitted periodically at least every five years to the NRA unless otherwise required by the NRA or when specific circumstances warrant the update. The Act requires an applicant for authorization to construct and operate a nuclear facility to ensure that adequate financial resources are available when needed to cover the costs associated with the safe decommissioning, including the management of the resulting waste during the operation of the facility.

The IRRS team was informed the decommissioning plan of the research reactor will be submitted by the licensee in 2026 and the decommissioning plan of the radioactive waste management facility will be submitted in 2025. **Recommendation R13 in section 5.2. addresses the issue**

## 5.6. AUTHORIZATION OF TRANSPORT

NRA is responsible for regulating all transport of all radioactive material as per the provisions of the Act.

Transport activities in Ghana currently involve type A and type B packages. The transport modes include air, road and sea for international transport, and road for national transport. NRA has signed MoU with Civil Aviation and the IRRS team was informed that it has planned to establish MoUs with customs and police.

Authorizations for transport are issued in a graded approach. An annual permit is issued to transport operators. Five transport companies have been issued this permit. Their activities mainly involve transport from ports to the users' site. Each case of transport is required to be notified to NRA for compliance verification prior to transport. The licensee that uses the services of a transport operator is also required to communicate information when collecting radioactive material from the port. Users are authorized to transport category 3 to 5 sources from the ports to their site. An annual permit is also issued to the operators for routine transport of radioactive material they are using.

The permits are issued following a review process using a template to assess compliance with SSR-6 (Rev. 1) requirements. The permit establishes conditions for transport with reference to IAEA regulations for safe transport. The IRRS team noted that sample permits reviewed refer to superseded IAEA safety standards and need to be updated in line with SSR-6 (Rev. 1) and SSG 65. The IRRS team was informed that the packaging for enriched uranium is imported and should comply with international requirements. Approval for packaging is not yet developed. The NRA verifies whether packages comply with SSR-6 (Rev. 1) requirements through the approval certificate from the manufacturer of supplier country.

NRA has draft regulations on the safe transport of radioactive material that establish the requirements for packages and packaging but these are yet to be finalized and approved. **Recommendation R3 in section 1.2. addresses the issue.**

## 5.7. AUTHORIZATION ISSUES FOR OCCUPATIONAL EXPOSURE

The draft BIRCR addresses the protection of workers in planned and emergency exposure situations. This specific regulation describes the responsibilities of the employers and workers at any workplace which may give rise to exposure, internal or external. The regulation establishes the requirements on the arrangements on safety in relation to work with ionizing radiation. It includes organizational, procedural and technical aspects for the control of occupational exposures, and the designation of controlled and supervised areas and provisions for protective equipment. The draft BIRCR requires the appointment of an RPO nominated in writing to carry out duties related to supervision of a facility or an activity that gives rise to occupational exposures. Under the draft BIRCR, a qualified expert must be contacted for the submission of a license application to design shielding, to help with the formulation of the radiation protection programme and set out the local rules for the facility. Arrangements are in place for the provision of radiation protection training of workers.

The dose limits for occupational exposures are aligned with those of the IAEA GSR Part 3 Schedule III.

The draft BIRCR requires that dose constraints are established for occupational exposures as part of the authorization procedure, but it is not required in practice and consequently seldom carried out by authorized parties. **Recommendation R12 in section 5.1. addresses the issue.**

NRA authorizes technical services. There are radiation protection training providers, approved dosimetry services, a calibration service provider (GAEC, RPI) and qualified experts. There are currently no technical services available to carry out internal dosimetry; neither to provide whole body counting nor laboratories are prepared to handle biological samples for the assessment of radionuclide contents and provide estimates on intakes. There is no passive or active neutron dosimetry available in the country and there are no arrangements for their provision from abroad. Both active and passive radon monitoring instrumentation and neutron area survey meters are used in Ghana; however there are no calibration facilities available for these instruments in the country. When such instruments require calibration, the instruments are sent abroad for calibration.

| **RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES** | |
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| **Observation:** *Not all technical services are currently available to assess personal doses and perform calibration of instruments.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 13 states that** *"The government shall make provision, where necessary, for technical services in relation to safety, such as services for personal dosimetry, environmental monitoring and the calibration of equipment."* |

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| **R14** | **Recommendation: The Government should make provisions for the availability of internal dosimetry, neutron monitoring as well as calibration of neutron and radon measuring instruments.** |

## 5.8. AUTHORIZATION ISSUES FOR MEDICAL EXPOSURE

Registration of all medical devices for manufacture, preparation, import, export, distribution, sale, supply or display is the responsibility of the Food and Drugs Authority (Ghana - FDA), while authorization for the import, supply, installation, maintenance and use of radiation medical devices is under the authority of NRA. When a new medical radiation device is intended to be imported into Ghana for the first time, the FDA requests, prior to registration, the approval of the NRA to demonstrate the device's compliance with radiation safety requirements.

The Health Facilities Regulatory Agency (HeFRA) carries out pre-authorization on-site inspections, issues licenses and inspects public and private health facilities. The NRA also inspects and authorizes those healthcare facilities that use radiation sources.

The IRRS team noted that good coordination between health agencies and the NRA would be essential to improve the effectiveness of regulatory oversight. **Recommendation R5 in section 1.5. addresses the issue**.

NRA authorizes technical service providers related to medical exposure, including for import, supply, installation and maintenance of medical radiation devices; performance of acceptance tests; calibration of dosimeters for calibrating medical sources; and training in radiation protection including in medical exposure.

NRA has developed application forms for the import and use of various radiation sources in medical facilities, and the following guidelines for applicants have been drafted to meet NRA requirements when setting up or operating a medical facility:

- Nuclear Medicine Authorisation Guidelines
- Radiotherapy Authorisation Guidelines
- Diagnostic Radiology Authorization Guidelines.

However, the supporting documents to be submitted with the authorization application in accordance with the guidelines are not complete to meet NRA's requirements and to demonstrate the implementation of the principles of justification and optimization, and the IRRS team noted that NRA needs to revise the draft guidelines to provide more detail on the documents to be submitted and how to meet the requirements for authorization of medical exposure. **Recommendation R21 in section 9.1. addresses the issue.**

The qualification and recognition of healthcare professionals (doctors, medical physicists, technologists, etc.) involved in medical exposures is the responsibility of the Ministry of Health. Doctors are recognized by the Medical and Dental Council, and medical physicists and radiographers are recognized by the Allied Health Professions Council.

Education, training and competence in radiation protection for health professionals is provided at the outset, during their diploma training, and refresher training in radiation protection is organized annually by an authorized organization that provides training services.

During the authorization process for diagnostic radiology facilities, recognition and training of health professionals are among the aspects that are confirmed by NRA. NRA verifies the designation of a medical physicist and a recognized radiology technician, but not of a radiologist physician.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
|---|---|
| **Observation:** *During the authorization process for diagnostic radiology facilities, NRA does not review the recognition of the radiologist physician.* | |
| **(1)** | **BASIS: GSR part 3 para. 3.150 states that "***The regulatory body shall ensure that the authorization for medical exposures to be performed at a particular medical radiation facility allows personnel (radiological medical practitioners, medical physicists, medical radiation technologists and any other health professionals with specific duties in relation to the radiation protection of patients) to assume the responsibilities specified in these Standards only if they:*<br>*(a) Are specialized in the appropriate area;*<br>*(b) Meet the respective requirements for education, training and competence in radiation protection, in accordance with para. 2.32;*<br>*(c) Are named in a list maintained up to date by the registrant or licensee."* |
| **R15** | **Recommendation: NRA should ensure during the authorization process that the practitioner is specialized in the appropriate area to assume his or her responsibilities with regard to medical exposure.** |

## 5.9. AUTHORIZATION ISSUES FOR PUBLIC EXPOSURE

Authorization of potential public exposures is included in the overall authorization process for all types of authorizations and as such the authorized party is responsible for any public exposures that may arise.

The draft BIRCR outlines the requirements for operational limits, which must be set by the authorized party and approved by the NRA, in relation to public exposure. The regulations state that the authorized party must apply the principle of optimization of protection and safety at all stages for a source and a facility, to protect and ensure the safety of the public. This includes submitting a safety assessment report for review by NRA. NRA has not prepared guidance material on how to evaluate and include public exposure issues in the Safety Assessment. **Recommendation R21 in section 9.1. addresses the issue.**

The draft BIRCR requires the licensee to ensure restricted access to controlled areas, allowing visitors only under supervision within the work premises. It also requires that relevant parties manage all discharges of radioactive material to the environment according to the regulations and after approval from NRA.

The draft BIRCR outlines the requirements regarding consumer products that manufacturers and suppliers must fulfill to obtain the necessary approval from the NRA, allowing their products to enter the market.

The draft BIRCR sets a requirement on the authorized party to use dose constraints as described by guidance documents. However, NRA has not published any guidance documents on dose constraints and the IRRS team was informed that dose constraints are not applied by NRA. **Recommendation R12 in section 5.1. addresses the issue**.

## 5.10. SUMMARY

The legal and regulatory framework in Ghana for the authorisation of nuclear installations, radiation sources facilities and activities and transport activities are established under the provisions of the Act. There is an internal process and procedure for notification and authorization but this is in draft. Areas for improvement in the authorization process were identified which include:

- Document the application of graded approach in the authorization
- Ensure that dose constraints for occupational and public exposure are used in the optimization of protection and safety;
- Make provisions for the availability of all relevant technical services for dosimetry; and
- Ensure during the authorization process that the practitioner is specialized in the appropriate area to assume his or her responsibilities with regard to medical exposure.

# 6. REVIEW AND ASSESSMENT

## 6.1. GENERIC ISSUES

The Act mandates NRA to conduct review and assessment of nuclear safety assessment and safety analysis reports from authorised persons. The draft BIRCR establishes that authorisation be granted only after submission of a safety assessment report by applicants and the report reviewed and assessed by NRA. Draft guidance documents for completing safety assessments by licensees have been developed but are not yet approved.

NRA through its review and assessment process verifies compliance with regulatory requirements, and requests for the submission of additional information to facilitate the review and assessment of an application where required. It also arranges for inspections, including pre-authorization, to verify adherence to the regulatory requirements.

NRA carries out review and assessment of authorization applications for radiation sources facilities and activities, including the applicant`s safety assessment submitted to NRA. Draft internal processes and procedures for review and assessment do not include criteria or guidance for NRA staff for consistent review and assessment of submitted safety documents although that is established as a requirement in the draft BIRCR.

The draft regulations for the management of radioactive waste require the applicant to submit a safety case and supporting safety assessment as demonstration of the safety of the waste management facility in the application for authorization. However, the internal guidance and procedures for review and assessment of the safety case of a radioactive waste facilility are in draft form.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
|---|---|
| **Observation:** *NRA`s draft internal processes and procedures do not include provision for review and assessment of applicant`s safety assessment for radiation sources facilities and activities. NRA has not developed internal guidelines for review of safety case for borehole disposal of radioactive waste facility.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) para. 4.26 states that** *"The regulatory process shall be a formal process that is based on specified policies, principles and associated criteria, and that follows specified procedures as established in the management system."* |
| **(2)** | **BASIS: GSR Part 1 (Rev. 1) para. 4.33 states that** *"Prior to the granting of an authorization, the applicant shall be required to submit a safety assessment, which shall be reviewed and assessed by the regulatory body in accordance with clearly specified procedures."* |
| **R16** | **Recommendation: NRA should develop procedures and criteria for review and assessment of the safety assessment for all radiation sources facilities and activities, and safety case for borehole disposal radioactive waste facility.** |

## 6.2. REVIEW AND ASSESSMENT FOR RESEARCH REACTORS

NRA conducts review and assessment for research reactors during renewal of the authorization. To facilitate this process, NRA has a draft internal procedure "Review and Assessment of Nuclear Installations". The IRRS team was informed that this procedure, together with IAEA guidelines, were

used for the renewal of the authorization for GHARR-1 after the core conversion. As part of the completed application for authorization to operate the research reactor facility, GAEC was required to submit the following documents: Commissioning Report, Final Operational Limits and Conditions, Operating Procedures, Operational Radiation Protection Programme, Revised Safety Analysis Report, Emergency Preparedness and Response Programme, Decommissioning Plan, Site Security Plan, and Revised Design Information Questionnaire.

The IRRS team was informed that since the authorization is granted for a five-year period, NRA considers this process to be part of a periodic safety review (PSR). As part of this PSR, GAEC is required to revise all the necessary documents and re-submit to NRA along with a complete application for the next renewal of the authorization.

### 6.3. REVIEW AND ASSESSMENT FOR WASTE MANAGEMENT FACILITIES

The draft regulations for management of radioactive waste require the applicant to submit a safety case and supporting safety assessment as a demonstration of the safety of the waste management facility in the application for authorisation. Similar provisions in the draft Licensing Regulations for Nuclear Installations and Manufacturers of Safety Class Equipment and Components in Ghana require an applicant to demonstrate safety by submitting a safety case in different phases of the nuclear installations and radiological facilities. These regulations are in draft form and are yet to be approved. **Recommendation R3 in section 1.2. addresses the issue.**

The IRRS team was informed that NRA has received the safety case, along with the siting report and relevant documents, for a "Borehole Disposal of Radioactive Waste Facility" and is currently under review. NRA has drafted Regulations for Borehole Disposal of Radioactive Waste. The IRRS team was informed that IAEA publications are being used to review the safety case since no guidance documents have been developed by NRA. **Recommendation R22 in section 9.1. addresses the issue.**

### 6.4. REVIEW AND ASSESSMENT FOR RADIATION SOURCES FACILITIES AND ACTIVITIES

Review and assessment is carried out for new applications for authorization of radiation sources facilities and activities, and during renewal of the authorization. History of compliance of the authorized party is taken into account during renewal of authorization; for example by following up the status of implementation of corrective actions. Review and assessment as well as inspections are performed by inspectors organized in a team of atleast two people.

Review and assessment of radiation sources facilities and activities generally include, as applicable, evaluation of the adequacy of the shielding; safety and design of facility for protection against primary and scatter radiation; verification of safety and security during the operation of equipment and accessories; audit of radiation protection programme and quality assurance programme; and verification of emergency response plan. The assessment report includes the observations and recommendations to the management of the authorized party, as well as to NRA whether authorization can be issued.

NRA has drafted review and assessment process and procedure for radiation sources facilities and activities, however it has not been finalized and approved. **Recommendation R9 in section 4.1. addresses the issue.** The IRRS team was shown examples of review and assessment reports that include the completed checklist for different radiation sources facilities and activities, and was informed that the review and assessment checklists are currently being reviewed by NRA.

Requirements for safety demonstration are established in draft BIRCR. A draft guidance document for conducting safety assessment is also developed. However, the draft guidance document contains only GSR Part 3 requirements and does not include additional explanation or provide guidance on implementation of regulatory requirements. The IRRS team noted that further developing the draft guide to include more explanation and guidance would benefit NRA, applicants and authorized parties. **Recommendation R22 in section 9.1. addresses the issue.**

The IRRS team was informed that RAIS database was used for recording inventory of radiation sources until the malfunction of the server in 2022. NRA is still maintaing the information and intends to migrate it to a new server. Considering that NRA issues authorizations and carries out inspections for each radiation source, and processes and procedures are only at a draft stage, the IRRS team highlighted to NRA the importance of record keeping and ease of retrievability of information for effective implementation of regulatory functions such as renewal of authorizations and planning inspections where facilities' operational experience is taken into account. **Suggestion S5 in section 3.7. addresses the issue.**

## 6.5. REVIEW AND ASSESSMENT FOR DECOMMISSIONING ACTIVITIES

The responsibilities of NRA related to the decommissioning of facilities are provided in the Act. The IRRS team was informed that there are currently no facilities undergoing decommisioning in Ghana and there are no safety cases for decommissioning activities currently under review by NRA. The current NRA requirements for conducting baseline radiological survey were drafted after the research reactor and radioactive waste management facility came into operation. However, the operator is conducting radiological monitoring periodically for air. The IRRS team noted that this radiological monitoring around the existing nuclear installations could be expanded to cover air, soil, water, and crops among others, at least for one time, for future reference.

The Act requires the applicant with intention to construct and operate a nuclear facility to perform a baseline survey of the site to develop information for comparison with the end state after decommissioning, including radiological conditions before construction. The review of the initial decommissioning plan and updates, and review and approval of the final decommissioning plan and supporting documents, are addressed in the draft Review and Assessment Process. **Recommendation R9 in section 4.1. addresses the issue.**

## 6.6. REVIEW AND ASSESSMENT FOR TRANSPORT

Prior to approval and issuing permits, NRA reviews and assesses relevant information submitted by the licensee to determine whether applications comply with the requirements of IAEA SSR-6 (Rev. 1) in accordance with a graded approach.

The review and assessment is conducted based on the provisions of the Act and the permit conditions. A template with the relevant requirements is used as a checklist for carrying out the review and assessment.

The review and assessment covers, among others, review of information and documentation related to the mode of transport, transport vehicle, container, package and packaging, labelling and placarding, qualification of personnel , other required certificates, handling tools, as well as emergency plan. Moreover, inspections are performed to support the review and assessment process. The IRRS team noted that the process of review and assessment would be improved by developing relevant procedures for review and assessment. **Recommendation R9 in section 4.1. addresses the issue.**

## 6.7. REVIEW AND ASSESSMENT FOR OCCUPATIONAL EXPOSURE

The review and assessment for occupational exposures occurs at the time of reviewing an application for authorisation. The draft BIRCR and the guides relevant to a given practice require that proof of availability of personal dosimeters is submitted with the application for authorisation

The IRRS team was informed that NRA had initiated a procedure to prepare their RAIS system to maintain a national dose registry. RAIS is not currently functional and consequently periodic review of occupational exposure is not being done. However it was noted that NRA staff review personal dosimetry records during inspections. **Suggestion S5 in section 3.7. addresses the issue.**

The approved dosimetry services, NRA and the authorized parties are required by the draft BIRCR to maintain records of occupational exposures. An investigation level of 1 mSv/month is set by NRA for any personal dosimetry results. In addition, records of occupational exposure are checked, and investigations are followed up during inspections.

The determination of controlled and supervised areas, local rules and workplace monitoring arrangements are required from the authorized parties according to the draft BIRCR. These requirements on occupational exposures are reviewed by the NRA and verified during inspections.

## 6.8. REVIEW AND ASSESSMENT FOR MEDICAL EXPOSURE

Review and assessment of medical exposure is done through review of documents submitted during the application for authorization and should demonstrate the implementation of justification and optimization in medical exposure. These reviews and assessments are supported by inspections, which are systematically carried out for medical facilities to confirm the facility's compliance with safety requirements.

As part of the review and assessment of the application for authorization to use new radiation medical device, the applicant submits acceptance and commissioning reports. In the case of radiotherapy equipment, the authorization applicant also submits the reports of an independent verification carried out by an authorized service provider for acceptance and commissioning tests.

NRA drafted review and assessment processes and procedures applicable to all types of activities, including, medical facilities and technical service providers for safety of medical exposure. The IRRS team was informed that checklists for review and assessment of medical facilities are to be developed. **Recommendation R9 section 4.1. addresses the issue.**

## 6.9. REVIEW AND ASSESSMENT FOR PUBLIC EXPOSURE

NRA requires the applicant for an authorization to submit, for review and assessment, documents such as the safety assessment and other design related documents that address the optimization of protection and safety; the design criteria and the design features relating to the assessment of exposure; and potential exposure of members of the public before authorization of a new or modified practice.

According to the draft BIRCR the authorized party is required to establish and implement source and environmental monitoring programmes, to record and review the results of these, and to make them available to NRA upon request.

The IRRS team was informed that facilities and activities that potentially discharge radionuclides to the environment in Ghana are two hospitals working with nuclear medicine, the oil and gas industry and the research reactor. NRA has required the hospitals to install hold-up containers to ensure that radionuclides decay below the exemption level before discharge and only after an approval from NRA. Similarly, for the oil and gas industry, licensees have to demonstrate that the contents of radionuclides in the discharge is below the exemption levels before NRA issues an approval for discharge. Discharges from the research reactor are in the form of gas that is let out through the chimney. The IRRS team was informed that NRA plans to require that the licensee measures and documents the contents of radioactivity in the discharge if any.

The draft BIRCR includes provisions for the control of existing exposure situations and requirements are in place for establishing protection strategies in relation to public exposures.

Several studies of radon have been performed and these are ongoing at different locations in Ghana. Therefore, there is knowledge of the radon levels at several locations, e.g. in mines. However, mapping of radon in dwellings and other buildings with high occupancy has not been performed through appropriate means, such as representative radon surveys. Further, relevant information on exposure due to radon and the associated health risk is not provided to the public.

| **RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES** | |
|---|---|
| **Observation:** *Insufficient information on radon in dwellings and other buildings is available and relevant information on health risks due to exposure to radon has not been made public. The issue was already included by NRA in the initial action plan prepared for the mission.* | |
| **(1)** | **BASIS: GSR Part 3 para. 5.19 states that** *"[…] the government shall ensure that:*<br>*a) Information is gathered on activity concentrations of radon in dwellings and other buildings with high occupancy factors for members of the public through appropriate means, such as representative radon surveys;*<br>*b) Relevant information on exposure due to radon and the associated health risks, including the increased risks relating to smoking, is provided to the public and other interested parties."* |
| **R17** | **Recommendation: The Government should ensure that information on radon concentration in dwellings and other buildings with high occupancy is gathered and relevant information on exposure due to radon and the associated health risks is provided to the public.** |

The draft BIRCR sets out the requirements for providers of commodities to comply with specific reference values for exposure due to radionuclides in commodities such as construction materials, food and feed, and in drinking water, based on an annual effective dose to the representative person. According to the draft regulations these values should be provided by NRA, but they have not been established yet.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
|---|---|
| **Observation:** *Specific reference levels for exposure due to radionuclides in commodities have not been established by NRA. The issue was already included by NRA in the initial action plan prepared for the mission.* | |
| **(1)** | **BASIS: GSR Part 3 para. 5.22 states that "***The regulatory body or other relevant authority shall establish specific reference levels for exposure due to radionuclides in commodities such as construction materials, food and feed, and in drinking water, each of which shall typically be expressed as, or be based on, an annual effective dose to the representative person that generally does not exceed a value of about 1 mSv.***"** |
| **R18** | **Recommendation: NRA should establish specific reference levels for exposure due to radionuclides in commodities.** |

## 6.10. REVIEW AND ASSESSMENT FOR EMERGENCY PREPAREDNESS AND RESPONSE

The NRA requires submission of an emergency plan as part of the application for authorization. The authorizations issued by NRA has a condition for the authorized person to update, exercise and rehearse the emergency plan and to keep records thereof. The emergency plan is required to be reviewed and updated annually. Review of the authorized person's emergency preparedness and response arrangements is done in accordance with the provisions in the NRA Act and the draft review and assessment process using a graded approach. Templates for NRA reviews are based on the approved Guidelines on Emergency Response Plan for Emergency Preparedness Category (EPC) III and IV, and the Guidelines on Emergency Response Plan for Medical Diagnostic Radiology Facilities. The templates are used to record the outcome of the review of the emergency preparedness and response elements identified in the guidelines. For medical diagnostic facilities, the responsibilities, response tools, immediate response actions, conduct of exercises, training and quality assurance are covered during the review. The template for EPC III and IV facilities and activities cover more elements. All new emergency plans are required to follow the approved guidelines, and existing facilities have been granted a specific timeframe to comply with NRA Guidelines. The review template contains observations, corrective actions and recommendations for the authorized person as well as recommendations for NRA.

## 6.11. SUMMARY

NRA through its review and assessment process verifies compliance with regulatory requirements, and if needed requests the applicant for the submission of additional information.

The following areas are identified for further improvement:

- NRA to develop procedures and criteria for review and assessment of the safety assessment for all radiation sources facilities and activities, and safety case for borehole disposal radioactive waste facility.
- NRA to establish specific reference levels for exposure due to radionuclides in commodities.
- The Government to ensure that information on radon concentration in dwellings and other buildings with high occupancy is gathered and relevant information on exposure due to radon and the associated health risks is provided to the public.

# 7. INSPECTION

## 7.1. GENERIC ISSUES

NRA carries out inspections of facilities and activities according to the provisions and authority granted by the Act. Powers of inspectors, provisions for reporting inspection and enforcement actions are also prescribed by the Act. In addition, it outlines the appointment process for qualified inspectors, their authority to inspect documents, equipment, facilities, personnel records, and compliance with various stages of facilities.

NRA has a draft 'Procedures for Regulatory Inspection' which establishes its inspection programme. According to this Procedure, high risk facilities and activities are inspected annually, while low to medium risk facilities and activities are inspected every three years. However, the draft Inspection Procedure does not address radioactive waste management facilities. (Addressed in section 7.3.)

Further, NRA`s draft Procedures set out inspection categorization, requirements for inspectors` qualification, steps of preparation for inspection, conduct of inspection, and preparation of inspection report. The draft procedures also state the inspection methods, including document review, interviews, observations and verifying measurements.

NRA inspections are carried out before issuing an authorization or renewal. For research reactors, annual inspections are carried out during the five-year validity of the license. The IRRS team was informed that the inspection plan is developed annually based on information of facilities and activities for which the authorisations expiring in the planning year, and includes planned and reactive inspections. Reactive inspections and follow-up inspections are mainly unannounced. During inspection, NRA verifies compliance with regulations and authorization conditions. NRA inspectors have undergone training. The IRRS team was informed that inspectors organize a meeting quarterly to discuss and exchange experiences.

## 7.2. INSPECTION OF RESEARCH REACTORS

NRA has implemented an inspection programme for research reactors. NRA applies a graded approach to inspections, and inspection checklists and procedures are available.

For research reactors, annual inspections are carried out during the five year validity of the license. NRA's annual inspection in the research reactor facility is conducted lasting from two days to two weeks in teams consisting of several inspectors. The inspection primarily focuses on safety but may also include a joint inspection covering security and safeguards. In 2023, NRA conducted a joint inspection for the renewal of the authorization of the research reactor facility. This inspection involved safety, security, and safeguards to ensure that regulatory requirements were met before granting the license to GAEC. The most recent inspection took place in November 2024.

The IRRS team accompanied NRA inspectors on a planned and announced inspection of the research reactor. Eight inspectors, divided into three teams, conducted the inspection. The inspection began with an entrance meeting and was concluded with an exit meeting. The licensee was informed about the content of the inspection and the topics to be covered by each team. The IRRS team was informed that this is a common practice. The IRRS team observed that checklists was used throughout. The inspection included measurements, interview of facility personnel and review of documentation. An exit meeting with staff management was conducted at the end of the inspection.

During discussion of the IRRS team with the relevant staff of the facility, the operators confirmed the competence of the inspectors and highlighted the need for additional guidance and early comments on the review and assessment result of documents submitted to NRA.

### 7.3. INSPECTION OF WASTE MANAGEMENT FACILITIES

NRA has established a system for the inspection of Radioactive Waste Management facilities and activities during construction, commissioning and operation.

NRA has a draft Procedures for Regulatory Inspection but does not explicitly cover inspection of a radioactive waste management facility.

The IRRS team observed a planned inspection conducted by the three-member team of NRA inspectors at the radioactive waste management facility. The inspection started with an entrance meeting. The IRRS team observed that the inspectors used a checklist for inspection and reviewed various documents. The inspectors verified some of the radioactive sources with their identification numbers and asked for certain documents to be presented for review during the meeting, which were not readily available.

During the discussion with the staff of the facility, the IRRS team was informed that they have a cordial relationship with NRA. They also highlighted that it would be helpful if NRA informs, prior to the inspection, about the relevant documents to be inspected so they could be made available.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *The current draft inspection procedure does not adequately address existing radioactive waste facilities and planned future facilities.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) para 4.50 states that** *"The regulatory body shall develop and implement a programme of inspection of facilities and activities, to confirm compliance with regulatory requirements and with any conditions specified in the authorization. In this programme, it shall specify the types of regulatory inspection (including scheduled inspections and unannounced inspections), and shall stipulate the frequency of inspections and the areas and programmes to be inspected, in accordance with a graded approach.* |
| **(2)** | **BASIS: GSG-13 para. 3.225 states that** *"The inspection programme should also be developed so that the regulatory body can determine whether the authorized party conducts activities in accordance with previously established procedures [...]"* |
| **S8** | **Suggestion: NRA should consider expanding the inspection procedure to cover all facilities and activities according to a graded approach.** |

### 7.4. INSPECTION OF RADIATION SOURCES FACILITIES AND ACTIVITIES

NRA carries out inspections of radiation sources facilities and activities in the process of issuing new authorization, renewal of license annually and renewal of registrations every 3 years, as well as related to issued permits for import and export. Since authorizations are issued for each radiation source, inspections are also carried out for each source and related activity separately. Inspection reports include description of any non-compliances, recommendations for the licensee or registrant, and deadline set for correcting the non-compliance. The IRRS team was informed that NRA inspectors follow up if information about corrective actions has been submitted.

Although NRA`s draft inspection procedure mentions checklists and protocols only for inspection of conventional X-ray, CT, mammography, and dental, the IRRS team was informed that inspection checklists for other facilities and activities are also used and examples of inspection reports were presented. The IRRS team highlighted that during finalization and approval of the processes and procedures that NRA is developing, account should be taken to also review and approve checklists as part of management system documentation together with the processes and procedures. **Recommendation R9 in section 4.1. addresses the issue.**

Inspections of radiation sources are carried out by the same department in NRA that conducts review and assessment. There are currently 22 inspectors available; three teams of inspectors are dedicated for industrial sources and five teams for medical sources. Teams are led by senior inspectors and the majority of inspectors have been working for more than 15 years. Inspection plans are prepared annually covering those radiation sources facilities and activities for which authorizations are expiring in the planning year, and more detailed quarterly assignment to the inspection teams of the facilities and activities to be inspected in the specific quarter. Inspection target for particular year is foreseen in the annual plan; for example for 2024, around 450 inspections were expected, also taking into account the percentage of possible follow-up inspections.

During site visit, the IRRS team observed NRA`s planned announced inspection to National Nuclear Research Institute that is authorized for carrying out non-destructive testing with sealed radioactive sources and also x-ray equipment. Indicative radiation measurements were done around the source storage area to verify that radiation is at the background level. In preparation for inspection, NRA reviewed documents both previously available and submitted by licensee for inspection. NRA followed up with finding of previous inspection and then continued with the fulfilment of checklist. Inspectors provided the licensee with information on inspection findings and made sure that the purpose of requirements is understandable for licensee. The IRRS team observed that inspection was carried out professionally and inspectors showed strong competence in the inspected topics. During discussion with the licensee IRRS team was informed that cooperation and communication with NRA is highly appreciated.

## 7.5. INSPECTION OF DECOMMISSIONING ACTIVITIES

NRA has not conducted any inspection related to decommissioning activities since to date there is no facility undergoing decommissioning activities in Ghana.

## 7.6. INSPECTION OF TRANSPORT

NRA has implemented inspection for transport of radioactive material including planned and unannounced inspections. Inspectors are required to have special training in the safety of transport of radioactive material.

The inspections cover radioactive material in transport in Ghana and in transit. Inspections extend to the verification of the conditions stated in the permit and the regulatory requirements for transport. The scope of the inspections covers documents of transport, certificates, staff qualification, packages, dose limits and records, and transport conditions among others. The inspectors of NRA use an inspection checklist. The inspectors perform visual verification, document review, dose measurement, and interview the personnel on relevant issues. The inspection report describes safety and security measures.

NRA requires the transport operator to implement an integrated management system. However, inspections do not cover appropriately verification of the management system of transport operators

including topics such as documentation and control of records, management responsibility, satisfaction of interested parties, resource management, information and knowledge management, communication and interfaces, development of procedures and processes for certain activities related to packages, self-assessment, independent assessment, non-conformance and corrective and preventive actions, and improvement.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
|---|---|
| **Observation:** *NRA inspections for transport do not review the management system of the transport company. .* | |
| **(1)** | **Basis: SSR-6 (Rev. 1) para 306** states that "*A management system based on international, national or other standards acceptable to the competent authority shall be established and implemented for all activities within the scope of the Regulations, as identified in para. 106, to ensure compliance with the relevant provisions of these Regulations. Certification that the design specification has been fully implemented shall be available to the competent authority. The manufacturer, consignor or user shall be prepared:*<br>*(a) To provide facilities for inspection during manufacture and use;*<br>*(b) To demonstrate compliance with these Regulations to the competent authority.*<br>*Where competent authority approval is required, such approval shall take into account, and be contingent upon, the adequacy of the management system."* |
| **(2)** | **Basis: SSG-78 para 4.21 states that** *"The competent authority should establish an inspection programme to verify that the user's management system covers all the relevant aspects identified in TS-G-1.4 [28] and is implemented and followed correctly. This should include management systems implemented in the transport of packages that are not subject to competent authority approval. […]."* |
| **S9** | **Suggestion: NRA should consider verifying that the transport organization's management system is implemented.** |

## 7.7. INSPECTION OF OCCUPATIONAL EXPOSURE

The verification of occupational exposures, for compliance with regulatory requirements provided in the Act and the draft BIRCR, is conducted through regulatory inspections by NRA staff. During inspections, NRA inspectors review safety related records of the authorized party, including personal dosimetry records for workers; investigations carried out by the authorized party on exposures above the investigation level of 1 mSv/month; the classification and appropriate delineation of areas and warning signs.

In general, inspections also cover compliance check of radiation monitoring instrumentation, protective equipment, training records of radiation workers and health surveillance records if available. Each inspection differs in its scope for the given type of facility and activity.

All observations and non-compliances are recorded in the inspection reports and communicated to the authorized party's RPO. The IRRS team was informed that regulatory inspections include taking measurements of the dose rates at different areas of interest.

The IRRS team observed a planned and announced NRA inspection to a catheterization lab at a medical university. During the entrance meeting, the radiation protection responsibilities of the facility was

discussed. The inspection included the necessary measurements; however, the IRRS team noted that the inspection checklist used does not address all relevant safety aspects related to medical and occupational exposures.

**Suggestion S10 in section 7.8. addresses the issue** regarding individual justification, and **Recommendation R25 in section 9.7. addresses the issue** regarding health surveillance of occupationally exposed workers.

During inspection, NRA inspectors orally presented the findings to the representatives of the facility and gave a copy of their inspection report at the end. The IRRS team observed that the inspectors carried out their duties with professionalism and proficiency.

During the discussion of the IRRS team with representatives of the facility, they emphasized having a very close and collaborative working relationship with NRA. The licensee highlighted that updating the guidelines on authorization and sending a reminder before the license expires would enhance the process. The licensee also highlighted that timely arrangement of inspections made for the authorization process would be desirable.

## 7.8. INSPECTION OF MEDICAL EXPOSURE

An inspection programme has been established for medical applications with a risk-based graded approach. High risk medical applications are inspected every year (radiotherapy facilities (Co-60, LINAC), and nuclear medicine), and every 3 years for medium to low risk (CT, conventional X-ray, Mammography, Fluoroscopy and Dental). Inspections in medical facilities addresses medical exposure control, occupational radiation protection and public radiation protection aspects at the same time.

Inspectors are provided with inspection protocols for each medical facility and activity. For medical exposure, inspection areas include responsibilities, training of professionals using radiation for medical exposure, measures taken to optimize doses (calibration and maintenance of medical devices, optimization protocols), measures taken for pregnant and breast-feeding women, and incident and accident management. The inspectors carry out quality control test measurements during their inspections.

The existing diagnostic radiology inspection protocol does not address all aspects for the verification of the individual justification ensuring that the consultation between the radiological medical practitioner and the referring medical practitioner has been conducted.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** NRA inspection procedure does not cover every aspect of the individual justification for medical exposure. | |
| **(1)** | **BASIS: GSR part 3 para. 3.157 states that "***The justification of medical exposure for an individual patient shall be carried out by means of consultation between the radiological medical practitioner and the referring medical practitioner, as appropriate, with account taken, in particular for patients who are pregnant or breast-feeding or are pediatric, of:*<br>*(a) The appropriateness of the request;*<br>*(b) The urgency of the radiological procedure;*<br>*(c) The characteristics of the medical exposure ;*<br>*(d) The characteristics of the individual patient ;* |

| | |
|---|---|
| | *(e) Relevant information from the patient's previous radiological procedures.***"** |
| **S10** | **Suggestion: NRA should consider further developing the inspection procedure to verify that individual justification of medical exposure was performed.** |

## 7.9. INSPECTION OF PUBLIC EXPOSURE

Inspections of authorized parties from which there is a potential for public exposures are integrated in the inspection programmes of NRA and are included in inspection plans.

NRA does not perform specific inspections with focus only on public exposures. The public exposure are verified as part of the regular inspections of facilities and activities.

The IRRS team accompanied NRA on an inspection to the Waste Management Facility. There were three inspectors from NRA performing the inspection, which began with a meeting with management, where various safety related issues were discussed in detail, including issues related to potential for public exposures. The inspection continued with a physical inspection of the waste storage and ended with an exit meeting. The inspectors were competent, thorough, and provided guidance without compromising their independence and authority as inspectors.

## 7.10. INSPECTION OF ON-SITE EMERGENCY PREPAREDNESS AND RESPONSE

The inspections related to emergency preparedness and response are performed in accordance with the draft NRA inspection procedure. Staff members from the Nuclear Installations Directorate support the Emergency Preparedness and Response Department in conducting inspections for the research reactor. The inspectors make use of checklists for the inspection of different facilities and activities. The checklists require the inspectors to verify the review and update of the emergency plan, training of staff and exercising of the emergency plan.

The Act makes provision for the authorised person to conduct exercises to test the adequacy of the plan and to ensure that persons who may be involved in the emergency interventions are adequately informed and prepared for possible emergencies. The IRRS team was informed that the authorised person is requested to inform NRA of the planned exercise. During inspections, NRA verifies that exercises are being conducted and has observed one exercise at the research reactor facility in 2016. The regulatory body participates in selected operator exercises; however, there is no programme for evaluation of the exercises conducted by the operators.

| **RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES** | |
|---|---|
| **Observation:** *NRA does not evaluate emergency exercises conducted by the operating organisations.* | |
| **(1)** | **BASIS: GSR Part 7 para. 6.30 states that "***… The exercises shall be systematically evaluated (see para. 4.10(h)) and some exercises shall be evaluated by the regulatory body. Programmes shall be subject to review and revision in the light of experience gained (see paras 6.36 and 6.38)."* |
| **R19** | **Recommendation: NRA should establish a programme to evaluate emergency exercises conducted by the operating organisations.** |

### 7.11. SUMMARY

NRA carries out inspections of all facilities and activities in accordance with the Act, the draft BIRCR and draft inspection procedures. The IRRS team noted several areas where improvements should be considered such as,

- expanding the inspection procedure to cover also inspection of radioactive waste management facilities,
- verifying the transport organization's management system,
- verifying that individual justification of medical exposure was performed, and
- evaluating emergency exercises conducted by the operating organisations.

The IRRS Team conducted four site visits to observe inspections at different authorized facilities, and it was verified that the inspectors exercise their responsibilities in professional manner.

## 8. ENFORCEMENT

### 8.1. ENFORCEMENT POLICY AND PROCESS

The Act provides NRA the authority to initiate enforcement actions which may be issued due to non-compliances of the legal provisions or conditions of authorizations. The Act applies to all applicants and NRA authorised parties. NRA has developed a draft enforcement policy. In addition, as part of NRA`s management system, an enforcement process and a set of procedures have been drafted. Enforcement actions are commensurate with the potential risk of a safety significant event. However, there is no documented criteria for consistency in approach for determining which non-compliances by licensees and registrants are to be corrected in a certain timeframe due to a bigger impact or less significant impact on safety. The IRRS team highlighted that to ensure consistent approach to corrective actions and set deadlines, there is a need to finalize and approve the enforcement policy and process.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
|---|---|
| **Observation:** *NRA has not finalized and approved the enforcement policy and process, including criteria and timeframes for corrective actions. The issue was already included by NRA in the initial action plan prepared for the mission.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 30 states that** *"The regulatory body shall establish and implement an enforcement policy within the legal framework for responding to non-compliance by authorized parties with regulatory requirements or with any conditions specified in the authorization."* |
| **(2)** | **BASIS: GSR Part 1 (Rev. 1) para. 4.58 states that** *"The regulatory body shall establish criteria for corrective actions, including enforcing the cessation of activities or the shutting down of a facility where necessary."* |
| **(3)** | **BASIS: GSG-13 para. 3.312. states that** *"The regulatory body should adopt clear administrative procedures governing the taking of enforcement actions, which should be documented in internal guidance. All inspectors and other staff of the regulatory body should be trained in, and knowledgeable about, the procedures."* |
| **R20** | **Recommendation: NRA should establish and implement an enforcement policy and process, including criteria for corrective actions.** |

## 8.2. ENFORCEMENT IMPLEMENTATIONS

After conducting inspections, NRA inspectors communicate their findings during the exit meeting and the authorized party has the right to express any disagreement. Discovered non-compliances are included in the inspection report together with a timeframe in which corrective actions have to be taken by the authorized party. The timeframes given for corrective actions to be taken by the authorized parties are determined by NRA and are discussed with the authorized party. NRA follows up if information is submitted about the corrective actions taken by the authorized party. The IRRS team was informed that NRA also carries out follow-up inspections to confirm that corrective actions have been implemented appropriately.

When no immediate threat to health and safety is observed then informal or formal notification may be given by the inspector which should be followed up in writing. More significant findings warrant fines, while adverse safety conditions or a history of poor performance would result in penalties or legal prosecutions. This corresponds to the evaluation of the safety culture aspects of the authorized parties.

NRA inspectors can also take immediate enforcement actions, including the cessation of the activity or the shutdown of the facility, if there is an imminent likelihood of safety significant events.

The IRRS team was informed that there were 7 enforcement actions taken in 2023. Those were mainly related to discovering facilities and activities that had obtained radiation sources but had not received NRA`s authorization. Therefore, following the inspection of those facilities and activities, an enforcement action was initiated and application for authorization was required. Training of NRA inspectors on enforcement actions is part of their regular training; however NRA recognises that implementation of the enforcement policy would require communication of changes and re-training to keep the inspectors up-to-date with decision making.

The NRA draft enforcement policy uses the national system of ’penalty points’. The penalty points correspond to fines or periods of imprisonment in accordance with the Fines (penalty units) Act, Act 572 Schedule I. Non-conformities listed in the NRA draft Enforcement Policy are related to topical issues (e.g. medical exposures, occupational exposures) but also cover common issues (e.g. when the authorized party withholds information from NRA). The NRA draft enforcement policy provides for some flexibility, however a set list of possible enforcement actions are available.

While appeals are possible by the authorized parties under the Act, the NRA does not have experience with such.

## 8.3. SUMMARY

The legal framework provides appropriate basis for enforcement actions and grants the powers for the NRA to carry out these actions when necessary. Graded approach is applied in terms of enforcement actions, both financial and other penalties for non-compliances. Proper implementation of the legal provisions would require the approval of the NRA draft enforcement policy.

# 9. REGULATIONS AND GUIDES

## 9.1. GENERIC ISSUES

NRA has a draft process for the development of regulations and guides, which describes the various steps and parties involved in the preparation, review, adoption and updating of regulations and guides.

NRA has developed draft regulations for nuclear and radiation safety for full implementation of the Act. Some of these regulations are in the final stages of review by the Attorney General's office, while other regulations are being developed by NRA which are subject to internal and stakeholder review. **Recommendation R3 in section 1.2. addresses the issue.**

In addition to regulations, NRA has developed several guides. Some guides have been reviewed by the Board and are undergoing final editing before being published on the NRA website (such as Diagnostic Radiology Authorization Guidelines, Industrial Radiation Applications Authorization Guidelines, Nuclear Medicine Authorization Guidelines, Radiotherapy Authorization Guidelines), others are still under development (such as Deterministic Safety Assessment Guide, Table of Content for Site Approval Report Guide, SSC Safety Classification Guide, Safety Analysis Report for Nuclear Installations Guide )

The IRRS mission team noted that the draft guides do not cover all aspects necessary to effectively advise authorized parties comprehensively on how to comply with the provisions of the Act and regulations, and how to implement regulatory requirements for improving effectiveness and efficiency and enhancing safety.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation: Several guides are in draft form and the need for additional guides has been identified.** | |
| **(1)** | **BASIS: GSR Part 1 (Rev.1) Requirement 2 states that** *"The government shall establish and maintain an appropriate governmental, legal and regulatory framework for safety within which responsibilities are clearly allocated."* |
| **(2)** | **BASIS: GSR Part 1 (Rev.1) Requirement 22 states that** *"The regulatory body shall ensure that regulatory control is stable and consistent."* |
| **(3)** | **BASIS: GSR Part 1 (Rev.1) Requirement 32 states that** *"The regulatory body shall establish or adopt regulations and guides to specify the principles, requirements and associated criteria for safety upon which its regulatory judgements, decisions and actions are based."* |
| **R21** | **Recommendation: NRA should identify and issue relevant guides for authorized parties to comply with the regulatory requirements.** |

The draft BIRCR includes provisions for the demonstration and assessment of safety to be submitted by applicants for authorization to operate research reactors, waste management facilities, and facilities and activities using radiation sources; however, guidance for conducting safety assessments by applicants and licensees is still being developed by NRA. NRA has not yet developed guidance on the format and contents of the safety case for radioactive waste management facilities. Draft guides related to safety

case for other nuclear installations, and conducting safety assessment for radiation source facilities and activities have been developed.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *NRA has not yet developed guidance on the format and contents of the safety case for Radioactive Waste Management Facilities. Draft guidance related to safety case for other nuclear installations and safety assessment for radiation source facilities and activities has been developed. This issue was already included by NRA in the initial action plan prepared for the mission.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) para 4.34 states that** *"The regulatory body shall issue guidance on the format and content of the documents to be submitted by the applicant in support of an application for authorization."* |
| **(2)** | **BASIS: GSG-13 para. 3.43. states that** *"The regulatory body should issue regulations and guides that describe the safety assessments to be performed by the authorized party for the facility or activity, and how these should be submitted for review by the regulatory body prior to the granting of the authorization at each lifetime stage."* |
| **(3)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 22 states that** *"The regulatory body shall ensure that regulatory control is stable and consistent."* |
| **R22** | **Recommendation: NRA should issue guidance documents on format and contents for submission of safety case including safety assessment for all facilities and activities.** |

The IRRS team noted that for NRA to enhance transparency and to promote common understanding for applicants and authorized parties, approval of NRA`s draft guides followed by making them available to interested parties would be necessary.

### 9.2. REGULATIONS AND GUIDES FOR RESEARCH REACTORS

The Act provides general requirements that NRA should apply to research reactors. The draft regulations for nuclear installations outline regulatory requirements for research reactors. However, these regulations do not cover experimental devices and facilities that are part of the research reactor. The IRRS team observed that most of the draft regulations for nuclear installations are aligned with IAEA requirements.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
|---|---|
| **Observation:** *Evaluation of the associated experimental facilities of the research reactor are not included in the regulations. The issue was already included by NRA in the initial action plan prepared for the mission.* | |
| **(1)** | **BASIS: SSR-3 Requirement 30 states that** "The design for a research reactor facility shall include features as necessary to facilitate the commissioning process for the reactor facility, including experimental facilities. These design features may include provisions to operate with transition cores of different characteristics. |

| | |
|---|---|
| **(2)** | **BASIS: SSR-3 Requirement 66 states that** "Experimental devices for a research reactor shall be designed so that they will not adversely affect the safety of the reactor in any operational states or accident conditions. In particular, experimental devices shall be designed so that neither the operation nor the failure of an experimental device will result in an unacceptable change in reactivity for the reactor, affect operation of the reactor protection system, reduce the cooling capacity, compromise confinement or lead to unacceptable radiological consequences." |
| **R23** | **Recommendation: NRA should include requirements in the regulation for the evaluation of the safety of associated experimental facilities as an integral part of research reactors.** |

## 9.3. REGULATIONS AND GUIDES FOR WASTE MANAGEMENT FACILITIES

The Act provides the basis for regulating radioactive waste management and spent fuel management facilities and activities. NRA has developed draft regulations for radioactive waste management which establishes requirements on the long-term safety of radioactive waste and spent fuel management. The draft regulations establish requirements, among others, for safety assessments and safety cases for radioactive waste management facilities and activities including the site, design, operation, closure, and decommissioning of predisposal and disposal facilities, as well as for identifying interdependencies, waste classification and processing, and waste characteristics, and provisions to ensure waste processing aligns with waste. **Recommendation R3 in section 1.2. addresses the issue.**

The IRRS team was informed that considering the radioactive waste management regulations are in draft, NRA does not currently have guides to support applicants in fulfilling its regulatory requirements for radioactive waste management facilities. **Recommendation R21 in section 9.1. addresses the issue.**

## 9.4. REGULATIONS AND GUIDES FOR RADIATION SOURCES FACILITIES AND ACTIVITIES

The Act provides general requirements that are applied by NRA for radiation sources facilities and activities. The draft BIRCR sets out further regulatory requirements. Guides for authorization of practice specific facilities and activities such as industrial radiation applications, diagnostic radiology, nuclear medicine, radiotherapy have been drafted by NRA. Furthermore, a draft guide with prescriptive requirements for structural shielding and room layout for diagnostic x-ray installation is available on NRA website.

The IRRS team was informed that regulations on requirements for technical services and regulations for well-logging are currently being drafted. The IRRS team emphasized that to carry out its core functions for oversight of current facilities and activities adequately, NRA needs to have a stable and consistent legislative and regulatory framework, including promulgated and published regulations. **Recommendation R3 in section 1.2. addresses the issue.**

## 9.5. REGULATIONS AND GUIDES FOR DECOMMISSIONING ACTIVITIES

NRA has draft regulations on decommissioning activities. Currently there are no guides related to decommissioning that are under development by NRA. To date, there are no facilities undergoing decommissioning activities in Ghana.

## 9.6. REGULATIONS AND GUIDES FOR TRANSPORT

The Act provides for authorization of transport activities. In accordance with these provisions, and in the absence of national specific regulations, NRA applies IAEA regulations for safe transport of radioactive material for regulating transport activities.

The IRRS team was informed that the draft regulations for the safe transport of radioactive material have been developed based on IAEA SSR-6 (Rev. 1), FNRBA's Technical Guide on Compliance Inspections by the African Competent Authorities on the Transport of Radioactive Material, the regulations from the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO).

The IRRS team was informed the draft regulations have been reviewed during the IAEA's School of Drafting Transport Safety Regulations organized in 2023, and the draft regulations will go through external expert review. Interested parties such as the national disaster committee encompassing police, customs, military, environmental departments have been involved in the process of drafting the regulation.

NRA has not issued guidance to support transport operators for implementing safety requirements.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
|---|---|
| **Observation:** *NRA has not developed guidance for the safe transport of radioactive material.* | |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 32 states that** *"The regulatory body shall establish or adopt regulations and guides to specify the principles, requirements and associated criteria for safety upon which its regulatory judgements, decisions and actions are based". …* |
| **(2)** | **BASIS: SSG-78 para 3.6 (9) states that** *"[…]the competent authority is required to establish or adopt regulations and guides. National regulations and guides for the transport of radioactive material should be appropriate to the size and type of transport industry to which they apply. "* |
| **S11** | **Suggestion: NRA should consider establishing transport safety guidance for carriers, consignors and consignees.** |

## 9.7. REGULATIONS AND GUIDES FOR OCCUPATIONAL EXPOSURE

Provisions for protection of workers and the responsibilities of all parties involved are established in the draft BIRCR, covering the three main principles of radiation protection and their application. These include requirements for recording of occupational exposures, on compliance by workers and cooperation between employers. The requirements for occupational exposure are generally consistent with the IAEA safety standards.

The IRRS team noted that several studies were undertaken in Ghana to identify existing exposure situations. This includes surveys conducted on industries related to mineral extraction from the earth's crust with different methods and identification of exposures due to radionuclides of natural origin. Such studies did not identify situations which should warrant actions in relation to occupational and public exposures due to residual contamination by radioactive materials of natural or artificial origin. The IRRS team encouraged to carry on with the efforts to identify, evaluate and lay down a protection strategy in

cases where naturally occurring radioactive materials are not negligible from the point of view of radiation protection.

The current regulatory framework does not contain specific requirements on health surveillance of radiation workers. Further, the IRRS team was informed that in some facilities, occupational health surveillance is not carried out or may not be comprehensive.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *Health surveillance of occupationally exposed workers is not comprehensive. Furthermore, verification of health surveillance is not consistently applied by NRA.* | |
| **(1)** | **BASIS: GSR Part 3 Requirement 25 states that** "*Employers, registrants and licensees shall be responsible for making arrangements for assessment and recording of occupational exposures and for workers' health surveillance."* |
| **(2)** | **BASIS: GSR Part 3 para. 3.108 (b) states that** *"Programmes for workers' health surveillance […] shall be designed to assess the initial fitness and continuing fitness of workers for their intended tasks."* |
| **R24** | **Recommendation: NRA, in cooperation with other relevant authorities, agencies or professional bodies should ensure that appropriate occupational health surveillance programmes are established.** |
| **R25** | **Recommendation: NRA should verify compliance by the authorized parties with the health surveillance programmes.** |

The relevant draft guides for the different practices' do not contain appropriate arrangements for optimising protection. **Recommendation R21 in section 9.1. addresses the issue.**

Furthermore, the IRRS team noted that there are inconsistencies within the draft BIRCR in that there are requirements related to exposure of air crew to cosmic radiation; however, cosmic radiation is excluded from the scope of the regulation.

## 9.8. REGULATIONS AND GUIDES FOR MEDICAL EXPOSURE

The provisions for medical exposure are addressed in the draft BIRCR, covering responsibilities regarding medical exposure, justification of medical exposures, optimization of protection and safety, pregnant or breast-feeding patients, release of patients after radionuclide therapy, unintended and accidental medical exposures and reviews and records. However, the following topics are not covered in the draft BIRCR:

- Diagnostic reference levels for medical imaging including image guided interventional procedures. Several scientific articles have been published on the establishment and use of national diagnostic reference levels (DRLs) in Ghana. These propose national DRLs for the most common CT examinations and interventional procedures.
- Dose constraints for exposures of carers and comforters and exposures due to diagnostic investigations of volunteers participating in a programme of biomedical research

- Criteria for the release of patients who have undergone therapeutic radiological procedures using unsealed sources or patients who still retain implanted sealed sources.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
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| **Observation:** *The Draft BIRCR does not address diagnostic reference levels, dose constraints, and criteria and guidelines for the release of patients in medical exposure.* | |
| **(1)** | ***BASIS:*** **GSR part 3 Requirement 34 states that** *"the government shall ensure that relevant parties are authorized to assume their roles and responsibilities, and that diagnostic reference levels, dose constraints, and criteria and guidelines for the release of patients are established."* |
| **R26** | **Recommendation: The Government should ensure that diagnostic reference levels, dose constraints, and criteria and guidelines for the release of patients are established, in consultation between the health authority, relevant professional bodies and the regulatory body.** |

## 9.9. REGULATIONS AND GUIDES FOR PUBLIC EXPOSURE

The Act provides general requirements for control of exposures of the public and the environment to ionizing radiation. Additionally, the draft BIRCR contains requirements consistent with the IAEA safety standards for control of public exposure.

BIRCR sets requirements that authorized parties are responsible for public exposure in planned exposure situations, including optimization of protection and safety; dose limits and operational limits; and conditions for public exposure and assessing effects for cases where impacts extend beyond national border. The draft BIRCR also sets the requirements on discharges, ensuring that all radioactive discharges are managed in accordance with authorization conditions. Additionally, it requires programmes for source and environmental monitoring and of reporting the results to NRA. Furthermore, the regulation stipulates that consumer products must be justified and authorized before being made available to the public.

BIRCR sets the requirements for managing existing exposure situations including on responsibility, establishment and implementation of protection strategies and information of the public.

The IRRS team was informed that guides regarding public exposures have, in general not been developed. **Recommendation R21 in section 9.1. addresses the issue.**

## 9.10. REGULATIONS AND GUIDES FOR EMERGENCY PREPAREDNESS AND RESPONSE

NRA has drafted regulations for Emergency Preparedness and Response for the authorized person which includes the planning basis, emergency preparedness and emergency response. The draft regulations on emergency preparedness and response for authorised parties are consistent with IAEA requirements. The draft regulation has been submitted to the Attorney Generals' office for legal review. **Recommendation R3 in section 1.2. addresses the issue.**

The IRRS team was informed that NRA has identified a number of guides that are to be developed based on the contents of the draft regulations. Further, NRA plans to consider the inclusion of additional

guidance and criteria on emergency classes, emergency planning zones and protection strategy in the guides. **Recommendation R21 in section 9.1. addresses the issue.**

To assist the authorised person on the development of their emergency response plans, NRA has approved Guidelines on Emergency Response Plan for EPC I and II Facilities, for EPC III and IV Facilities as well as for diagnostic radiology facilities.

### 9.11. SUMMARY

NRA has drafted regulations and several guides to support the implementation of the Act and enhance nuclear and radiation safety measures. The regulations need to be approved. In addition, some areas for improvement have been identified such as the establishment of regulatory requirements for the safety assessment of associated experimental facilities as an integral part of research reactors; the establishment of diagnostic reference levels, dose constraints, criteria and guidelines for patient authorisation; the identification and publication of additional guides for authorized parties to comply with regulatory requirements; the publication of guidance documents on the format and content of safety cases; the publication of guidance documents on transport safety; and the revision of guides to further assist licensed parties in implementing health surveillance of occupationally exposed workers.

## 10. INTERFACE WITH NUCLEAR SECURITY

### 10.1. LEGAL BASIS

The Act stipulates that safety, security, emergency arrangement and safeguards are coordinated together under the supervision of NRA. The Act requires NRA to facilitate the development of national policies on the regulation and management of activities and practices with respect to security of nuclear material and radioactive materials. The interface of safety with security is addressed in the draft Nuclear Security Regulations which require an authorized person to ensure that the physical protection interface with safety, safeguards and nuclear material accounting and control activities are managed in a manner that enables these functions, to be mutually supportive and does not adversely affect each other.

### 10.2. REGULATORY OVERSIGHT ACTIVITIES

The Nuclear Security, Nuclear Safety and Nuclear Safeguards Departments of NRA are under the same Nuclear Installations Directorate, thus enhancing cooperation among the different departments.

The IRRS team noted that NRA has developed draft regulations for nuclear safety and security, and a safety and security culture programme. Apart from requirement 30(c) in draft Nuclear Security Regulations, there are no other requirements addressing the interface between safety and security.

Additionally, there are no internal documents that provide guidance on how to address interfaces between safety and security for the authorized person or within NRA.

There is no requirement specifying how the authorized person should provide evidence that safety and security issues are effectively integrated and do not compromise each other. NRA inspections do not address the interfaces between safety and security.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
|---|---|
| | **Observation:** *There is no internal guidance on how to manage safety and security interfaces within NRA. Furthermore, there are no requirements for the authorised person to specifically identify and evaluate those interfaces, and no targeted inspection plan on such interfaces.* |
| **(1)** | **BASIS: GSR Part 1 (Rev. 1) Requirement 12 states that** *"Safety measures and nuclear security measures shall be designed and implemented in an integrated manner so that nuclear security measures do not compromise safety and safety measures do not compromise nuclear security."* |
| **(2)** | **BASIS: GSR Part 2 para. 4.10 states that** *"Arrangements shall be made in the management system for the resolution of conflicts arising in decision making processes. Potential impacts of security measures on safety and potential impacts of safety measures on security shall be identified and shall be resolved without compromising safety or security."* |
| **(3)** | **BASIS: GSR Part 1 (Rev. 1) para. 4.26 states that "***The regulatory process shall be a formal process that is based on specified policies, principles and associated criteria, and that follows specified procedures as established in the management system. The process shall ensure the stability and consistency of regulatory control and shall prevent subjectivity (...). (...) the regulatory body shall inform applicants of the objectives, principles and associated criteria (...) on which its requirements, judgements and decisions are based."* |
| **R27** | **Recommendation: NRA should document how the interface between safety and security should be managed within NRA.** |
| **R28** | **Recommendation: NRA should issue requirements for management of the interface between safety and security by the authorized party.** |
| **R29** | **Recommendation: NRA should verify the practical implementation of the safety and security interface by the authorized party.** |

### 10.3. INTERFACE AMONG AUTHORITIES

The Act provides a list of authorities having responsibilities in regulating various aspects related to nuclear and radiation facilities and activities which includes Ministries responsible for National Security and the Interior; the National Security Council for the threat assessment; Ghana Immigration Service and Customs Division of the Ghana Revenue Authority for the control of import and export of nuclear material, radioactive sources or other controlled items. NRA collaborates with various security agencies in the framework of the National Nuclear Security Committee led by the National Security Coordinator's Secretariat, to develop infrastructure for nuclear security in Ghana. NRA has signed in February 2023 a Charter for National Nuclear Security Committee consisting of a total of 26 entities including NRA and NADMO. NRA's actions in developing and maintaining a national emergency plan for responding to potential nuclear or radiological emergencies and collaboration with authorities and organisations responsible for emergency response arrangement such as NADMO are discussed in section 3.9.

While NRA has good cooperation and dialogue with each of the authorities or organisations for ensuring the prevention of potential gaps and overlaps in the implementation of their respective duties and responsibilities, the IRRS team noted that this coordination could be enhanced. Working arrangement

are in place, however some of these cooperations are not formalized. **Recommendation R5 in section 1.5. addresses the issue.**

The Act assigns NRA the function to exchange information and co-operate with regulatory authorities of other countries and relevant international organisations on matters of nuclear safety, nuclear security and safeguards.

### 10.4. SUMMARY

NRA has established various draft documents and arrangements regarding safety, security and safeguards. Only one requirement specifically addresses in the draft regulations the interfaces between safety and security and requires the authorized person to manage them in a manner that enables these functions to be mutually supportive and no adversely affect each other. However, there is no guidance to address the interfaces between safety and security neither within NRA nor for the authorised person.

There is good cooperation and dialogue with each of the involved authorities and organisations for ensuring the prevention of potential gaps and overlaps in the implementation of their respective duties regarding safety, security and emergency response. Enhancement of coordination among them would strengthen the nuclear safety and security culture within all organizations.

## 11. COUNTRIES EMBARKING ON NUCLEAR POWER

### 11.1. INTRODUCTION

The nuclear power programme of Ghana has taken more tangible form with the establishment of the Ghana Nuclear Power Programme Organisation (GNPPO) in 2012 for nationwide coordination of activities for embarking on a nuclear power programme. In 2015, an independent regulatory authority was established by the promulgation of the Act. A governmental enterprise, The Nuclear Power Ghana (NPG) was established in 2018 as a governmental company to be the future operator and the licensee for the nuclear power plant.

The Government hosted an INIR mission of IAEA in 2017 and a follow up mission in 2019. The Initial mission reported twelve (12) recommendations, eight suggestions and three good practices, which are mainly corresponding to the Phase 1 activities. The follow-up mission identified four recommendations and two suggestions requiring further actions by the Government, mostly on planning for Phases 2 and 3.

GNPPO has implemented a detailed study of the national energy mix and demand, legal and regulatory infrastructure for nuclear power and safety, and prepared a Programme Comprehensive Report (PCR). The PCR detailed how the necessary factors were considered for making a decision for nuclear power. The PCR established the basis for governmental declaration on embarking on a nuclear power programme made by the President of Ghana on 28 July 2022.

The Government, through the NPG, identified the preferred site from among the four candidate ones and a backup site for the Nuclear Power Plant (NPP). Concurrently, technical information has been requested from potential vendors of different NPP designs. The NPG received information on six different designs from five vendor countries. Upon the review of the information provided, the communications were on going with the vendors of two designs, one SMR and one large scale NPP. The IRRS team was informed that final decision is expected to be made in 2025.

Taking into consideration the above initiatives, this review is made for a Phase 2 country against the relevant actions established in the IAEA Safety Guide SSG-16 (Rev 1), with particular attention to actions addressed to the Government and the regulatory body, and with due consideration to selected issues from Phase 1.

## 11.2. CONSIDERATION OF ELEMENTS OF SSG-16

### 11.2.1 SSG-16 ELEMENT 01 NATIONAL POLICY AND STRATEGY

The National Policy for Nuclear and Radiation Safety has been drafted based on the fundamental safety objectives of IAEA. The draft policy addresses all the safety principles in the IAEA Safety Fundamentals SF-1. **Recommendation R1 in section 1.1. addresses the issue** regarding the need for approval of the National Policy and strategy. Further detail discussion about the draft national policy and strategy for safety can be found in section 1.1.

The Government provided a strong coordination among the relevant organizations by establishing the GNPPO in the early stages of embarking on nuclear power, which was recognized as a good practice by the INIR Mission carried out in 2017.

The Government also established all relevant organizations that would be needed for development and implementation of the safety infrastructure and for embarking on nuclear power. Establishment of the NRA as an independent regulatory body was an important step. In addition to NRA, the Government established the NPG to be the future licensee organization to operate the nuclear power plant.

The Government has signed various agreements with foreign governments and organizations to collaborate with them regarding the development of infrastructure, exchange of information on potential technologies to be used and on the safety of such facilities and activities. The Government benefitted from the European Commission Instrument for Nuclear Safety Cooperation, particularly on development of competencies in all relevant organizations.

### 11.2.2 SSG-16 ELEMENT 02 GLOBAL NUCLEAR SAFETY REGIME

Ghana is a party to several international instruments regarding safety, security and safeguards of nuclear facilities and activities. These instruments include:

- Convention on Nuclear Safety
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
- Convention on Early Notification of a Nuclear Accident
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency
- Convention on Supplementary Compensation for Nuclear Damage
- Vienna Convention on Civil Liability for Nuclear Damage
- Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage
- Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention and the codes of conduct that promote the adoption of good practices in the relevant facilities and activities:
- Code of conduct on the Safety and Security of Radioactive Sources
- Code of conduct on the Safety of Research Reactors

The IRRS team was informed that the Government has also signed agreements for cooperation for peaceful use of nuclear energy with the Russian Federation and China.

There is no direct provision requiring the authorized person to share their operational experience with all interested parties, including relevant international organizations, or require NRA to establish such a system. NRA has addressed this issue in the draft regulation on operation of nuclear facilities, which needs to be promulgated. **Recommendation R3 in the section 1.2. addresses the issue**.

The Act mandates NRA to exchange information and co-operate with regulatory authorities of other countries and relevant international organisations on matters of nuclear safety, nuclear security and safeguards. In this respect, NRA has initiated cooperation with various foreign regulatory bodies such as the USNRC, the CNSC and the PNRA, and has participated in international platforms such as Forum of Nuclear Regulatory Bodies in Africa (FNRBA), Regulatory Cooperation Forum (RCF) and activities of the IAEA, as well as collaborates with the European Commission and the IAEA on training and educational matters.

Both the National Policy on Nuclear Energy and the presidential declaration mention transparency as one of the main pillars of the Ghanaian nuclear power programme. The IRRS team was informed that the intentions of Ghana to embark on nuclear power have been under discussion in sub-regional platforms of Africa. However, an official dialogue with neighbouring countries has not been established yet.

| RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES | |
|---|---|
| **Observation:** An official dialogue with neighbouring countries has not been initiated following the presidential declaration on embarking nuclear power. | |
| **(1)** | **BASIS: SSG-16 (Rev. 1) Action 12 states that** *"The government should begin a dialogue with neighbouring States with regard to its projects for establishing a nuclear power programme."* |
| **S12** | **Suggestion: The Government should consider initiating the communication and dialogue with the neighbouring countries regarding the planned nuclear power programme in Ghana.** |

### 11.2.3 SSG-16 ELEMENT 03 LEGAL FRAMEWORK

The Act establishes the legal framework for safety in Ghana. It establishes the NRA, defines the organization, regulatory roles and responsibilities of the NRA and other relevant stakeholders regulating nuclear installations, radiation facilities and activities, radioactive waste safety, decommissioning, safeguards of nuclear materials, third party liability, inspection and enforcement, and offences and penalties. However, there are some gaps in accordance with the IAEA safety standards that have been identified in the Act. **Recommendation R2 in the section 1.2. addresses the issue**.

The main steps of licensing a nuclear installation are prescribed in the Act, including review and assessment role of the regulatory body during authorizations. The PCR prepared by GNPPO identified 13 regulatory authorities that need to collaborate with NRA during the licensing of an NPP. Among them are the Environmental Protection Agency, the Water Resources Commission, the Ghana Maritime Authority, and the Land Use & Spatial Planning Authority (LUSPA. The GNPPO provides for the coordination of any collaborative actions.

Additionally, a detailed licensing procedure has been developed for nuclear installations in the Draft Licensing Regulation, which together with other draft regulations establishes the authorization process for safe construction, commissioning, operation and decommissioning of nuclear facilities.

**Recommendation R3 in the section 1.2. addresses the issue** with regards to the need for issuing draft regulations.

### 11.2.4 SSG-16 ELEMENT 04 REGULATORY FRAMEWORK

NRA reports to the MESTI, which is responsible for similar regulatory bodies of Ghana as well as GAEC. The Ministry of Energy is the main promoter of the nuclear power programme through GNPPO and with active support of GAEC.

The roles and responsibilities of NRA have been laid out in the Act. The use of some terms is not clear in their intentions and should be considered to be revised during an update of the Act. Among them are:

- Section 4(b) gives the NRA an objective of providing protection of persons and environment, while the usual term used should be ensuring the protection. The objective phrased as such may lead NRA to be held responsible for taking actual measures for protecting people, which should not be among the responsibilities of NRA.
- The Act uses the terms nuclear safety, safety and radiation safety interchangeably, which may result in misinterpretations.
- Sections 5 and 6 miss the regulatory oversight of safety and security of facilities and activities.
- Section 5(r) limits the review to the nuclear safety assessment and safety analysis reports from authorised persons, creating a gap for review and assessment of other documents that may be received from other sources.
- Section 6(k) limits the inspection authority of the NRA to radiation safety and security.

According to the Act, the Board does not take part in the decision making process regarding the authorization of facilities and activities. According to the draft IMS process of authorization of NRA, the authorization decision is recommended to the Director General (DG) by the Department Director. The authorization document, the licence and its conditions is signed by the DG. The DG is appointed by the and in accordance with Section 15 (4) of the Act can be relieved of duty for any stated reasons or claimed incompetence.

NRA has adopted a hybrid regulatory approach between prescriptive and goal setting regulatory framework. This approach is reflected in its draft Regulatory Strategy document. The Corporate Strategic Plan 2021-2025 of NRA also reflects the same approach. The IMS of the NRA is still in draft. Processes for its main functions of developing regulations, authorizations and inspections were drafted in accordance with the IAEA Safety Standards. Further details about the IMS are given in section 4.1.

Safety regulations are also in draft form, covering the following areas;

- Basic Ionising Radiation Control,
- Licensing of Nuclear Installations,
- Integrated Management Systems,
- Site Evaluation,
- Design,
- Construction,
- Commissioning,
- Operation,
- Emergency Preparedness and Response,
- Radioactive Waste Management,

- Transport Safety,
- Decommissioning.

Some of these draft regulations have undergone internal and interested parties' reviews in accordance with the draft IMS process for communication and consultation with interested parties and are finalized and awaiting approval. At present, the public participation in the development of regulations is limited to the parliamentary stage. NRA is involved in the resolution of the comments. This stage has not been completed for any of the draft documents. Both the opening of the draft regulations for public comment and their promulgation are recognized in the NRA's Action Plan. **Recommendation R3 in the section 1.2. addresses the issue.**

NRA has signed an Arrangement for Technical Information Exchange with the future licensee, NPG. NRA has also signed MoUs with EPA and GAEC for technical information exchange. NRA has informal arrangements with other agencies such as the Ghana Meteorological Agency and Ghana Geological Survey Authority to collaborate during the licensing process.

### 11.2.5 SSG-16 ELEMENT 05 TRANSPARENCY AND OPENNESS

The Government established the GNPPO for effective coordination of activities related to embarking on nuclear power, including the involvement of stakeholders and informing the public about the risks arising from the nuclear power project. Informing the public and other stakeholders was also addressed in the National Energy Policy 2021 of the Ministry of Energy. Based on this policy and the mandate defined by the Government during the establishment of the GNPPO, the organization prepared and issued a Stakeholder Engagement Strategy, which includes strategies for informing the public and other interested parties.

On the other hand, Section 5(k) of the Act authorizes NRA to inform the public on nuclear and radiation matters. While this provision does not limit NRA's responsibilities on safety aspects, NRA informs the public on matters within its competence.

The current public communication plans focus on raising public awareness on the roles and responsibilities of the existing organizations such as NRA, GNPPO and NPG and is planned to focus on the safety implications of the nuclear power programme. The Government has demonstrated its commitment to public communication in various ways. One implementation has been the extensive and regular use of radio programmes on science to increase the visibility of NRA and public awareness of its roles and responsibilities.

According to the NRA Press Conference Report August 2023, NRA held a widely publicised conference on roles and responsibilities of stakeholders. NRA presented awards to media personalities who were nominated on the basis of the factual content of their product, clarity and accuracy of the information, originality and adherence to ethical reporting or the journalistic code of ethics of using original sources. Awards were given in the categories of radio, TV, printed media, online media and overall best reporter.

More on the role of the regulatory body in this respect can be found in section 3.8. of this report.

### 11.2.6 SSG-16 ELEMENT 06 FUNDING AND FINANCING

The draft National Policy on Nuclear and Radiation Safety includes the commitment of the Government to promote, support and provide a framework for research and development for nuclear and radiation safety, including the provision of the necessary financial and human resources for this commitment. GAEC has been mandated as the main organization responsible for identifying the areas of research and

development that will help improve safety in the use of these technologies. NRA can provide the necessary input to the safety research and development in accordance with the Act.

GAEC was mandated with carrying out the research and development and GNPPO is the main body to coordinate all activities including research and development, regarding the nuclear power programme. NRA may contribute to identification of areas of research as it is represented in the Board of GNPPO. While the system is in place for supporting and coordinating the education as well as training and research activities, the IRRS team was informed that the implementation of the National Policy is slow, and funds are insufficient particularly for research activities.

The Act requires the authorized person to allocate the necessary financial resources for decommissioning activities including the radioactive waste produced during operation but does not stipulate that it is also the authorized person's responsibility to ensure necessary financial resources for safe operation of the nuclear facility or nuclear power plant, including safe management of the radioactive waste during the operation. Section 5(f) of the Act mandates NRA to define the detailed obligations, including financial conditions, to be placed on persons who possess radiation sources and nuclear materials, but the draft regulation on Operation of Nuclear Installations does not require that the authorized person provides for the financial resources of safe operations. Ensuring financial resources for the radioactive waste generated during the operation has been defined as a responsibility of the authorized person in the draft regulation on radioactive waste management.

| **RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES** | |
|---|---|
| **Observation:** *The Act lacks a provision regarding the financial resources for the safe operation of a nuclear installation (including nuclear power plants). The issue was already included by the NRA in the initial action plan prepared for the mission.* | |
| **(1)** | **BASIS: SSG-16 (Rev. 1) Action 49 states that** *"The government should require that the operating organization allocate the necessary financial resources to ensure the safety of its nuclear power plants until the end of their planned operating lifetime."* |
| **S13** | **Suggestion: The Government should consider including provisions in the Act that the necessary financial resources need to be provided by the authorized party for the safe operation of the nuclear installation and the safe management of radioactive waste generated during the operation.** |

In accordance with Section 5(q) of the Act, NRA should ensure that the "polluter pays" principle is applied in the management of nuclear and radioactive waste in the country. The costs of the operation of the radioactive waste management organization and the regulatory oversight by NRA will be covered from the State budget. According to the draft regulation on radioactive waste management, it is the authorized persons' responsibility to provide the necessary financial resources for the safe management of radioactive waste during the lifetime of the facility.

The IRRS team was informed that a radioactive waste management fund will be established by NRA in consultation with the relevant authorities to cover the main costs for disposal, relevant research and development, and capacity building. According to the National Policy document, the NRA will be responsible for managing the fund. The IRRS team finds this responsibility to be beyond the usual role, responsibility and competence of a regulatory body. Further information regarding this issue can be found in section 1.7.

### 11.2.7 SSG-16 ELEMENT 07 EXTERNAL SUPPORT ORGANIZATIONS AND CONTRACTORS

The Government has taken steps to encourage domestic industrial organizations to develop their capabilities for participating in the NPP project through GNPPO. However, the IRRS team was informed that the interest of potential industrial organizations was low, and considerable need for competence building was identified as the main reason for this. Government investment in capacity building may improve this issue in the long term.

The future operator NPG uses the Nuclear Power Institute (NPI) and Radiation Protection Institute (RPI)of GAEC as technical support organizations. NPG also trains its staff to equip them with the necessary capacity for an internal technical support and oversight of its technical support organizations and contractors.

NRA does not have an established national technical support organization. NRA has established a committee to identify areas for technical support needs and also possible organisations that could provide such support in the regulatory oversight of the NPP. NRA participates in the activities of the TOSCA working group to develop a plan for technical and scientific external support development in Ghana. Additionally, NRA is planning to exploit the support of some governmental institutions during the review and assessment, such as EPA, Ghana Institution of Engineering, Ghana Geological Survey Authority, Ghana Meteorological Agency and Ghana Statistical Service.

NRA and NPG are expected to plan and make arrangements for overseeing the activities of their own technical support organizations within the scope of the IMS. NRA does not have such arrangements in its IMS documentation.

| **RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES** | |
|---|---|
| **Observation:** NRA does not have any arrangements for overseeing the activities and performance of its potential technical support organizations. | |
| **(1)** | **BASIS: SSG-16 (Rev. 1) Action 66 states that** *"The regulatory body and the operating organization should plan arrangements for overseeing the activities performed by their respective external support organizations and contractors"* |
| **(2)** | **BASIS: GSR Part 2 para. 4.34 states that "***The organization shall have a clear understanding and knowledge of the product or service being supplied. The organization shall itself retain the competence to specify the scope and standard of a required product or service, and subsequently to assess whether the product or service supplied meets the applicable safety requirements."*.. |
| **S14** | **Suggestion: NRA should consider developing arrangements for overseeing the activities performed by its external support organizations in line with the responsibilities of being an informed customer.** |

### 11.2.8 SSG-16 ELEMENT 08 LEADERSHIP AND MANAGEMENT FOR SAFETY

The draft National Policy on Nuclear and Radiation Safety requires that leadership and management for safety should be part of all nuclear-related organisations. NRA has already started to establish its management system fostering safety culture.

NRA's safety policy statement includes elements of leadership and safety culture and promotes it within the organization. NRA's safety policy addresses, among others, the priority of safety, compliance with legislations, and developing and continually improving the IMS of NRA. The safety policy also addresses the defining attributes of the expected safety culture.

As an integral part of their IMS, NRA and NPG have systems for measurement, self-assessment, independent assessment, and continuous improvement. NRA has implemented an internal review of its IMS. In order to receive a certificate of compliance with ISO 9001:2015, NRA is preparing for external review. NRA's IMS is yet to be finalized and approved. **Recommendation R9 in the section 4.1. addresses the issue.**

### 11.2.9 SSG-16 ELEMENT 09 HUMAN RESOURCES DEVELOPMENT

GAEC in collaboration with the University of Ghana and with support from the IAEA established the School of Nuclear and Allied Sciences (SNAS) in September 2006 to provide education in nuclear science and technology at the graduate level. The school is providing a pool of educated personnel for involvement in regulatory oversight of the nuclear power programme. At SNAS, graduate programmes in Nuclear Engineering, Nuclear Physics, Health Physics, Radiation Protection, and Environmental Monitoring among others are offered. Also, short term courses in radiation protection are provided under the Department of Nuclear Safety and Security. SNAS is recognised by the IAEA as a Regional Designated Centre for Education and Training in Radiation Protection and Safety of Radiation Sources for English-speaking Africa.

Ghanaian students can also participate in nuclear power related programmes, based on the informal cooperations established with some countries, in:

- Harbin Institute of Technology, China
- Tomsk Polytechnic University, Russia
- National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Russia
- KEPCO International Nuclear Graduate School, South Korea
- Tshingua University, China

The GNPPO has worked on the general human resource planning regarding the nuclear power programme, including human resource needs of NRA, to implement the provisions of the draft National Policy. Even though NRA drafted generic human resource plans, there is a need to make sure that elements of the GNPPO Human Resource Plan for the nuclear power programme are also included.

The specific measures for attracting and retaining the necessary human resources mentioned in the GNPPO plan also applies to the NRA human resource plan. Among them are adequate return arrangements for trainees sent abroad, competitive salaries, favourable working conditions, and clear career progression pathways. However, implementation of these measures is not clear. **Suggestion S3 in the section 3.2. addresses the issue** related to NRA's human resource planning.

NRA still uses GAEC's Condition and Scheme of Service to hire new staff which provides additional financial advantages due to the specific status of GAEC. The IRRS team was informed that NRA does not have the same status, therefore the staff may lose some advantages if NRA uses its own Conditions and Scheme of Service, and that NRA is negotiating this issue with the Government to retain the same conditions for NRA.

In 2021, NRA recruited forty staff to support their work. NRA has requested approval from the Government to recruit an additional sixty-one staff members. The Government approved only

approximately a third of the request. Similarly, NPG is experiencing significant problems regarding its human resources. Due to its legal statute, the NPG is unable to hire its own staff in accordance with the human resource plan. NPG currently uses loaned staff from GAEC, and the Volta River and Bui Power Authorities currently producing electricity. The salaries of NPG staff are paid by these organizations. NPG drafted the Ghana Nuclear Power Corporation Bill (Bill) to raise its status to a public authority, similar to the Volta River Authority or Bui Power Authority, to have the necessary financial resources to hire its own staff. The draft Bill has been submitted to the parliament for approval.

The Government's commitment to developing and implementing an effective funding mechanism for the planned nuclear programme is contained in the Nuclear Energy Policy of 2021.

The competence development programme for NRA staff is finalized (Draft Training Programme for Technical Staff of NRA, 2017) as recommended by the IAEA SARCON approach and the IRRS team was informed that it is actively being implemented even though it is a draft. The training programme includes national and international training for NRA staff, benefitting from the EC-INSC and IAEA projects. Also, bilateral MoU's signed with experienced regulators provides vocational training options for NRA staff.

### 11.2.10 SSG-16 ELEMENT 10 RESEARCH FOR SAFETY AND REGULATORY PURPOSES

In general, GAEC carries out the research and development in nuclear and radiation science and technology through its research centres, such as the National Nuclear Research Institute.

Additionally, the Act mandates NRA to facilitate the development of national policies on the regulation and management of activities and practices with respect to the nuclear safety and research. According to the Act, NRA is also authorized to regulate research on radiation and nuclear safety and security, and of radioactive waste matters. In this respect, NRA collaborates with USNRC under the RAMP (Radiation Protection Code and Analysis and Maintenance Program) or CAMP (Code Application and Maintenance Program) for training in various safety analysis codes.

The Government also established various new research organizations, nuclear and non-nuclear, to promote research in safety. The NPI of GAEC is the latest one providing research activities on nuclear power and safety and acting as a technical support organization to the authorized person. GNPPO also acts as a coordination body for the research on safety. Since both NRA and NPG as well as GAEC are represented in the coordination, they have the opportunity to be involved in identification of areas of research for safety.

### 11.2.11 SSG-16 ELEMENT 11 RADIATION PROTECTION

The first regulation on radiation protection in Ghana was established by the Radiation Protection Board (RPB) under GAEC in 1993 as a radiation protection programme which mainly addressed radiation sources and their applications in the country. The RPI was established in the year 2000 under GAEC by the Act 588 to provide technical services, while the RPB continued to regulate the use of radiation sources. By the enactment of the Act in 2015, NRA was given the responsibility to regulate and manage the activities and practices for the peaceful use of nuclear and radioactive materials, and the protection of people and the environment against the harmful effects of radiation hazards. After the enactment of the Act, the RPI continues to provide technical support services in the area of radiation protection.

The Act requires NRA to regulate the radiation protection in the country. Additionally, the Act holds the authorized person responsible for complying with the requirements regarding radiation protection and to minimize the doses during the operation of the facility or conduct of an activity.

NRA has drafted a regulation (BIRCR) based on GSR part 3 establishing all necessary dose limits and constraints for workers and the public for normal operation and for potential exposures. The regulations are in draft form since 2020 creating an important gap in the regulatory framework and need to be promulgated. **Recommendation R3 in section 1.2. addresses the issue.**

The Act requires NRA to collaborate with EPA to identify activities and practices that may require environmental impact assessment and develop environmental guidelines for those activities and practices. The Act also a requires NRA to review and assess the potential environmental impact of the proposed nuclear installations during pre-construction review of the facility and also during the decommissioning process of the facility.

Within the scope of preparatory work, the roles and responsibilities for environmental impact assessment for NPPs were assessed and findings are reported in the PCR in 2019. The PCR states that the exact roles of the EPA and NRA are not clear and mandates the NRA to sign an MoU with EPA. The MoU has been signed with EPA in 2022.

According to the MoU, the environmental impact assessment of an NPP will be submitted to both NRA and EPA for review and is approved by the EPA with NRA as co-signatory to the environmental permit issued by EPA.

### 11.2.12 SSG-16 ELEMENT 12 SAFETY ASSESSMENT

NRA has signed various arrangements for technical information exchange and cooperation with experienced nuclear regulators. Additionally, NRA uses IAEA and EC-INSC projects to receive support in education and training from European technical support organizations, mainly for building capacity within the regulatory body. It is planned that this capacity will be utilised for review and assessment of safety for submissions related to NPPs as defined in the Act.

### 11.2.13 SSG-16 ELEMENT 13 SAFETY OF RADIOACTIVE WASTE, SPENT FUEL MANAGEMENT AND DECOMMISSIONING

Radioactive waste management, spent fuel management and decommissioning are addressed in various provisions of the Act. Under the Act, it is the responsibility of the authorized person to ensure the safe management and disposal of radioactive waste, and safe decommissioning. These arrangements are subject to the preconstruction review by NRA. The Act includes provisions for regulating radioactive waste management facilities and lays out the main safety regulations. Similarly, it includes provisions for regulating decommissioning activities. According to the Act, the authorization of nuclear installations for construction and operation should include the verification of availability of adequate financial resources for safe decommissioning, including waste management.

With plans to construct a nuclear power plant, NRA has drafted a Radioactive Waste Management Policy and Strategy in 2020, which addresses high level choices made for the management of radioactive waste and spent fuel and decommissioning. In this policy document, the National Radioactive Waste Management Authority (NRWMA) is assigned to carry out management of radioactive waste and spent nuclear fuel in the future. NRWMA should be established leveraging on the expertise already existing in the RWMC of GAEC. This policy document is in draft form and needs to be approved. **Recommendation R6 in section 1.7. addresses the issue.**

Main safety requirements for the management and disposal of radioactive waste, and operation of radioactive waste management facilities, are drafted by NRA in the Radioactive Waste Management Regulations; and for decommissioning of facilities, in the Decommissioning Regulations. Both documents are still in draft form and and are yet to be promulgated.

According to the Radioactive Waste Management Policy prepared by NRA, in order to ensure that funds are available for the management of radioactive waste, the user should be required to provide a financial guarantee prior to authorisation. NRA, in consultation with the waste management organisation, and with the approval of the responsible Minister/Parliament of Ghana, should agree on a fee to be charged on an annual basis to establish a fund for the management of the waste and be responsible for managing the fund. Further discussions on this issue are in section 11.2.6 of this report and under sections 5.3 and 9.3.

### 11.2.14 SSG-16 ELEMENT 14 EMERGENCY PREPAREDNESS AND RESPONSE (REGULATORY ASPECTS)

The National Disaster Management Organisation (NADMO), which manages all disasters in the country, published the National Disaster Management Plan (NDMP) in 2010 that defines the general scope of disaster management in Ghana, and identifies nuclear and radiological disasters under man-made disasters. In the framework of the NDMP, a National Nuclear and Radiological Emergency Response Plan (NNRERP) was also developed. The NNRERP provides a general description of the roles and responsibilities of ministries, and other organisations, and facilities that would be involved in responding to a nuclear or radiological emergency. However, the NNRERP did not consider emergencies originating from nuclear power plants and was reviewed to cover safety and security events at nuclear power plants and current international requirements. The update was completed in 2023 and the NNRERP is awaiting formal approval.

The Act makes the authorized person responsible for preparing an emergency plan that should be reviewed and updated annually. NRA collaborates with all relevant organizations to support the development of the on-site and off-site emergency response plans, and for the development of a national plan for nuclear and radiological emergencies. The Act also authorizes NRA to develop regulations for effective emergency preparedness and response for a nuclear or radiological emergency at all levels.

The NNRERP and the regulations on emergency preparedness and response provide details on the roles and responsibilities of the relevant organizations during an emergency, based on the guidance provided in the IAEA safety standards. For example, it uses the IAEA emergency preparedness categories based on the likelihood and severity of the emergency. According to the revised NNRERP, NRA acts as a technical lead, while NADMO leads the coordination of responses during an event of a nuclear or radiological emergency. A total of 19 other government organizations are expected to respond in such an emergency. In addition, three guidelines regarding preparation of emergency plans for different categories have been approved.

National responsibilities in relation to the IAEA Early Notification and Assistance Conventions in the event of a nuclear accident or emergency were established as a requirement in the Act. The responsibilities of the Government on these issues were delegated to NRA.

Other general findings related to emergency preparedness and response that may have an impact on the nuclear power programme are addressed under the Sections 1 and 3 of this report, depending on their relation to the Government or NRA.

### 11.2.15 SSG-16 ELEMENT 15 OPERATING ORGANIZATION

The challenges associated with the absence of a requirement in the Act related to the prime responsibility for safety are addressed in **Recommendation R2 in section 1.2**. It is recognized that NPG has been assigned the role as future licensee and operator of the NPP and as such it is expected to assume the prime responsibility for safety of the NPP.

### 11.2.16 SSG-16 ELEMENT 16 SITE SURVEY, SITE SELECTION AND EVALUATION

The Act addresses siting in sections 36 and 37. Section 36 requires NRA to establish a process for the evaluation of proposed sites, and to approve the proposed location prior to the commencement of detailed site investigations on the basis of exclusion criteria which are also listed in the section. Section 37 requires the applicant to prepare a site evaluation report for the NRA to be reviewed and assessed during the pre-construction review, and defines the content of the site evaluation report.

The site selection process has already been carried out by the GNPPO, referred to in the Programme Comprehensive Report (PCR), on the basis of the siting criteria also established by the GNPPO. According to the PCR, which has been approved in accordance with the Presidential Declaration, four candidate sites have been selected for further investigation. The operating organization is expected to submit a Site Approval Report after the preferred site has been identified based on the ranking of the candidate sites. The site needs to be approved by NRA before site characterisation activities can commence. However, the application for site approval for the NPP project has not yet been submitted.

NRA has drafted the Site Evaluation Regulations that address the general and specific requirements for the site evaluation; requirements on establishment of baseline data and monitoring requirements on site characteristics but is not yet promulgated. **Recommendation R3 in section 1.2. addresses the issue.**

### 11.2.17 SSG-16 ELEMENT 17 DESIGN SAFETY

The GNPPO carried out a detailed assessment of various designs as potential technologies to be built in Ghana in order to select the most appropriate reactor design that would comply with the safety principles and requirements, as well as the technical criteria set by the Government. Four large scale designs and five small scale reactor designs were considered. These were favoured for their evolutionary designs and reliability, while modular designs were favoured for complying with the limitations imposed by the national conditions on available grid and investment capacity.

The comparison was based on the IAEA Reactor Technology Assessment (RTA) methodology. The results are reported in the PCR which formed the basis for the Presidential Declaration made in 2022. According to the PCR, one SMR design was more suitable for Ghana’s purposes. The comparison of the large-scale reactor designs did not yield a clear technical preference and the final decision was made using additional criteria.

The decision on technology is still to be made by the Ministry of Energy and the NPG based on further considerations. All NPG staff participated in relevant training on the alternative designs to make an informed evaluation and decision. In addition, staff of the GNPPO are also undergoing training to help them get familiar with international safety requirements applicable in the design of nuclear power plants.

Meanwhile, NRA has drafted the Design Regulation based on the IAEA's Safety Requirements on Nuclear Power Plant Design SSR-2/1 (Rev. 1), which ensures the safe and secure design, construction, operation, and decommissioning of nuclear facilities and activities and establishes the technical and

safety requirements that nuclear facilities must meet to protect public health, safety, and the environment.

The draft regulations address various aspects of design such as safety objectives, fundamental safety functions, operational limits, accident mitigation, radiation protection, installation layout, safety management, engineering design rules, instrumentation and control, fire safety, seismic qualification, ageing management, safety assessment, decommissioning, etc. It emphasizes defence-in-depth principles, requiring rigorous safety assessments and proven engineering practices. Additionally, it also addresses hazard analysis, deterministic and probabilistic safety assessment, environmental protection, nuclear security interface, and safeguards.

The Design Regulations are still in draft form and are not yet promulgated. **Recommendation R3 in section 1.2. addresses the issue.**

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### 11.2.18 SSG-16 ELEMENT 19 TRANSPORT SAFETY

The Act states that an authorization would be needed for the transport of radioactive material. According to the definition given in Section 93 of the Act, radioactive material includes fresh fuels or spent fuels as they contain radionuclides that may cause radiation exposure. Section 51 of the Act also stipulates that the transport of radioactive material shall comply with the provisions of the Act and regulations.

The Act further provides that if the relevant regulations do not exist, the transport of radioactive or nuclear material should be carried out in accordance with the applicable technical requirements of the regulations for the safe transport of radioactive materials made by the International Atomic Energy Agency.

There are further provisions in the Act addressing transport of materials subject to export/import control (Section 28), re-import of radioactive materials if export cannot be completed in accordance with regulations (Section 50). It also stipulates liabilities for transportation (Section 63). However, these provisions are high level provisions requiring further details in regulations.

A regulation on safe transport of radioactive material, in line with international safety standards, have been drafted by NRA. It addresses general transport regulations, regulatory approvals, prohibitions, management systems, and special transport arrangements. The document also emphasizes radiation protection, material segregation, and public information and sets activity limits, material classifications, and compliance calculations. Some further provisions on transport of radioactive waste were included in the draft regulation for the management of radioactive waste. Also, there are some provisions regarding the transport of radioactive waste in the draft Regulation on Radioactive Waste Management.

The IRRS team was informed that NRA actively participates in regional and international workshops on safe transport of radioactive materials and carries out national responsibilities under the relevant international conventions.

### 11.2.19 SSG-16 ELEMENT 20 INTERFACES WITH NUCLEAR SECURITY

The interface between Nuclear Safety and Nuclear Security is described in section 10 of this report.

NPG has also developed its Safety Culture Policy document which serves as a guide to promote nuclear safety and security culture within the organization.

Safety and security culture issues are also addressed in the drafts of the Regulation on Operation of Nuclear Installations and the Regulation on Integrated Management Systems.

The Programme Comprehensive Report (PCR) details the governmental approach to nuclear security, recognizing the importance of early engagement in the nuclear power project to ensure synergy and integration when the project takes concrete steps. In line with this approach, the NRA drafted the Nuclear Security Regulations addressing also the safety considerations.

In addition, various draft regulations on the safety of nuclear facilities, such as the Regulation on Construction and Regulation on Design have provisions to ensure the security of the facility and activities at relevant stages.

## APPENDIX I – RECOMMENDATIONS (R), SUGGESTIONS (S) AND GOOD PRACTICES (GP)

| AREA | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|---|---|---|
| 1. RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMENT | R1 | **Recommendation: The Government should issue the comprehensive national safety policy and strategy for all facilities and activities, which is consistent with IAEA Safety Standards.** |
| | R2 | **Recommendation: The Government should ensure that all the elements for safety are established through the Act including the application of the graded approach, assignment of prime responsibility for protection and safety and stipulation that compliance with regulations does not relieve the authorized party from its prime responsibility for safety.** |
| | R3 | **Recommendation: The Government should expedite the promulgation of the regulations.** |
| | R4 | **Recommendation: The Government should ensure that the NRA is effectively independent, so that regulatory judgements and decisions follow a process free from any undue influence that might compromise safety.** |

| AREA | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|---|---|---|
| | R5 | **Recommendation: The Government should support the NRA to ensure that there is effective coordination between NRA and all relevant authorities that have responsibilities for safety and security.** |
| | R6 | **Recommendation: The Government should establish, issue and implement a comprehensive national policy and strategy on radioactive waste and spent nuclear fuel management.** |
| **2. THE GLOBAL SAFETY REGIME** | S1 | **Suggestion: The Government should consider expressing its political commitment to the Supplementary Guidance on the Import and Export of Radioactive Sources and Supplementary Guidance on the Management of Disused Radioactive Sources.** |
| **3. RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY** | S2 | **Suggestion: NRA should consider including in its human resources plan provisions to ensure new staff members that may be recruited directly from authorized parties remain effectively independent when carrying out their regulatory duties.** |
| | S3 | **Suggestion: NRA should consider expanding its strategy for succession of qualified staff to all levels, in order to allow it to timely replace staff that may decide to leave.** |

| AREA | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|---|---|---|
| | **S4** | **Suggestion: NRA should consider formalizing provisions to ensure that consultation of advisory bodies and technical support organizations does not relieve it of its assigned responsibilities.** |
| | **S5** | **Suggestion: NRA should consider ensuring efficient retrievability of safety related records.** |
| | **S6** | **Suggestion: NRA should consider establishing formal arrangements for consultation and communication with the public regarding regulatory judgements and decisions, following a graded approach.** |
| | **R7** | **Recommendation: NRA should expedite the review of the NNRERP and submit it for approval.** |
| | **R8** | **Recommendation: NRA should develop an emergency plan and procedures for the functions assigned to NRA in preparedness and response to nuclear or radiological emergencies.** |
| **4. MANAGEMENT SYSTEM OF THE REGULATORY BODY** | **R9** | **Recommendation: NRA should expedite the development and approval of the management system in a graded approach, prioritizing the completion of elements covering current activities.** |
| **5. AUTHORIZATION** | **R10** | **Recommendation: NRA should apply graded approach in the authorization of nuclear installations.** |

| AREA | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|---|---|---|
| | R11 | Recommendation: NRA should document application of consistent graded approach in the authorization of radiation sources facilities and activities. |
| | R12 | Recommendation: NRA should ensure that dose constraints for occupational and public exposure are used in the optimization of protection and safety. |
| | R13 | Recommendation: NRA should ensure that the decommissioning plan is submitted and reviewed prior to the renewal of the licence. |
| | S7 | Suggestion: NRA should consider establishing a regulatory requirement for a safety committee for research reactors. |
| | R14 | Recommendation: The Government should make provisions for the availability of internal dosimetry, neutron monitoring as well as calibration of neutron and radon measuring instruments. |
| | R15 | Recommendation: NRA should ensure during the authorization process that the practitioner is specialized in the appropriate area to assume his or her responsibilities with regard to medical exposure. |

| AREA | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|---|---|---|
| 6. REVIEW AND ASSESSMENT | R16 | Recommendation: NRA should develop procedures and criteria for review and assessment of the safety assessment for all radiation sources facilities and activities, and safety case for borehole disposal radioactive waste facility. |
| | R17 | Recommendation: The Government should ensure that information on radon concentration in dwellings and other buildings with high occupancy is gathered and relevant information on exposure due to radon and the associated health risks is provided to the public. |
| | R18 | Recommendation: NRA should establish specific reference levels for exposure due to radionuclides in commodities. |
| 7. INSPECTION | S8 | Suggestion: NRA should consider expanding the inspection procedure to cover all facilities and activities according to the graded approach. |
| | S9 | Suggestion: NRA should consider verifying that the transport organization's management system is implemented. |
| | S10 | Suggestion: NRA should consider further developing the inspection procedure to verify that individual justification of medical exposure was performed. |

| AREA | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|---|---|---|
| | **R19** | **Recommendation: NRA should establish a programme to evaluate emergency exercises conducted by the operating organisations.** |
| **8. ENFORCEMENT** | **R20** | **Recommendation: NRA should establish and implement an enforcement policy and process, including criteria for corrective actions.** |
| **9. REGULATIONS AND GUIDES** | **R21** | **Recommendation: NRA should identify and issue relevant guides for authorized parties to comply with the regulatory requirements.** |
| | **R22** | **Recommendation: NRA should issue guidance documents on format and contents for submission of safety case including safety assessment for all facilities and activities.** |
| | **R23** | **Recommendation: NRA should include requirements in the regulation for the evaluation of the safety of associated experimental facilities as an integral part of research reactors.** |
| | **S11** | **Suggestion: NRA should consider establishing transport safety guidance for carriers, consignors and consignees.** |

| AREA | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|---|---|---|
| | **R24** | **Recommendation: NRA in cooperation with other relevant authorities, agencies or professional bodies should ensure that appropriate occupational health surveillance programmes are established.** |
| | **R25** | **Recommendation: NRA should verify compliance by the authorized parties with the health surveillance programmes.** |
| | **R26** | **Recommendation: The Government should ensure that diagnostic reference levels, dose constraints, and criteria and guidelines for the release of patients are established, in consultation between the health authority, relevant professional bodies and the regulatory body.** |
| **10. INTERFACE WITH NUCLEAR SECURITY** | **R27** | **Recommendation: NRA should document how the interface between safety and security should be managed within NRA.** |
| | **R28** | **Recommendation: NRA should issue requirements for management of the interface between safety and security by the authorized party.** |
| | **R29** | **Recommendation: NRA should verify the practical implementation of the safety and security interface by the authorized party.** |

| AREA | R: Recommendations S: Suggestions G: Good Practices | Recommendations, Suggestions or Good Practices |
|---|---|---|
| 11. COUNTRIES EMBARKING ON NUCLEAR POWER | S12 | Suggestion: The Government should consider initiating the communication and dialog with the neighbouring countries regarding the planned nuclear power programme in Ghana. |
| | S13 | Suggestion: The Government should consider including provisions in the Act that the necessary financial resources need to be provided by the authorized party for the safe operation of the nuclear installation and the safe management of radioactive waste generated during the operation. |
| | S14 | Suggestion: NRA should consider developing arrangements for overseeing the activities performed by its external support organizations in line with the responsibilities of being an informed customer. |

## APPENDIX II – LIST OF PARTICIPANTS

| INTERNATIONAL EXPERTS: | | |
|---|---|---|
| Thiagan Pather | National Nuclear Regulator (NNR), South Africa | tpather@nnr.co.za |
| Geraldine Pina | Commissaire Autorité de sûreté nucléaire (ASN), France | Geraldine.PINA@asn.fr |
| Paul Brejza | Commission for the Protection from Ionising and Non-Ionising Radiation, Malta | paul.brejza@gov.mt |
| Pedro Rosario | Agência Portuguesa do Ambiente, Portugal | pedro.rosario@apambiente.pt |
| Justice Chipuru | Radiation Protection Authority, Zimbabwe | jchipuru@rpaz.co.zw |
| Richard Elek | National Center for Public Health and Pharmacy, Hungary | elek.richard@nngyk.gov.hu |
| Alan Muller | National Nuclear Regulator (NNR), South Africa | amuller@nnr.co.za |
| Serhat Alten | Turkiye | seralten@gmail.com |
| Wilma Tolud | The Authority for Nuclear Safety and Radiation Protection (ANVS), The Netherlands | wilma.tolud@anvs.nl |
| Agnese Aizpuriete | Radiation Safety Centre, Latvia | agnese.aizpuriete@vvd.gov.lv |
| Mahammad Ayub | Pakistan | smayub123@gmail.com |
| Delwende Nabayaogo | National Radiation Protection and Nuclear Safety Authority, Burkina Faso | n.delwend@outlook.com |
| Houda Idihia | Moroccan Agency for Nuclear and Radiological Safety (AMSSNuR) Morocco | h.idihia@amssnur.org.ma |
| Haraldur Hannesson | Danish Health Authority, Denmark | hah@sis.dk |
| IAEA STAFF | | |
| Teodros Hailu | IAEA/NSRW | t.g.hailu@iaea.org |
| Sonal Gandhi | IAEA/NSNI | S.Gandhi@iaea.org |
| Baan Fischer | IAEA/NSRW | b.fischer@iaea.org \| |
| LIAISON OFFICER | | |
| Kwashie Nii Allotey | Nuclear Regulatory Authority (NRA), Ghana | nii.allotey@nra.gov.gh |
| Emmanuel Ampomah-Amoako | Nuclear Regulatory Authority (NRA), Ghana | emmanuel.amoako@nra.gov.gh |

**GROUP PHOTO**

## APPENDIX III – LIST OF IRRS REVIEWERS AND COUNTERPARTS

| | IRRS EXPERTS | LEAD COUNTERPART | SUPPORT STAFF |
|---|---|---|---|
| 1. | LEGISLATIVE AND GOVERNMENTAL RESPONSIBILITIES | | |
| | Paul Brejza (Malta)<br>Alan Muller (South Africa) | Bright Osafo Darko<br>Prince Kwabena Gyekye | Seth Banu<br>Emmanuel Ampomah-Amoako<br>Nii Kwashie Allotey<br>Emmanuel Pobee<br>Efua Kayang<br>Gordon Asartenga Ajubala<br>Lennox Assan<br>Adriana Asare-Ampene |
| 2. | GLOBAL NUCLEAR SAFETY REGIME | | |
| | Paul Brejza (Malta) | Matthew Asamoah | Rex Gyeabour Abrefah<br>Emmanuel Ampomah-Amoako |
| 3. | RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY | | |
| | Pedro Rosario (Portugal)<br>Alan Muller (South Africa) | Theodora Amarh<br>Prince Kwabena Gyekye, | Linda Sarpong<br>Nii Kwashie Allotey<br>Emmanuel Ampomah-Amoako<br>Emily Nyuur<br>Gordon Asartenga Ajubala<br>Lennox Assan<br>Adriana Asare-Ampene |
| 4. | MANAGEMENT SYSTEM OF THE REGULATORY BODY | | |
| | Justice Chipuru (Zimbabwe) | Selom Dzide | Jonas Mba<br>Samuel Wotorchi-Gordon<br>Andrew Ashong |
| 5. | AUTHORIZATION | | |
| | Wilma Tolud (Netherlands)<br>Mahammad Ayub (Pakistan)<br>Agnese Aizpuriete (Latvia)<br>Delwende Nabayaogo (Burkina Faso) | Prince Kwabena Gyekye<br>Suleman Alhaji Zakaria,<br>Cyrus Cyril Arwui,<br>Emmanuel Akrobortu, | Adriana Asare-Ampene<br>Alexander Efah Opoku<br>Augustiine Faanu<br>Bright Baiden |

| | IRRS EXPERTS | LEAD COUNTERPART | SUPPORT STAFF |
|---|---|---|---|
| | Richard Elek (Hungary)<br>Houda Idiha (Morocco)<br>Haraldur Hannesson (Denmark)<br>Alan Muller (South Africa) | Theophilus Adjirackor,<br>Isaac Owusu,<br>Cynthia Engmann,<br>Henry Lawluvi, | Charles Kansaana<br>Emmanuel Akomaning-Adofo<br>Emmanuel Ampomah-Amoako<br>Felix Opoku Boamah<br>Gordon Asartenga Ajubala<br>Lennox Assan<br>Michael Obeng<br>Rex Gyeabour Abrefah<br>Rita Kwabea Osei<br>Samuel Wotorchi-Gordon |
| 6. | REVIEW AND ASSESSMENT | | |
| | Wilma Tolud (Netherlands)<br>Mahammad Ayub (Pakistan)<br>Agnese Aizpuriete (Latvia)<br>Delwende Nabayaogo (Burkina Faso)<br>Richard Elek (Hungary)<br>Houda Idiha (Morocco)<br>Haraldur Hannesson (Denmark)<br>Alan Muller (South Africa) | Prince Kwabena Gyekye<br>Suleman Alhaji Zakaria,<br>Cyrus Cyril Arwui,<br>Emmanuel Akrobortu,<br>Theophilus Adjirackor,<br>Isaac Owusu,<br>Cynthia Engmann,<br>Henry Lawluvi, | Adriana Asare-Ampene<br>Alexander Efah Opoku<br>Augustiine Faanu<br>Bright Baiden<br>Charles Kansaana<br>Emmanuel Akomaning-Adofo<br>Emmanuel Ampomah-Amoako<br>Felix Opoku Boamah<br>Gordon Asartenga Ajubala<br>Lennox Assan<br>Michael Obeng<br>Rex Gyeabour Abrefah<br>Rita Kwabea Osei<br>Samuel Wotorchi-Gordon |
| 7. | INSPECTION | | |
| | Wilma Tolud (Netherlands)<br>Mahammad Ayub (Pakistan)<br>Agnese Aizpuriete (Latvia)<br>Delwende Nabayaogo (Burkina Faso) | Prince Kwabena Gyekye<br>Suleman Alhaji Zakaria,<br>Cyrus Cyril Arwui,<br>Emmanuel Akrobortu, | Adriana Asare-Ampene<br>Alexander Efah Opoku<br>Augustiine Faanu<br>Bright Baiden |

| | IRRS EXPERTS | LEAD COUNTERPART | SUPPORT STAFF |
|---|---|---|---|
| | Richard Elek (Hungary)<br>Houda Idiha (Morocco)<br>Haraldur Hannesson (Denmark)<br>Alan Muller (South Africa) | Theophilus Adjirackor,<br>Isaac Owusu,<br>Cynthia Engmann,<br>Henry Lawluvi, | Charles Kansaana<br>Emmanuel Akomaning-Adofo<br>Emmanuel Ampomah-Amoako<br>Felix Opoku Boamah<br>Gordon Asartenga Ajubala<br>Lennox Assan<br>Michael Obeng<br>Rex Gyeabour Abrefah<br>Rita Kwabea Osei<br>Samuel Wotorchi-Gordon |
| 8. | ENFORCEMENT | | |
| | Richard Elek (Hungary) | Isaac Owusu | Alexander Efah Opoku,<br>Augustiine Faanu |
| 9. | REGULATIONS AND GUIDES | | |
| | Wilma Tolud (Netherlands)<br>Mahammad Ayub (Pakistan)<br>Agnese Aizpuriete (Latvia)<br>Delwende Nabayaogo (Burkina Faso)<br>Richard Elek (Hungary)<br>Houda Idiha (Morocco)<br>Haraldur Hannesson (Denmark)<br>Alan Muller (South Africa) | Prince Kwabena Gyekye<br>Suleman Alhaji Zakaria,<br>Cyrus Cyril Arwui,<br>Emmanuel Akrobortu,<br>Theophilus Adjirackor,<br>Isaac Owusu<br>Cynthia Engmann<br>Henry Lawluvi | Adriana Asare-Ampene<br>Alexander Efah Opoku<br>Augustiine Faanu<br>Bright Baiden<br>Charles Kansaana<br>Emmanuel Akomaning-Adofo<br>Emmanuel Ampomah-Amoako<br>Felix Opoku Boamah<br>Gordon Asartenga Ajubala<br>Lennox Assan<br>Michael Obeng<br>Rex Gyeabour Abrefah<br>Rita Kwabea Osei<br>Samuel Wotorchi-Gordon |

| | IRRS EXPERTS | LEAD COUNTERPART | SUPPORT STAFF |
|---|---|---|---|
| 10. | INTERFACE WITH NUCLEAR SECURITY | | |
| | Geraldine Pina (France) | Ann Mensah | Michael Annor-Nyarko,<br>Obed Agbenorku,<br>Rex Gyeabour Abrefah,<br>Felix Opoku Boamah |
| 11. | COUNTRIES EMBARKING ON NUCLEAR POWER | | |
| | Serhat Alten (Turkiye) | Prince Amoah | Leslie Enos,<br>Nii Kwashie Allotey,<br>Mumuni Sulley,<br>Sheila Gbormittah,<br>James Kuofie,<br>Andrew Ashong |

## APPENDIX IV – MISSION PROGRAMME

GHANA IRRS MISSION PROGRAMME

| IRRS MISSION PROGRAMME | | |
|---|---|---|
| **Sunday, 24 November 2024** | | |
| **IRRS Initial IRRS Review Team Meeting** | | |
| 13:30 - 17:30 | • *Opening remarks by the IRRS Team Leader*<br>• *Introduction by IAEA*<br>• *Self-introduction of all attendees*<br>• *IRRS Process (IAEA)*<br>• *Report writing (IAEA)*<br>• *Schedule (TL, IAEA, LO)*<br>• *First impression of experts from the Advanced Reference Material (ARM) (All Experts)*<br>• *Administrative arrangements (IRRS Liaison Officer, IAEA): Detailed Mission Programme* | Venue: *Fiesta Royale Hotel*<br><br>Participants: the IRRS Team and Liaison Officer (LO) |
| **Monday, 25 November 2024** | | |
| **IRRS Entrance Meeting** | | |
| 09:00 – 12.00 | 09:00 Arrival, registration,<br>09:30 Introduction of Chairperson<br>09:32 Chairperson's Opening Remarks<br>09:40 Welcome Address<br>10:00 IRRS Team Leader – Expectations for the Mission<br>10:15 Self-introduction of IRRS Team Members and Counterparts.<br>10:30 NRA's Presentation – Regulatory Overview, SARIS results (strength, challenges, action plan)<br>11:15 Group Photo | Venue: *School of Nuclear and Allied Sciences (SNAS) Conference Room*<br><br>Participants: High Level Government Officials, NRA Management and staff, Officials from relevant organizations, and the IRRS Team |
| 12:00 – 13:00 | Lunch | |
| 13:00 – 17:00 | Interviews and discussions with counterparts (parallel discussions – see detailed programme)<br><br>(*detailed programme to follow*) | Venue: NRA Headquarters (HQ)<br><br>Participants: IRRS Team and counterparts |
| 17:00 - 18:00 | Daily IRRS Team meeting | Venue: NRA HQ<br>Participants: IRRS Team and LO. |

| IRRS MISSION PROGRAMME | | |
|---|---|---|
| 18:00- | Report writing | IRRS Team |
| **Tuesday, 26 November 2024** | | |
| **Daily Discussions / Interviews** | | |
| 09:00 – 17:00 | Interviews and discussions with counterparts (parallel discussions) | Venue: NRA HQ<br>Participants: IRRS Team and counterparts |
| 12:00 – 13:00 | Lunch | |
| 17:00 – 18:00 | Daily IRRS Review Team meeting | Venue: *NRA HQ*<br>Participants: IRRS team and LO |
| 18:00- | Report writing | IRRS team |
| **Wednesday, 27 November 2024** | | |
| **Daily Discussions / Interviews** | | |
| 09:00 – 17:00 | Follow-up interviews and discussions with counterparts for all modules | Venue: NRA HQ counterparts offices<br>Participants: IRRS Team and counterparts |
| 08:30 – 13:00 | Site Visits | IRRS Experts and NRA Inspectors (GHARR-1 Research reactor, RWMC-RPI/GAEC Radioactive waste management facility, NDT-NNRI/GAEC Industrial facility using a radioactive source, and UGMC medical facility) |
| 12:00 – 13:00 | Lunch | |
| 13:00 – 17:00 | Follow-up interviews and discussions with counterparts for all modules | Venue: NRA HQ counterparts offices<br>Participants: IRRS Team and counterparts |
| 13:00 – 17:00 | Writing first draft of preliminary findings (Rs, Ss and GPs) | Venue: *NRA HQ*<br>Participants: IRRS Team |
| 17:00 -17:15 | Quick briefing on site visits | Venue: *NRA HQ*<br>Participants: IRRS Team and LO |
| 17:15– 20:00 | Daily IRRS Team meeting<br>(First draft of preliminary findings) | Venue: *NRA HQ*<br>Participants: the IRRS team and LO. |
| 20:00 - | Report Writing | IRRS Team |
| **Thursday, 28 November 2024** | | |
| **Daily Discussions / Interviews** | | |

| IRRS MISSION PROGRAMME | | |
|---|---|---|
| 09:00 – 12:00 | Follow-up Interviews and discussions with counterparts (parallel discussions if needed) | Participants: IRRS Team<br><br>Venue: Counterparts Offices |
| 12:00 -13:00 | Lunch | |
| 16:00 – 23:00 | Daily IRRS Review Team Meeting: observations, recommendation, suggestions, and good practices | Venue: *NRA HQ*<br><br>Participants: the IRRS team and LO. |
| **Friday, 29 November 2024** | | |
| **Daily Discussions / Interviews** | | |
| 09:00 – 10:00 | Discussion of Discussion of Observations (Recommendations, Suggestions and GP) with counterparts | Participants: IRRS Team<br>Venue: Counterparts Offices |
| 10:30 – 13:00 | Finalize Observations, Recommendations, Suggestions and Good Practices<br><br>Team members write draft report (individually). | Participants: IRRS Team |
| 12:00 -13:00 | Lunch | |
| 13:00 – 15:00 | Policy issue discussions | Participants: Reviewers and Counterparts<br>Venue: *NRA HQ* |
| 15:00 – 22:00 | Daily Team Meeting:<br><br>Cross Reading<br><br>IRRS Team finalizes Observations, Recommendations, Suggestions and Good Practices | Participants: IRRS Team and LO<br>Venue: *NRA HQ* |
| **Saturday, 30 November 2024** | | |
| **Daily Discussions/ Interviews (if needed)** | | |
| 08:00 – 22:00 | IRRS Team finalizes the report together | Venue: *Fiesta Royale Hotel*<br>Participants: IRRS Team |
| **Sunday, 1 December 2024** | | |
| | | |
| 8:00 -10:00 | Finalize the draft report and submit to NRA for comments | Venue: *Fiesta Royale Hotel*<br><br>Participants: IRRS Team |
| 10:00 - | IRRS Team rest day | |
| **Monday, 2 December 2024** | | |
| **Daily Discussions** | | |
| 08:00 – 16:00 | NRA review draft report | NRA |
| 16:00 | NRA submits comments to IRRS team | NRA |

| IRRS MISSION PROGRAMME | | |
|---|---|---|
| 16:00 - 18:00 | IRRS Team reviews comments | Participants: IRRS Team<br>Venue: Fiesta Royale Hotel |
| **Tuesday, 3 December 2024** | | |
| **Daily Discussions** | | |
| 09:00 – 11:00 | IRRS Team review NRA comments | Venue: NRA HQ |
| 11:00 – 12:30 | Discuss the draft report with NRA | Participants: IRRS Team and NRA |
| 14:00 – 17:00 | IRRS meeting for finalization of the report based on discussion with Hosts | Venue: NRA HQ<br>IRRS Team |
| 19:00 – 21:00 | Social Event | IRRS Team and NRA |
| **Wednesday, 4 December 2024** | | |
| | | |
| 09:00 – 11:00 | EXIT MEETING<br>Main findings of the IRRS mission (Team Leader) | Venue: *School of Nuclear and Allied Sciences (SNAS) Conference Room*<br>Participants: Government Officials, NRA Management and<br>staff, Officials from relevant organizations, the IRRS Team + the LO + counterparts |
| | Remarks by NRA in response to the mission findings | |
| | Closing Remarks by IAEA Official | |
| | Press Conference (if included) | |
| 11:00 – 12:00 | Meeting of IAEA Director(NSRW) with Chief Directors of MESTI and MoE | NRA New Building Conference Room |
| 12:00 – 13:00 | Lunch | |
| 13:00 – 15:00 | General Meeting with IAEA IRRS Team | NRA New Building Conference Room |

**APPENDIX V – SITE VISITS**

# Site Visit Programme

# 27 November 2024

## *UGMC Medical Facility, Accra*

| **Time** | **Place** | **IRRS Participants** | **NRA Participants** | Remarks |
|---|---|---|---|---|
| 08:30 | Pick up from Hotel | Richard Elek | Dr Cynthia Engmann | |
| 09:00 | Travel to the medical facility | Houda Idiha | Mr Samuel Wotorchi-Gordon | |
| 09:30 – 11:30 | Inspection at the medical facility | | Dr Prince Gyekye | |
| 11:30 – 11:45 | Discussion IRRS Team with Facility | | | |
| 11:45 – 12:15 | Travel back to NRA | | | |

## *GHARR -1 Research Reactor, Accra*

| **Time** | **Place** | **IRRS Participants** | **NRA Participants** | Remarks |
|---|---|---|---|---|
| 09:00 | Travel to GAEC | Wilma Tolud | Prof. Rex Gyeabour Abrefah | |
| 09:30 – 12:00 | Inspection of GHARR-1 | | Mr. Gordon Asartenga Ajubala | |
| 12:00 – 12:30 | Discussion of IRRS Team with Facility | | Mr. Bright Kweku Ansah Baiden | |
| 12:30-12:45 | Travel back to NRA | | Mr. Suleman Alhaji Zakaria | |
| | | | Dr. Linda Sarpong | |
| | | | Mr. Kwabena Amofa | |
| | | | Ms. Priscilla Abba | |

| | | | | |
|---|---|---|---|---|
| | | | Prof. Emmanuel Ampomah-Amoako | |

## *NDT/GAEC Industrial Facility, Accra*

| **Time** | **Place** | **IRRS Participants** | **NRA Participants** | Remarks |
|---|---|---|---|---|
| 09:00 | Travel to GAEC | Agnese Aizpuriete | Mr Michael Obeng | |
| 09:30 – 11:30 | Inspection of NDT | | Dr Theophilus Adjirackor | |
| 11:30 – 11:45 | Discussion of IRRS Team with Facility | | Mr Alex Opoku Efa | |
| 11:45-12:00 | Travel back to NRA | | | |

## *RWMC-RPI/Radioactive Waste Management Facility, Accra*

| **Time** | **Place** | **IRRS Participants** | **NRA Participants** | Remarks |
|---|---|---|---|---|
| 09:00 | Travel to GAEC | Mahammad Ayub | Dr. Henry Lawluvi | |
| 09:30 – 11:30 | Inspection of RWMC | Haraldur Hannesson | Dr. Charles Kansaana | |
| 11:30 – 11:45 | Discussion of IRRS Team with Facility | | Dr. Cyrus Arwui | |
| 11:45-12:00 | Travel back to NRA | | | |

## APPENDIX VI – GHANA'S REFERENCE MATERIAL USED FOR THE REVIEW

001_National_Policy_Nuclear_Radiation_Safety
002_Nuclear_Regulatory_Authority_ Act_2015_Act_895
003_GAEC_Act
004_Draft_NRA_Training_Programme_2017
005_NRA_EPA_MOU
006_NRA_GCAA_MOU
007_Final_Report_Search_Secure_2016
008_Basic_Ionising_Radiation Control Regulations
009_Decommissioning_Regulations
010_Radioactive_Waste_Management_Regulations
011_Radioactive_Waste_Management_Policy
012_NPP_Programme_Comprehensive_Report
013_SNAS_Atomic_Programmes
014_Licensing_Regulations
015_Technical_Support_Services
016_MS_Comments_DS486
017_INIR_Report_2017
018_INIR_Report_2019
019_Odoi_etal_RERTR
020_NID_Annual_Report_2021
021_NID_Annual_Report_2022
022_IAEA_Membership_Ghana
023_RCF_Membership_Ghana
024_FNRBA_Member
025_AFRA_Member
026_Ghana_CNS_Report_2022
027_Ghana_Joint_Convention_Report_2017
028_Ghana_Joint_Convention_Report_2020
029_Ghana_CNS_Report_2017
030_USRNC_NRA_MOU
031_CNSC_NRA_MOU
032_NRA_Official_Website_https://nra.gov.gh/about.php
033_Draft_Scheme_Service_April_2024
034_NRA_Corporate_Strategic_Plan
035_NRA_Code_Conduct_Employees
036_Public_Service_Commission_1994_Act_482
037_NRA_NPG_Information_Framework_Agreement
038_NRA_Enforcement_Policy
039_PSC_HR_Policy_Manual
040_Recruit_61_Staff_NRA_Request
041_Staff_Establishment_2030
042_IMS_Knowledge_Management_Process

043_NRA_Communication_Strategy
044_NRA_GAEC_MOU_Operations
045_Geosystems_Consulting_Authorisation
046_Sample_Authorisation_Conditions
047_NRA_Safety_Policy_Statement
048_IMS_NRA_Management_System_Manual
049_IMS_Document_Records_Control_Process
050_Cyclotron_Training_Report
051_Operation_Regulations
051_GHARR_1_Inspection_Report
053_Site_Evaluation_Regulations
054_NRA_Stakeholder_Strategy
055_NRA_NPG_Site_Visit_Report
056_Minutes_NRA_NPG_Site_Visit
057_Emergency_Preparedness_Response_Regulations
058_Safety_Security_Culture_Programme
059_IMS_Assessment_Leadership_Safety_Procedure
060_IMS_Performance_Management_Process
061_NRA_Regulatory_Strategy
062_NRA_Regulatory_Strategy_Action_Plan
063_Risk_Management_Policy_Procedures_Manual
064_IMS_Communication_Consultation_Process
065_NRA_Governance_Manual
066_IMS_Directing_Managing_Organisation_Process
067_Inspection_Procedures_Radiological
068_IMS_Document_Control_Procedure
069_IMS_Records_Control_Procedure
070_Ghana_Public_Records_Archives_1997_Act_535
071_IMS_Human_Resource_Management_Process
072_TSO_Assessment_Committee
073_IMS_Gap_Analysis
074_IMS_GSR_Part_2_Assessment
075_IMS_Process_Management_Process
076_Public_Procurement_2003_Act_663
077_IMS_Procurement_Stores_Process
078_IMS_Internal_Audit_Report
079_IMS_Management_Review_Procedure
080_Safety_Security_Culture_Committee_Letter
081_Authorisation_Guidelines_Diagnostic_Radiology
082_Authorisation_Guidelines_Industrial_Radiation
083_Authorisation_Guidelines_Nuclear_Medicine
084_Authorisation_Guidlelines_Radiotherapy
085_Transport_Safety_Regulations
086_Deterministic_Safety_Guidelines

087_TOC_Site_Approval_Report_Guidelines
088_SSC_Safety_Classification_Guidelines
089_SAR_Installations_Guidelines
090_IMS_Notification_Authorisation_Process
091_IMS_Review_Assessment_Process
092_IMS_Review_Assessment_Radiological_Procedure
093_IMS_Review_Assessment_Nuclear_Installations_Procedure
094_GHARR_1_Core_Conversion_Review_Report
095_Abrefah_etal_Core_Conversion
096_IMS_Planning_Process
097_IMS_Inspection_Process
098_Inspection_Procedures_Nuclear_Installations
099_Integrated_Management_Systems_Regulations
100_IMS_Enforcement_Process
101_Design_Regulations
102_Commissioning_Regulations
103_Construction_Regulations
104_IMS_Regulations_Guidelines_Process
105_Emergency_Response_Plan_EPC_I_II_Guidelines
106_Emergency_Response_Plan_EPC_III_IV_Guidelines
107_Emergency_Response_Plan_Diagnostic_Radiology_Guidelines
108_Inspection_Protocol_Diagnostic_Facilities
109_Emergency_Response_Plan_Review_Assessment
110_Emergency_Preparedness_Response_Process
111_Draft_NNRERP_Ghana_2023
112_Ghana_NNRERP_2010
113_NDMP
114_NADMO_2016_Act_927
115_NERPNRA
116_SAR_Chapter_11_Experimental
117_Medical_Inspection_CheckList
118_Faanu_etal_2011_Tarkwa
119_Faanu_etal_2013_Chirano
120_Faanu_etal_2024_General_Landscape
121_Radon_Monitoring_Newmont
122_RMWF_PIL_April_2024
123_Safeguards_Regulations
124_Nuclear_Security_Regulation
125_Final_African_Transport_Inspection_Guide
126_Radiation_Protection_Programme_Classic_Amodel
127_Emergency_Response_Plan_Classic_Amodel
128_Holy_Family_Hospital_Authorisation
129_IAEA_Programme_Support_GNPPO_Formation
130_NPG_Integrated_Management_System_Manual

131_NPG_Management_Change_Manual
132_NPG_Occupational_Health_Safety_Policy
133_NPG_Safety_Culture_Policy
134_NPG_Safety_Policy
135_GNPPO_Nuclear_Energy_Policy
136_National_Energy_Policy_2021
137_US_Ghana_Clean_Energy_Hub_Cooperation
138_Ghana_Presidential_Declaration_Nuclear_Power
139_Financial_Clearance_Officers_2021
140_NRA_Interested_Parties_2023
141_2023_NRA_Press_Conference_Report
142_W4NSEC_Final_Report
143_GNPPO_Stakeholder_Strategy
144_GNPPO_NPI_RPI_Editors_Report
145_GNPPO_Oct2016_Newsletter
146_2024_National_Budget_Statement
147_2010_IAEA_Eduta_Mission_Report
148_TOSCA_National_Workshop_Report
149_GNPPO_Feb2019_Newsletter
150_Workshop_QAQC_Management_Systems
151_Ghana_Safety_Culture_Conference
152_Local_Industry_Appraisal_Report
153_Workshop_Report_Local_Industry_Involvement
154_Selecting_Appointing_Staff_Regulatory_Body
155_GNPPO_Human_Resource_Plan
156_Ampomah_etal_2009
157_Ampomah_etal_2011
158_Ampomah_etal_2012
159_Emails_NRA_USNRC_CAMP
160_Resource_Requirements_Nuclear_Programme
161_ToR_EPR_Fellowship_Scientific_Visit
162_Establishment_NPG_MoE_Directive
163_GNPPO_Siting_Criteria
164_NRA_Act_Amendment_IRPA_Comments
165_Ghana_ALEP_Agenda_September_2024
166_IMS_Authorisation_Nuclear_Installations_Procedure
167_GNPPO_Air_Noise_Monitoring_Report

## APPENDIX VII – IAEA REFERENCE MATERIAL USED FOR THE REVIEW

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| 1. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Fundamental Safety Principles, No SF-1, IAEA, Vienna (2006) |
| 2. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Governmental, Legal and Regulatory Framework for Safety, General Safety Requirements Part 1, No GSR Part 1 (Rev. 1), IAEA, Vienna (2016) |
| 3. **INTERNATIONAL ATOMIC ENERGY AGENCY –** Leadership and Management for Safety, General Safety Requirements Part 2, No GSR Part 2, IAEA, Vienna (2016) |
| 4. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements Part 3, No GSR Part 3, IAEA, Vienna (2014). |
| 5. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Safety assessment for facilities and activities, General Safety Requirements Part 4, No GSR Part 4 (Rev. 1), IAEA, Vienna (2016) |
| 6. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Predisposal Management of Radioactive Waste, General Safety Requirements Part 5, No GSR Part 5, IAEA, Vienna (2009) |
| 7. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Decommissioning of Facilities, General Safety Requirements No GSR Part 6, IAEA, Vienna (2014) |
| 8. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Preparedness and Response for Nuclear or Radiological Emergency, General Safety Requirements No GSR Part 7, IAEA, Vienna (2015) |
| 9. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Safety of Nuclear Power Plants: Design, Specific Safety Requirements No SSR-2/1 (Rev. 1), IAEA, Vienna (2016) |
| 10. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Safety of Research Reactors, Specific Safety Requirements No SSR-3, IAEA, Vienna (2016) |
| 11. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Regulations for the Safe Transport of Radioactive Material, 2018 Edition, Specific Safety Requirements No SSR-6 (Rev. 1), IAEA, Vienna (2018) |
| 12. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Communication and Consultation with Interested Parties by the Regulatory Body, General Safety Guide No GSG-6, IAEA, Vienna (2017) |
| 13. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Occupational Radiation Protection, Safety Guide No GSG-7, IAEA, Vienna (2018) |
| 14. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Regulatory Control of Radioactive Discharges to the Environment, Safety Guide No GSG-9, IAEA, Vienna (2018) |
| 15. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Organization, Management and Staffing of the Regulatory Body for Safety, General Safety Guide No GSG-12, IAEA, Vienna (2018) |
| 16. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Functions and Processes of the Regulatory Body for Safety, General Safety Guide No GSG-13, IAEA, Vienna (2018) |
| 17. **INTERNATIONAL ATOMIC ENERGY AGENCY** Leadership, Management and Culture for Safety in Radioactive Waste Management, Safety Guide No GSG-16, IAEA, Vienna (2022) |
| 18. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Arrangements for Preparedness for a Nuclear or Radiological Emergency, Safety Guide No GS-G-2.1, IAEA, Vienna (2007) |
| 19. **INTERNATIONAL ATOMIC ENERGY AGENCY -** Environmental and Source Monitoring for Purposes of Radiation Protection, Safety Guide No RS-G-1.8, IAEA, Vienna (2005) |
| 20. **INTERNATIONAL ATOMIC ENERGY AGENCY** - Borehole Disposal Facilities for Radioactive Waste, Safety Guide No SSG-1 (Rev. 1), IAEA, Vienna (2024) |

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| **21. INTERNATIONAL ATOMIC ENERGY AGENCY** - Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material Specific Safety Guide (2018 Edition) No SSG-26 (Rev.1), IAEA, Vienna (2022) |
| **22. INTERNATIONAL ATOMIC ENERGY AGENCY** - Management of Waste from the Use of Radioactive Material in Medicine, Industry, Agriculture, Research and Education, Safety Guide No SSG-45, IAEA, Vienna (2019) |
| **23. INTERNATIONAL ATOMIC ENERGY AGENCY** - Radiation Protection and Safety in Medical Uses of Ionizing Radiation, Safety Guide No SSG-46, IAEA, Vienna (2018) |
| **24. INTERNATIONAL ATOMIC ENERGY AGENCY** –Decommissioning of Medical, Industrial and Research Facilities, Safety Guide No SSG-49, IAEA, Vienna (2019) |
| **25. INTERNATIONAL ATOMIC ENERGY AGENCY** – Operating Experience Feedback for Nuclear Installations, Safety Guide No SSG-50, IAEA, Vienna (2018) |
| **26. INTERNATIONAL ATOMIC ENERGY AGENCY** - Preparedness and Response for a Nuclear or Radiological Emergency Involving the Transport of Radioactive Material, Safety Guide No SSG-65, IAEA, Vienna (2022) |
| **27. INTERNATIONAL ATOMIC ENERGY AGENCY** - Radiation Protection Programmes for the Transport of Radioactive Material, Safety Guide No TS-G-1.3, IAEA, Vienna, (2007) |
| **28. INTERNATIONAL ATOMIC ENERGY AGENCY** - The Management System for the Safe Transport of Radioactive Material Safety Guide No TS-G-1.4, IAEA, Vienna (2008) |
| **29. INTERNATIONAL ATOMIC ENERGY AGENCY** - Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material (2018 Edition), Specific Safety Guide No SSG-33 (Rev.1) IAEA, Vienna (2021) |
| **30. INTERNATIONAL ATOMIC ENERGY AGENCY** - Storage of Radioactive Waste, Safety Guide No WS-G-6.1, IAEA, Vienna (2006) |
| **31. INTERNATIONAL ATOMIC ENERGY AGENCY** - Safety Assessment for the Decommissioning of Facilities Using Radioactive Material, Safety Guide No. WS-G-5.2, IAEA, Vienna (2009) |
| **32. INTERNATIONAL ATOMIC ENERGY AGENCY** - Storage of Radioactive Waste, Safety Guide No WS-G-6.1, IAEA, Vienna (2006) |

## APPENDIX VIII – ORGANIZATIONAL CHART OF NRA