IAEA
International Atomic Energy Agency

MISSION REPORT

ON

THE INTEGRATED NUCLEAR INFRASTRUCTURE REVIEW (INIR) - PHASE 1

Counterpart: Ghana Nuclear Power Programme Organisation (GNPPO)

16–23 January 2017

Accra, Ghana

CONTENTS

EXECUTIVE SUMMARY

The lack of consistent electricity supply severely hampers Ghana's economic development. With a population of 27 million, Ghana's total installed generating capacity is 3,900 MWe (1,580 MWe hydropower, 2,297.5 MWe thermal power, 22.5 MWe solar power). Ghana's grid is interconnected with the neighbouring countries Cote d'Ivoire, Benin and Togo. In September 2012, the Government established the Ghana Nuclear Power Programme Organisation (GNPPO) to coordinate the governmental activities in introducing nuclear power into the country's energy mix.

In 2015, Ghana enacted the Nuclear Regulatory Authority (NRA) Act (Act 895) to establish an autonomous regulatory authority and to address nuclear safety, nuclear security, safeguards and civil liability for nuclear damage. The NRA has been established and is currently developing new regulations, as well as reviewing existing regulations.

The GNPPO has carried out a number of studies, including a self-evaluation of Ghana's infrastructure for nuclear power based on the International Atomic Energy Agency (IAEA) methodology. The self-evaluation report was updated by the GNPPO and sent to the IAEA in December 2016, along with 168 supporting documents.

The Phase 1 INIR Mission was conducted from 16–23 January 2017.

Professor Benjamin Nyarko, Director General of the Ghana Atomic Energy Commission (GAEC) and Acting Chairman of the GNPPO, and Mr Dohee Hahn, Director of the IAEA Division of Nuclear Power in the Department of Nuclear Energy, provided opening remarks for the INIR mission. Dr Nii Moi Thompson, Director-General of the National Development Planning Commission provided a keynote address. On the Ghanaian side, the mission was coordinated by Dr Nii Kwashie Allotey, Director of the Nuclear Power Institute. The INIR mission team was led by Mr Anthony Stott of the IAEA Nuclear Infrastructure Development Section, and consisted of staff from the IAEA Departments of Nuclear Energy and Safeguards and the Office of Legal Affairs as well as international experts recruited by the IAEA.

The INIR mission and associated activities were funded through a combination of a cost-sharing contribution from the Government of Ghana, the IAEA Technical Cooperation project GHA2003 "Establishing Nuclear Power Infrastructure for Electricity Generation, Phase III" and an extrabudgetary contribution from the United States through a Peaceful Uses Initiative (PUI) Project entitled "Strengthening Nuclear Power Infrastructure Development in Member States".

The INIR team concluded that Ghana has made considerable progress in the development of its nuclear power infrastructure. It has established effective mechanisms to involve a wide and comprehensive range of national stakeholders in the relevant activities. Ghana has already completed or initiated a significant number of studies, but some studies on key issues remain to be completed in order for the government to be able to make a knowledgeable commitment to a nuclear power programme.

In order to assist Ghana in making further progress in its infrastructure development, the INIR team made 12 recommendations and 8 suggestions, several related to the planning for Phase 2 activities. The INIR team also identified 3 good practices that may benefit other countries considering the introduction of nuclear power.

Based on the recommendations and suggestions, the key areas for further action are summarized below:

Ghana needs to complete all the studies needed for the government to be able to make a knowledgeable commitment to a nuclear power programme.

Ghana has already completed or initiated a significant number of studies, and it now needs to finalize them. These include the update of Ghana's national energy planning projections, which, in addition to supporting the rationale for introducing nuclear power, will also support the necessary analysis of the feasibility of incorporating a nuclear power plant (NPP) into the national and/or West African electrical grid. Ghana has developed a siting process with input from various stakeholders. It has identified candidate areas and should proceed with the identification of candidate sites.

Ghana should ensure that appropriate resources are available to complete all remaining activities.

Ghana needs to further assess its legal framework to ensure its adequacy for nuclear power.

Ghana has enacted a comprehensive nuclear law and has started to assess other laws that may have an impact on the nuclear power programme. In preparation for Phase 2, Ghana is encouraged to continue assessing the adequacy of its national legal framework.

Ghana should also finalize the review of its existing environmental protection framework.

Ghana needs to prepare itself for early Phase 2 activities including discussions with vendors and other potential partners.

Ghana should analyse and develop a broader range of options for financing, nuclear fuel cycle and industrial involvement in order to be well informed during discussions with vendors and other potential partners. In the context of these options, Ghana should further elaborate its national human resource strategy for the nuclear power programme.

Ghana should also develop a structured stakeholder engagement plan while continuing to implement its short term activities.

1. INTRODUCTION

In a letter dated 3 December 2015, the Ghana Atomic Energy Commission (GAEC) writing on behalf of the Government of Ghana and the Ghana Nuclear Power Programme Organisation (GNPPO) requested the International Atomic Energy Agency (IAEA) to carry out a Phase 1 Integrated Nuclear Infrastructure Review Mission (INIR) in Ghana. The GNPPO coordinated the preparation of a self-evaluation report based on the IAEA methodology contained in the IAEA Nuclear Energy Series technical report *Evaluation of the Status of National Nuclear Infrastructure Development* (NG-T-3.2 (Rev. 1)). The self-evaluation report and supporting documents were sent to the IAEA in April 2016. A Self-

Evaluation Report Support Mission and a Pre-INIR Mission were conducted in Ghana from 8–10 August, and a revised self-evaluation report and 168 supporting documents were submitted to the IAEA in December 2016. The Phase 1 INIR Mission was conducted from 16–23 January 2017.

Professor Benjamin Nyarko, Director General of GAEC and Acting Chairman of the GNPPO, and Mr Dohee Hahn, Director of the IAEA Division of Nuclear Power in the Department of Nuclear Energy, provided opening remarks for the INIR mission. Dr Nii Moi Thompson, Director-General of the National Development Planning Commission provided a keynote address. On the Ghanaian side, the mission was coordinated by Dr Nii Kwashie Allotey, Director of the Nuclear Power Institute. The INIR mission team was led by Mr Anthony Stott of the IAEA Nuclear Infrastructure Development Section, and consisted of staff from the IAEA Departments of Nuclear Energy and Safeguards and the Office of Legal Affairs as well as international experts recruited by the IAEA.

The INIR mission and associated activities were funded through a combination of a cost-sharing contribution from the Government of Ghana, the IAEA Technical Cooperation project GHA2003 "Establishing Nuclear Power Infrastructure for Electricity Generation, Phase III" and an extrabudgetary contribution from the United States through a Peaceful Uses Initiative (PUI) Project entitled "Strengthening Nuclear Power Infrastructure Development in Member States".

2. OBJECTIVES OF THE MISSION

The main objectives of the INIR mission were to:

- Evaluate the development status of the national infrastructure to support the nuclear power programme according to the NE Series guide *Milestones in the Development of a National Infrastructure for Nuclear Power* (NG-G-3.1 (Rev. 1)) and the evaluation conditions described in NE Series technical report *Evaluation of the Status of National Infrastructure Development* (NG-T-3.2 (Rev. 1)).

- Identify the areas needing further actions to reach Milestone 1: Ready to make a knowledgeable commitment to a nuclear power programme;

- Provide recommendations and suggestions which can be used by the Government of Ghana and national institutions to prepare an action plan.

3. SCOPE OF THE MISSION

The INIR mission evaluated the status of the infrastructure in Ghana covering all of the 19 infrastructure issues relative to the conditions identified in the above publications for Phase 1.

4. WORK DONE

Prior to the mission, the INIR team reviewed the self-evaluation report and supporting documentation that included relevant national laws, regulations, studies and reports. The INIR team sought input from IAEA staff members with relevant expertise working with Ghana. INIR team meetings were conducted prior to the mission in Vienna on 12–13 January 2017 and in Accra on 15 January 2017.

The INIR mission was conducted from 16–23 January 2017. The meetings were held at the Mensvic Grand Hotel in Accra. The main interviews were conducted over four days. Ghana was very well prepared for the mission and managed its participation in the review effectively. During the interviews, the Ghanaian counterparts provided an update on the current status of issues where progress had been made since the self-evaluation report was finalized, and provided additional supporting documentation requested by the INIR team.

The preliminary draft report was prepared by the INIR team and discussed with the counterparts. The main mission results were presented to representatives of the Government in an exit meeting on 23 January 2017. The preliminary draft report was delivered to the counterparts during the exit meeting.

The results of the mission are summarized in Section 5 and presented in tabular form in Section 6 for each of the 19 infrastructure issues in Phase 1. Attachment 1 provides the evaluation results for each issue.

5. MAIN CONCLUSIONS

The INIR mission was conducted in a cooperative and open atmosphere. The mission was coordinated on the Ghanaian side by the GNPPO with participation from 35 organizations involved in the nuclear power programme and corresponding infrastructure development. The full list of participants can be found in Attachment 2.

The INIR team concluded that Ghana has made considerable progress in the development of its nuclear power infrastructure. It has established effective mechanisms to involve a wide and comprehensive range of national stakeholders in the relevant activities. Ghana has already completed or initiated a significant number of studies, but some studies on key issues remain to be completed in order for the government to be able to make a knowledgeable commitment to a nuclear power programme.

In order to assist Ghana in making further progress in its infrastructure development, the INIR team made 12 recommendations and 8 suggestions, several related to the planning for Phase 2 activities. The INIR team also identified 3 good practices that may benefit other countries considering the introduction of nuclear power.

Based on the recommendations and suggestions, the key areas for further action are summarized below:

Ghana needs to complete all the studies needed for the government to be able to make a knowledgeable commitment to a nuclear power programme.

Ghana has already completed or initiated a significant number of studies, and it now needs to finalize them. These include the update of Ghana's national energy planning projections, which, in addition to supporting the rationale for introducing nuclear power, will also support the necessary analysis of the feasibility of incorporating a NPP into the national and/or West African electrical grid. Ghana has developed a siting process with input from various stakeholders. It has identified candidate areas and should proceed with the identification of candidate sites.

Ghana should ensure that appropriate resources are available to complete all remaining activities.

Ghana needs to further assess its legal framework to ensure its adequacy for nuclear power.

Ghana has enacted a comprehensive nuclear law and has started to assess other laws that may have an impact on the nuclear power programme. In preparation for Phase 2, Ghana is encouraged to continue assessing the adequacy of its national legal framework.

Ghana should also finalize the review of its existing environmental protection framework.

Ghana needs to prepare itself for early Phase 2 activities including discussions with vendors and other potential partners.

Ghana should analyse and develop a broader range of options for financing, the nuclear fuel cycle and industrial involvement in order to be well informed during discussions with vendors and other potential partners. In the context of these options, Ghana should further elaborate its national human resource strategy for the nuclear power programme.

Ghana should also develop a structured stakeholder engagement plan while continuing to implement its short term activities.

Recommendations

R-1.3.1 Ghana should complete the update of its energy planning studies and ensure they encompass the projected timeframe in the Roadmap for Ghana Nuclear Power Programme.

R-1.3.2 Ghana should complete the outstanding Phase 1 studies and compile the comprehensive report required for the government to make a knowledgeable commitment to a nuclear power programme.

R-4.1.1 The GNPPO should complete the work to estimate the funding required for Ghana's ministries and organizations to develop the national nuclear power infrastructure in Phase 2 and Phase 3.

R-4.2.1 The GNPPO should analyse and develop proposals for NPP financing options, assessing their viability and their implications for Ghana.

R-9.1.1 Ghana should complete its study of the national and West African grid systems, covering all relevant requirements for nuclear power.

R-10.2.1 The GNPPO should complete its Phase 1 work on national human resource development planning and submit a summary document to the GNPPO Board.

R-11.1.1 The GNPPO should develop a plan to implement its Stakeholder Engagement Strategy with a schedule of identified activities, responsibilities and required resources.

R-11.1.2 Ghana should conduct a survey to determine the public's knowledge of and receptiveness to nuclear power.

R-12.1.1 The GNPPO should complete its study to identify NPP candidate sites.

R-13.2.1 The GNPPO should complete the review of Ghana's existing environmental protection framework.

R-16.1.1 The GNPPO should consider a broader range of nuclear fuel cycle options for the first NPP as an input to the development of a national nuclear fuel cycle policy.

R-18.1.1 The GNPPO should develop a policy for national industrial involvement in the nuclear power programme.

Suggestions

S-1.2.1 Ghana is encouraged to ensure that the GNPPO has appropriate financial resources to complete all remaining Phase 1 activities.

S-2.1.1 The GNPPO is encouraged to consider mechanisms to ensure that all GNPPO Board members understand nuclear safety and its implications.

S-4.1.1 The GNPPO is encouraged to identify how adequate funds for radioactive waste and spent fuel management and decommissioning will be assured.

S-4.2.1 The GNPPO is encouraged to continue its work to identify potential investment by industrial consumers in its nuclear power programme.

S-5.2.1 Ghana is encouraged to further assess Act 895 and plan for its amendment as necessary to provide for specific matters that may still need to be addressed.

S-5.3.1 Ghana is encouraged to complete its assessment of the adequacy of other national laws that may affect the nuclear power programme and to prepare a plan for submitting required amendments to the national approval process.

S-14.1.1 Ghana is encouraged to review and clarify as necessary the interfaces between the National Disaster Management Plan (NDMP), the National Nuclear and Radiological Emergency Response Plan (NNRERP) and the National Chemical, Biological, Radiological and Nuclear Emergencies Response Plan (NCBRN-ERP).

S-18.1.1 The GNPPO is encouraged to engage potential NPP suppliers to better understand where Ghanaian industry could participate and to develop awareness of the required quality standards and procedures for qualification of contractors.

Good Practices

GP-1.2.1 The GNPPO has established an effective Technical Body with a strong programme management function and mechanisms to involve a wide and comprehensive range of national stakeholders. This ensures an inclusive process in the studies required for the government to make a knowledgeable commitment to a nuclear power programme.

GP-3.1.1 The GNPPO set up the Nuclear Programme Management Centre at an early stage to develop an understanding of management system requirements, and several processes have been established within the GNPPO, including a process for document management. This knowledge is being used to support the other key organizations in the development of their own management systems.

GP-13.1.1 The GNPPO established several working groups of relevant environmental stakeholders. This structured and collaborative approach ensures that the environmental protection criteria are comprehensive and provides a mechanism for the elaboration of detailed environmental protection requirements.

6. EVALUATION RESULTS FOR PHASE 1

For the purposes of the INIR mission results, the following definitions are used:

Significant* actions needed:

The review observations indicate that important work still needs to be initiated or completed to meet the condition.

Minor* actions needed:

The review observations indicate that some additional work or steps are needed to meet the condition or that plans for the next phase need to be enhanced.

No actions needed:

The available evidence indicates that all the work to meet the condition has been completed.

*The judgment whether the actions are significant or minor is based on the importance of the work to the overall programme and/or the resources needed to complete it. The classification is done through a consensus of the INIR team, and is not based solely upon the judgment of any individual team member.

Recommendations:

Recommendations are proposed when the expectations of the condition have not been met. A recommendation should:

- Emphasize “what” needs to be done, not “how”;
- Be based on the IAEA Milestones Approach / Evaluation Methodology;

- Be succinct, self-explanatory and achievable;
- Be supported by the Review Observation text—a "gap" must be identified; already planned work can still be a recommendation if it is required to reach the milestone.

Suggestions:

Suggestions propose the consideration of new or different approaches to develop infrastructure and enhance performance, or to point out better alternatives to current work. A suggestion:

- Should be clear and self-explanatory;
- Should be supported by the Review Observation text;
- May relate to work already under consideration for the next phase.

Good practices:

A good practice is identified in recognition of an outstanding practice or arrangement, superior to those generally observed elsewhere. It is more than fulfilment of the conditions or expectation, and worthy of the attention of other countries involved in the development of nuclear infrastructure as a model in the drive for excellence.

It should be noted that the results summarized in the following tables neither validate the country actions and programmes, nor certify the quality and completeness of the work done by a country.

1. National position	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
1.1. Long term commitment made and importance of safety, security and non-proliferation recognized			**X**
1.2. Nuclear energy programme implementing organization (NEPIO) established		**X**	
1.3. National strategy defined	**X**		
2. Nuclear safety	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
2.1. Key requirements of nuclear safety understood		**X**	
2.2. Support through international cooperation initiated			**X**
3. Management	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
3.1. Need for appropriate leadership and management systems recognized			**X**
4. Funding and financing	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
4.1. Strategies for funding established	**X**	**X**	
4.2. Potential strategies for financing identified	**X**	**X**	

5. Legal framework	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
5.1. Adherence to all relevant international legal instruments planned			**X**
5.2. Plans in place for development of comprehensive national nuclear law		**X**	
5.3. Plans in place to enact and/or amend other legislation affecting the nuclear power programme		**X**	
6. Safeguards	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
6.1. Terms of international safeguards agreement in place			**X**
6.2. Strengthening of the state system of accounting for and control of nuclear material (SSAC) planned			**X**
6.3. Recommendations from any previous reviews or audits being addressed			**X**
7. Regulatory framework	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
7.1. Development of an adequate regulatory framework planned			**X**
8. Radiation protection	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
8.1. Enhancements to radiation protection programmes planned			**X**

9. Electrical grid	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
9.1. Electrical grid requirements considered	**X**		
10. Human resource development	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
10.1. Necessary knowledge and skills identified, and gaps in current capability assessed			**X**
10.2. Development of human resources planned	**X**		
11. Stakeholder involvement	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
11.1. Open and transparent stakeholder involvement programme initiated	**X**		
12. Site and supporting facilities	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
12.1. General survey of potential sites conducted and candidate sites identified	**X**		
13. Environmental protection	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
13.1. Environmental requirements considered			**X**
13.2. Framework for environment protection reviewed	**X**		

14. Emergency planning	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
14.1. Requirements of, and resources for, developing an emergency response capability recognized		**X**	
14.2. Recommendations from any previous reviews or audits being addressed			**X**
15. Nuclear security	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
15.1. Nuclear security requirements recognized and the actions of all relevant organizations coordinated			**X**
15.2. Recommendations from any previous reviews or audits being addressed			**X**
16. Nuclear fuel cycle	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
16.1. Options for nuclear fuel cycle (front-end and back-end) considered	**X**		
17. Radioactive waste management	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
17.1. The requirements for management of radioactive waste from NPP recognized			**X**
17.2. Options for disposal of all radioactive waste categories understood			**X**

18. Industrial involvement	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
18.1. National policy developed with respect to industrial involvement	**X**	**X**	
19. Procurement	**Phase 1**		
Condition	**Actions Needed**		
	SIGNIFICANT	**MINOR**	**NO**
19.1. Requirements for purchasing NPP services recognized			**X**

ATTACHMENT 1: REVIEW OBSERVATIONS, RECOMMENDATIONS AND SUGGESTIONS FOR PHASE 1

<table>
<tr><td colspan="2">1. National position
Condition 1.1: Long term commitment made and importance of safety, security and non-proliferation recognized</td><td>Phase 1</td></tr>
<tr><td>Summary of the condition to be demonstrated</td><td colspan="2">A clear statement adopted by government of its intent to develop a nuclear power programme and of its commitment to safety, security and non-proliferation, with evidence that their importance is embedded in the ongoing work programme.</td></tr>
<tr><td>Examples of how the condition may be demonstrated</td><td colspan="2">(1) A clearly stated government commitment
(2) Evidence of clear responsibilities for each issue with government coordination of activities</td></tr>
<tr><td colspan="3">Review observations
The Strategic National Energy Plan (SNEP 2006–2020), developed by the Energy Commission (mandated under the Energy Commission Act 541, 1997) and published in July 2006, includes nuclear energy as part of “alternative expansion plans for meeting the (national) electricity supply requirements”. It recommends the undertaking of a “pre-feasibility study for the possibility of including nuclear power in the grid power supply mix in the foreseeable future.”
The Ghanaian Cabinet approved the 2007 report of a Presidential Committee (Adjei-Bekoe Committee) which recommended, inter alia, the establishment of a Presidential Commission to prepare a draft nuclear power policy and undertake feasibility studies, establish a legal framework and regulatory body and accede to international agreements related to non-proliferation, physical protection, nuclear safety and security, as well as the civil liability regime.
The National Energy Policy developed by the Ministry of Energy, and approved by the Ghanaian Cabinet on 16 March 2010 includes a policy objective to “diversify the national energy mix by promoting renewable energy sources, nuclear and coal”.
The Government of Ghana, in a letter dated 23 August 2013 signed by the Minister of Energy and Petroleum, informed the IAEA of “Ghana’s intention to utilize nuclear energy for electricity generation”.
The INIR team was informed that there is consensus among the leading political parties in Ghana regarding the nuclear power programme.
Ghana has already adhered to the international legal instruments related to safety, security and safeguards. The Nuclear Regulatory Act, 2015 (Act 895) contains provisions related, inter alia, to nuclear safety, radiation protection, nuclear security and non-proliferation/safeguards, and identifies the responsibilities of the main stakeholders.</td></tr>
<tr><td rowspan="2">Areas for further action</td><td>Significant</td><td>No</td></tr>
<tr><td>Minor</td><td>No</td></tr>
<tr><td colspan="3"></td></tr>
</table>

RECOMMENDATIONS	
None	
SUGGESTIONS	
None	
GOOD PRACTICES	
None	
1. National position **Condition 1.2: The NEPIO established**	**Phase 1**
Summary of the condition to be demonstrated	The NEPIO: (a) Has clear terms of reference that call for a comprehensive review of all the issues relevant to making a decision to proceed with a nuclear programme; (b) Is recognized by all relevant ministries as having that role; (c) Reports to a senior minister or directly to the head of government; (d) Has appropriate human and financial resources; (e) Involves all relevant stakeholders, including the country's major utilities, the regulatory body for security and radiation safety, other relevant government agencies, legislative representatives and other decision makers.
Examples of how the condition may be demonstrated	(1) The charter establishing the NEPIO and to whom it reports (2) Evidence that the roles and responsibilities of the NEPIO are known by all its members and by other government ministries (3) A document defining objectives and timescales and an adequate scope of investigations (4) A clear description of how the NEPIO operates in terms of funding, planning, reporting, scope of studies and use of consultants (5) Evidence that the NEPIO has adequate skills to address all issues either directly or through commissioning specialist studies (6) Evidence of relevant interactions between the head of NEPIO and appropriate ministries such as those responsible for energy and the environment
Review observations The Ghana Nuclear Power Programme Organisation (GNPPO) was established in September 2012. The INIR team was informed that the Cabinet approval of the report of the 2007 Presidential	

Committee (which recommended the establishment of a Presidential Commission to prepare a draft nuclear power policy and undertake feasibility studies) provides the mandate for the GNPPO.

The activities of the GNPPO are guided by its Concept and Working document, which outlines responsibilities and estimates funding requirements for the implementation of the programme to develop the nuclear power infrastructure.

The GNPPO Board serves as the high-level decision making body and provides direction to and reviews the work of the Technical Body. The GNPPO Board is composed mainly of Directors/CEOs of a broad spectrum of key national stakeholders (government ministries, regulatory bodies, utilities, educational institutions, specialized agencies).

The Technical Body of the GNPPO is composed of the Nuclear Power Institute (NPI) of GAEC, the Nuclear Installations Directorate of the Ghana Nuclear Regulatory Authority and other key national stakeholders (e.g. electricity utility, grid company, energy commission, environmental protection agency, geological and meteorological agencies, technical non-governmental organizations), and has expertise in the relevant science and engineering disciplines.

The NPI has five centres: the Nuclear Programme Management Centre, the Nuclear Safety Assessment Centre, the Localization and Stakeholder Support Centre, the Nuclear Energy Planning Centre, the Public Relations and Information Centre. The Nuclear Installations Directorate of the NRA has three departments for safety, security and safeguards. These centres and departments work in close cooperation with other relevant stakeholders forming multi-organizational working groups to address the infrastructure issues.

The organizational entities that make up the Technical Body are individually funded. The NPI has a budgetary allocation through the Ministry of Environment, Science Technology and Innovation (MESTI) with support from the Ministry of Power through the GNPPO. The Nuclear Installations Directorate has a budgetary allocation through the NRA. Annual budgetary funding of specific government ministries and agencies involved in the nuclear power programme activities is used in support of GNPPO work. The INIR team noted that several important Phase 1 activities are still to be completed, some of which may require the use of external consultants, and appropriate financial resources have not yet been allocated.

The INIR team was informed that the Volta River Authority (VRA) is a member of the GNPPO Board and a member of the Nuclear Power Institute Board. VRA has participated in energy planning studies and is participating in the nuclear infrastructure development programme. In October 2016 VRA agreed in principle to be the future owner/operator of the country's first nuclear power plant. VRA's current expertise and experience is in conventional electricity generation (hydro and thermal) and the planning, procurement, construction and operation of power plants.

Areas for further action	**Significant**	No
	Minor	Funding to complete Phase 1 activities

RECOMMENDATIONS

None

SUGGESTIONS

S-1.2.1 Ghana is encouraged to ensure that the GNPPO has appropriate financial resources to complete all remaining Phase 1 activities.

GOOD PRACTICES	
GP-1.2.1 The GNPPO has established an effective Technical Body with a strong programme management function and mechanisms to involve a wide and comprehensive range of national stakeholders. This ensures an inclusive process in the studies required for the government to make a knowledgeable commitment to a nuclear power programme.	
1. National position **Condition 1.3: National strategy defined**	**Phase 1**
Summary of the condition to be demonstrated	A comprehensive report, defining and justifying the national strategy for nuclear power, including: (a) An analysis of energy demand and energy alternatives; (b) An evaluation of the impacts of nuclear power on the national economy, for example gross domestic product and employment; (c) A preliminary technology assessment to identify technologies that are consistent with the national expectations; (d) Consideration of siting possibilities and grid capacity; (e) Consideration of financing options, ownership options and operator responsibilities; (f) Consideration of long term costs and obligations relating to spent fuel, radioactive waste and decommissioning; (g) Consideration of the human resource needs and external support needs of the regulatory body and the owner/operator; (h) Recognition that there remains a non-zero possibility of a severe accident and the need to deal with the consequences of such an accident will need to be addressed; (i) Consideration of the demands of each of the infrastructure issues and a plan for how they will be met in the next phase of development. **Note:** Any prefeasibility study conducted during Phase 1 can provide significant input to the comprehensive report, although it is important that the report fully address all 19 infrastructure issues.
Examples of how the condition may be demonstrated	(1) List of the studies that are feeding into the report(s) (2) Current status and conclusions (3) Contents list for the report(s) (4) Executive summary of the report(s) (5) Evidence of ministerial review of the report(s)

Review observations

Various studies have been undertaken by Ghana, including energy planning studies (Strategic National Energy Plan (2006–2020) prepared by the Energy Commission; Planning for Sustainable Energy Development (2004–2030) Ghana Country Study completed in 2010; Generation Master Plan Study for Ghana prepared by the Ghana Grid Company (GRIDCo) for 2011–2026) and the feasibility report by the Presidential Committee in 2007. The INIR team noted that the energy planning studies that will provide the justification for the nuclear power programme need to be updated to be consistent with current demand and growth projections.

The INIR team was informed that the Energy Commission has the mandate to carry out energy studies and that an update of the Strategic National Energy Plan (2006–2020) is currently in progress. The National Development Planning Commission is responsible for long term planning for Ghana, including energy planning. The Ghana National Infrastructure Plan (2018–2047) identifies electricity, petroleum, renewable and alternative energy, and nuclear energy in the section on energy. The INIR team was also informed that regional demand for electricity is considered in the plans since Ghana aspires to be a net exporter of electricity.

Various other studies are being undertaken by Ghana, including:

- An assessment of available nuclear power plant technologies;
- Various siting studies;
- Grid assessment studies;
- Assessment of the environmental impact assessment framework for nuclear power;
- Preliminary study on the macroeconomic contribution of introducing nuclear energy;
- Preliminary human resource development plan;
- Financing, ownership and procurement options;
- Spent fuel and radioactive waste management options.

With respect to studies containing different options (for example for financing, ownership, procurement, spent fuel), the INIR team was informed that once the relevant studies have been completed, the GNPPO will make recommendations regarding viable options that are consistent with current government policy.

The GNPPO has developed “The Roadmap for Ghana Nuclear Power Programme”, which recognizes the demands of each of the nuclear infrastructure issues and provides a plan for how they will be met in Phase 2 of the programme. Actions and the responsible national organizations have been identified for each of the 19 infrastructure issues spanning across the 3 Phases. Following the preparation of a comprehensive report, the Roadmap envisages a knowledgeable decision being taken in 2018 leading to commissioning and operation of the first nuclear power plant in 2029.

The INIR team was informed that a specific plan to compile the comprehensive report has not been developed but that the experience with developing the self-evaluation report on nuclear infrastructure has been helpful and could form a framework for the compilation of the comprehensive report, which will address all 19 infrastructure issues.

Areas for further action	**Significant**	Energy planning Comprehensive report
	Minor	No

RECOMMENDATIONS
R-1.3.1 Ghana should complete the update of its energy planning studies and ensure they encompass the projected timeframe in the Roadmap for Ghana Nuclear Power Programme. **R-1.3.2** Ghana should complete the outstanding Phase 1 studies and compile the comprehensive report required for the government to make a knowledgeable commitment to a nuclear power programme.
SUGGESTIONS
None
GOOD PRACTICES
None

2. Nuclear safety **Condition 2.1: Key requirements of nuclear safety understood**	**Phase 1**
Summary of the condition to be demonstrated	The key requirements for nuclear safety, specified in the IAEA safety standards, are understood by the NEPIO and other relevant stakeholders, and their implications are recognized.
Examples of how the condition may be demonstrated	1. Evidence that the NEPIO has an understanding of, and commitment to, nuclear safety and the principles described in IAEA Safety Standards Series No. SF-1, Fundamental Safety Principles, and is aware how nuclear safety requirements are taken into account in various designs of nuclear power plants (NPPs) 2. Evidence that the responsibility for nuclear safety is recognized, for example in consideration of leadership, funding and expertise 3. Evidence that the need to develop adequate capability and skills in nuclear safety is recognized 4. Evidence of familiarity with IAEA safety standards and other States' practices, and recognition of the need for, and commitment to, the development of national safety standards

Review observations

The NRA Act (Act 895) recognizes the prime responsibility of the licensee for nuclear safety, and Section 91 provides for the issuance of regulations in accordance with IAEA safety standards. The Regulatory Strategy issued by the GNPPO in 2014 refers to the IAEA safety standards. The GNPPO makes significant use of IAEA safety standards in its documents. For example, the GNPPO's management system documents make reference to IAEA GSR Part 2. The GNPPO promotes safety culture, and the NRA plans to seek the services of qualified consultants and technical support organizations (TSOs) in critical areas to assure that international safety standards are met.

In the GNPPO structure, the advisory board is made up of senior officials from key state institutions and professional bodies. The technical body of the GNPPO comprises NPI (lead technical institution) and staff of other key stakeholder institutions and professional bodies for nuclear power infrastructure development. The director of NPI worked with Atomic Energy of Canada Limited from 2007–12 on the design certification of Advanced CANDU. One of NPI's five centers is the Nuclear Safety Assessment Center which addresses the issues of site and supporting facilities, environmental protection, emergency preparedness, nuclear safety, nuclear security and safeguards. Under NRA, there is a Directorate of Nuclear Installations with a Nuclear Safety Department responsible for regulations and guides, review and assessment for licensing purposes and inspection and enforcement. The INIR team was informed that Ghana performed its own safety analysis for the Ghana Research Reactor-1 (GHARR-1) core conversion and that the reactor has been operated safely for over 20 years.

The other GNPPO members and stakeholders are being "nuclearized" through meetings and participation in local and foreign workshops and training programmes. For example, the INIR team was informed that VRA conducted a one-week training course on nuclear infrastructure. Other examples provided were the organization by NRA of a one-day training for VRA on their responsibilities as an operating organization, licensing and an overview of the 19 infrastructure

issues. The INIR team was informed that not every member of the GNPPO Board is familiar with the key requirements for nuclear safety.		
Areas for further action	**Significant**	No
	Minor	GNPPO Board nuclear safety awareness
RECOMMENDATIONS		
None		
SUGGESTIONS		
S-2.1.1 The GNPPO is encouraged to consider mechanisms to ensure that all GNPPO Board members understand nuclear safety and its implications.		
GOOD PRACTICES		
None		
2. Nuclear safety **Condition 2.2: Support through international cooperation initiated**		**Phase 1**
Summary of the condition to be demonstrated	The need for international cooperation and open exchange of information related to nuclear safety as an essential element is recognized and demonstrated.	
Examples of how the condition may be demonstrated	(1) Evidence of review of options for bilateral or regional cooperation and specific actions for selected cooperation started, especially with countries with an established nuclear power programme (2) Implementation of a national technical cooperation programme with the IAEA and evidence of government financial support including nuclear safety aspects	

Review observations

The GNPPO has established bilateral cooperation with Russia and China. The INIR team was informed that in both cases the cooperation includes the sharing of knowledge in nuclear and radiation safety. Regarding the NPP project, China has provided a technical proposal for their reactor design, which is being reviewed by the GNPPO Technical Body. With Russia, working groups have been established including one on nuclear safety.

The INIR team was also informed that, further to an agreement between the GNPPO and the KEPCO International Nuclear Graduate School (KINGS), three personnel from VRA have been awarded scholarships and admitted to the 2017–2018 KINGS Masters in Nuclear Power Plant Engineering Programme. The GNPPO has also initiated talks with Texas A&M University on possible cooperation on training for the Ghana nuclear power programme. Ghana's projects with the IAEA Technical Cooperation (TC) Programme provide support in nuclear safety.

NRA is already engaged with international partners (U.S. Nuclear Regulatory Commission, IAEA and Forum of Nuclear Regulatory Bodies in Africa) and has initiated actions to cooperate with the

Canadian Nuclear Safety Commission. NRA has expressed formal interest in joining the Regulatory Cooperation Forum and is exploring the possibility to engage in cooperation through the European Commission's Instrument for Nuclear Safety Cooperation. The INIR team was informed that a workshop was conducted with the U.S. Nuclear Regulatory Commission on Siting Application Review for Nuclear Power Plants, and another workshop is planned in 2017 to review draft siting regulations.		
Areas for further action	**Significant**	No
	Minor	No
RECOMMENDATIONS		
None		
SUGGESTIONS		
None		
GOOD PRACTICES		
None		

3. Management Condition 3.1: Need for appropriate leadership and management systems recognized	Phase 1
Summary of the condition to be demonstrated	There is a commitment to leadership and management systems that will ensure success and promote a safety and security culture as well as the peaceful use of nuclear technologies. There are plans to ensure the knowledge gained by the NEPIO is transferred to the future regulatory body and the owner/operator of the programme.
Examples of how the condition may be demonstrated	(1) Plans to ensure appointment of leaders with the appropriate training and experience to plan, procure, construct and operate a NPP as well as to ensure the leadership and management of nuclear safety, security and safeguards (2) Evidence that the importance of nuclear safety and security culture in each of the organizations to be established is recognized (3) Evidence that the importance of ensuring the peaceful use of nuclear technology is recognized (4) Evidence of a clear understanding of management system requirements (5) A plan to implement management systems in future key organizations is consistent with the appropriate standards and guidance

Review observations

The NPI's Nuclear Programme Management Centre (NPMC) is responsible for developing the fundamentals for implementing effective management systems in the GNPPO, the NRA and the VRA. Guidelines for the identification of processes and a document on the management system map for the GNPPO have been drafted. The NPI has established the function of "management system manager" to guide the process owners, and the NRA is considering the same approach. The INIR team was informed that staff from NPI will share their experience with other organizations to support the development of organization-specific management systems.

The INIR team was informed that the NRA plans to develop regulatory requirements to ensure that NPP licensees have appropriate management systems and is cooperating with NPMC in the development of the NRA's management system. VRA has an established relationship with Ontario Hydro of Canada and uses its Safety Management System (SMS) in the operation of VRA hydro and thermal plants; however, VRA has started a pilot project to develop a Safety Management System for thermal plants that meets the Occupational Health and Safety Assessment Series (OHSAS) 18001 standard. As a potential future owner/operator of the NPP, the VRA is considering the characteristics of a management system needed for NPP operations, but is waiting for a government decision on the nuclear power programme to proceed.

In line with the Guidelines for the GNPPO Management System document, processes for controlling and classifying documents have been developed and implemented in NPI, and this will eventually be supported by an electronic documentation management system. The completion of such a system will contribute to effective knowledge transfer to the other organizations. It is expected that some of the

experienced GNPPO managers will take positions in the NRA or VRA, and through mentoring, knowledge will be transferred to staff joining the nuclear power programme.

Managers from government organizations in Ghana often receive leadership training from the Ghana Institute of Management and Public Administration (GIMPA) based on standard management and leadership approaches. Managers and staff of GNPPO have also participated in IAEA training courses dealing with leadership and safety and security culture aspects. GNPPO is considering collaborating with GIMPA to organize a nuclear specific leadership training programme. VRA's leadership development programme consists of three modules, each lasting a week. It uses external experts and could be expanded to cover nuclear-specific leadership aspects. NRA plans to incorporate leadership development into its own internal training programme.

Areas for further action	**Significant**	No
	Minor	No

RECOMMENDATIONS

None

SUGGESTIONS

None

GOOD PRACTICES

GP-3.1.1 The GNPPO set up the Nuclear Programme Management Centre at an early stage to develop an understanding of management system requirements, and several processes have been established within the GNPPO, including a process for document management. This knowledge is being used to support the other key organizations in the development of their own management systems.

4. Funding and financing Condition 4.1: Strategies for funding established	Phase 1
Summary of the condition to be demonstrated	Mechanisms have been defined for funding a range of key activities that are specific to a nuclear power programme but may not be the fiscal responsibility of the owner/operator. The activities include: (a) Establishing the legal framework; (b) Activities of the regulatory body for safety, security and safeguards; (c) The government's stakeholder involvement programme; (d) Siting and environmental protection activities that are the responsibility of the government; (e) Emergency preparedness and response (EPR); (f) Education, training and research; (g) Any required improvements to the electrical grid, if such improvements are the government's responsibility; (h) Any proposed incentives and direct government support to promote localization; (i) Storage and disposal of radioactive waste, including spent fuel; (j) Decommissioning of the NPP.
Examples of how the condition may be demonstrated	(1) Clear statements of how the above areas will be funded, based on consideration of options (2) Evidence that the scale of the costs of each of these activities has been recognized

Review observations

Ghana has created the Ghana Infrastructure Investment fund (GIIF), which seeks to stimulate economic growth by investing in flagship infrastructure projects, including energy. The GNPPO submitted a funding proposal to the GIIF, which included an initial estimate of the costs of the work to be done for each of the 19 infrastructures issues. These were provided as an initial first estimate recognizing that further work would be required. The INIR team was informed that the estimates were based on information published by another country, together with discussions with some vendor countries translated to the national context. The analysis assumes that a significant amount of work would be done by local experts, but also allows for the engagement of international consultants for specific tasks and external review. Ghana recognizes that further work is required and plans to re-evaluate the costs based on a "bottom-up" approach, i.e. identifying the activities required for each infrastructure issue and estimating their costs.

The INIR team was informed that the board of the GIIF has approved the proposal to contribute to the development of infrastructure for nuclear power. The next step is to discuss further with investment partners of GIIF and to provide more details on the costs and activities, including the split between national and international spending where possible. The other main source of funding for infrastructure development is through annual ministerial/institutional budgetary allocations, particularly the Ministry of Power, but also through the involvement of staff from other relevant

organizations, funded from their own organizations' budgets.

GRIDCo is solely responsible for grid infrastructure development. As part of its responsibility and duty, GRIDCo periodically carries out a grid assessment and upgrade. In addition, a policy direction of the government to support private sector co-financing for grid extension and upgrade is anticipated. The INIR team was informed that normally, independent power producers pay only for the grid lines required to connect to the nearest sub-station. In the case of a large nuclear power station, Ghana recognized that significant enhancements to the grid may be required and that GRIDCo would need to discuss the funding of such enhancements with the NPP owner/operator.

The NRA Act states that the NRA funding sources include:

- Moneys approved by Parliament;
- Loans, loan guarantees and grants;
- Fees and charges due to the Authority from services rendered by or through the Authority;
- Donations and gifts; and
- Any other moneys that the Minister responsible for Finance may approve.

The INIR team was informed that currently the regulatory body receives the majority of its funding through its approved Government budget, with fees from licensees accounting for less than 20% of the total budget. The additional funding that would be required to prepare for a nuclear power programme was included in the overall infrastructure costs discussed above.

The NRA Act identifies that an applicant applying for authorization to construct and operate a nuclear facility shall ensure that adequate financial resources are available when needed to cover costs associated with safe decommissioning. It also states that the authority shall, on the advice of the Ministry of Finance, Controller and Accountant-General's Department and Bank of Ghana, establish the necessary mechanisms to enforce the obligations. Ghana is aware of different mechanisms that are used in a number of countries but has not yet established any policies on how the funding mechanism will be assured. The INIR team was informed that in a different industrial sector, mine operators have been required to purchase investment bonds to cover the costs of environmental remediation. The INIR team was also informed that the NRA maintains a fund to cover the costs of disposal of orphan sources. In this regard, the NRA has a Finance Committee that, among other things, reviews investment instruments for financial sustainability.

Areas for further action	**Significant**	Estimation of infrastructure development costs
	Minor	Funding for radioactive waste management and decommissioning

RECOMMENDATIONS

R-4.1.1 The GNPPO should complete the work to estimate the funding required for Ghana's ministries and organizations to develop the national nuclear power infrastructure in Phase 2 and Phase 3.

SUGGESTIONS

S-4.1.1 The GNPPO is encouraged to identify how adequate funds for radioactive waste and spent fuel management and decommissioning will be assured.

GOOD PRACTICES
None

4. Funding and financing **Condition 4.2: Potential strategies for financing identified**		**Phase 1**
Summary of the condition to be demonstrated	Potential options have been identified with financial and risk management strategies, which together: (a) Create sufficient confidence for lenders and investors to support an NPP project; (b) Ensure the long term viability of the owner/operator to fulfil all its responsibilities. **Note:** A large part of the government's role in nuclear power financing, if the government is not directly a sponsor of the project, relates to financial risk reduction.	
Examples of how the condition may be demonstrated	A review of financing options and risk management strategies, considering the long term economics and risks associated with the NPP and including the extent of government funding, equity partners and borrowing, among other things.	

Review observations

Ghana has adopted a public-private partnership (PPP) national policy on energy generation to meet the increasing electricity demand. Due to the recent decision by the Government not to add to the national debt, a project financing model is proposed for the country's first nuclear power plant. The INIR team was informed that due to the current fiscal position, the Government would only be able to provide a small fraction of the capital required to finance the plant's construction. Other potential investors are being considered, such as the national pension fund, a potential bauxite/aluminum project that will have a significant demand for electricity and other bulk electricity consumers.

Discussions have been held with some vendor countries and financing could potentially be based on government-to-government loans or a build-own-operate-transfer (BOOT) model. If the latter is adopted, the INIR team was informed that the timescale for transfer of the asset could be up to 25 years. Ghana recognized that they would need to develop a power purchase agreement (PPA) and have been studying some PPA schemes that have recently been implemented in Ghana.

If Ghana contracts directly with a vendor, it would contract via a single Engineering, Procurement and Construction (EPC) contract with a combination of fixed and reimbursable elements. A number of VRA projects have been based on an EPC model, hence the organization has some relevant expertise and experience in contracting/procurement of power plants using this approach.

The GNPPO recognizes that further analysis is required to develop viable financial options and to understand their implications and risks. The INIR team was informed that the work is planned for completion by the end of 2017.

Areas for further action	**Significant**	Financial modelling
	Minor	Discussions with potential investors

RECOMMENDATIONS
R-4.2.1 The GNPPO should analyse and develop proposals for NPP financing options, assessing their viability and their implications for Ghana.
SUGGESTIONS
S-4.2.1 The GNPPO is encouraged to continue its work to identify potential investment by industrial consumers in its nuclear power programme.
GOOD PRACTICES
None

5. Legal framework **Condition 5.1: Adherence to all relevant international legal instruments planned**	**Phase 1**
Summary of the condition to be demonstrated	There is an understanding of the requirements of the relevant international legal instruments, their implications and a commitment to adhere to them. The following instruments are covered: (a) Convention on Early Notification of a Nuclear Accident (INFCIRC/335); (b) Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (INFCIRC/336); (c) Convention on Nuclear Safety (INFCIRC/449); (d) Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (the 'Joint Convention') (INFCIRC/546); (e) Convention on the Physical Protection of Nuclear Material (INFCIRC/274) and Amendment thereto (INFCIRC/274/Rev.1/Mod.1); (f) Vienna Convention on Civil Liability for Nuclear Damage (INFCIRC/500); (g) Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage (INFCIRC/566); (h) Convention on Supplementary Compensation for Nuclear Damage (INFCIRC/567); (i) Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention (INFCIRC/402); (j) Comprehensive safeguards agreement – based on The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons (INFCIRC/153 (Corrected)); (k) Additional protocol – following the provisions of Model Additional Protocol to the Agreement(s) Between State(s) and the International Atomic Energy Agency for the Application of Safeguards (INFCIRC/540(Corrected)); (l) Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the IAEA.
Examples of how the condition may be demonstrated	(1) Plans for when each of the instruments will be adhered to (2) Identification of the actions that will need to be undertaken and the required timescales (3) Evidence that the resources required are understood and have been defined

Review observations

Ghana has already adhered to the following international legal instruments adopted under the auspices of the IAEA:

(a) Convention on Early Notification of a Nuclear Accident (INFCIRC/335);

(b) Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (INFCIRC/336);

(c) Convention on Nuclear Safety (INFCIRC/449);

(d) Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (the 'Joint Convention'), INFCIRC/546;

(e) Convention on the Physical Protection of Nuclear Material (INFCIRC/274) and Amendment thereto (INFCIRC/274/Rev.1/Mod.1); and

(f) Convention on Supplementary Compensation for Nuclear Damage (INFCIRC/567);

Ghana has also concluded a Comprehensive Safeguards Agreement (INFCIRC/226) and an Additional Protocol (INFCIRC/226/Add.2) with the IAEA.

In addition, Ghana is taking steps to adhere to the following nuclear liability instruments:

(a) Vienna Convention on Civil Liability for Nuclear Damage (INFCIRC/500);

(b) Protocol to Amend the 1963 Vienna Convention on Civil Liability for Nuclear Damage (INFCIRC/566);

(c) Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention (INFCIRC/402).

The INIR team was informed that the internal adherence process, which starts with the submission of a Cabinet Memorandum for approval, is expected to be initiated during the second quarter of 2017 and finalized by 2018.

Areas for further action	**Significant**	No
	Minor	No

RECOMMENDATIONS

None

SUGGESTIONS

None

GOOD PRACTICES

None

5. Legal framework **Condition 5.2: Plan in place for development of a comprehensive national nuclear law**	**Phase 1**
Summary of the condition to be demonstrated	There is an understanding of the requirements of the comprehensive national nuclear law that needs to be enacted, a plan with the actions and timescales for development and enactment, together with a commitment from government to achieve the stated plan. The plan includes the need for the law to: (a) Establish an independent nuclear regulatory body with adequate human and financial resources and a clear and comprehensive set of functions; (b) Identify responsibilities for safety, security and safeguards; (c) Formulate safety principles and rules (radiation protection, nuclear installations, radioactive waste and spent fuel management, decommissioning, mining and milling, EPR and the transport of radioactive material); (d) Formulate nuclear security principles; (e) Give appropriate legal authority to, and define the responsibilities of, the regulatory body and all competent authorities establishing a regulatory control system (authorization, inspection and enforcement, review and assessment, and development of regulations and guides); (f) Implement IAEA safeguards including a State System of Accounting for and Control of Nuclear Materials (SSAC); (g) Implement import and export control measures of nuclear and radioactive material and items; (h) Establish compensation mechanisms for nuclear damage.
Examples of how the condition may be demonstrated	(1) A plan on how the law will be developed and approved (2) A summary of how each of the areas listed above will be addressed within the law (3) Interactions with IAEA and the other relevant organizations

Review observations

Ghana enacted the NRA Act (Act 895) on 14 August 2015. This act establishes the NRA as a body corporate with objects, functions and powers pertaining to, inter alia, the "regulation of activities and practices for the peaceful use of nuclear material or energy".

Act 895 is a comprehensive nuclear law that contains, among others, provisions on the NRA, the development and issuance of regulations, authorization, inspection and enforcement, radiation protection and nuclear safety, emergency preparedness and response, nuclear installations, radioactive waste management, transportation of radioactive materials, decommissioning, some aspects of nuclear security (including criminalization provisions pursuant to the Convention on Physical Protection of Nuclear Material and its Amendment) and safeguards, as well as civil liability for

nuclear damage.

However, there are some aspects of nuclear legislation that may still need to be addressed or further assessed in the national law. In particular, the INIR team noted that Section 14 of Act 895 provides that the "Minister responsible" may give policy directives to the NRA Board, a provision which may have an impact on the independence of the NRA, particularly if this function is assigned to a Minister with responsibilities that may give rise to potential conflicts of interest in the exercise of regulatory functions.

The INIR team was informed that the decision on the designation of the "Minister responsible" for the NRA is still to be taken by the Parliament but that there is an understanding at the national level of the relevant requirements for the establishment of an effectively independent regulatory body.

The INIR team noted that the authorization process for a nuclear installation (Sections 34–42), namely the authorization steps and the process and responsibilities to select the "proposed location for the development of a nuclear installation" (Section 36), may need to be revised. The INIR team was informed that the authorization process and requirements stated in Sections 34–42, will also be clarified in subsequent subsidiary regulations, guidelines, codes and standards and that NRA is currently taking steps in this regard (see infrastructure issue No. 7, Regulatory framework).

Moreover, there is a need to incorporate provisions on spent fuel management, which are currently not stipulated in the Act. In addition, the INIR team was informed that Section 18, dealing with the appointment of NRA staff, would be clarified.

Areas for further action	**Significant**	No
	Minor	Further assessment of Act 895

RECOMMENDATIONS

None

SUGGESTIONS

S-5.2.1 Ghana is encouraged to further assess Act 895 and plan for its amendment as necessary to provide for specific matters that may still need to be addressed.

GOOD PRACTICES

None

5. Legal framework **Condition 5.3: Plans in place to enact and/or amend other legislation affecting the nuclear power programme**	**Phase 1**

Summary of the condition to be demonstrated	There is an understanding of what other legislation that affects the nuclear power programme needs to be enacted and/or amended, the timescales for its development and approval, together with a commitment from government to achieve the stated plan. The other legislation to be considered includes that on: (a) Environmental protection;

	(b) EPR; (c) Occupational health and safety of workers; (d) Protection of intellectual property; (e) Local land use controls; (f) Foreign investment; (g) Taxation, fees, electricity tariffs and incentives; (h) Roles of national and local governments; (i) Stakeholders and public involvement; (j) International trade and customs; (k) Financial guarantees and any other required financial legislation; (l) R&D.
Examples of how the condition may be demonstrated	(1) A plan of how the legislation will be developed and approved (2) A summary of how each of the areas listed above will be addressed within proposed legislation (3) Interactions with IAEA and the other relevant organizations

Review observations

An assessment of national legislation requiring amendment to ensure consistency with the nuclear law was already conducted in the context of the development of the Nuclear Regulatory Act, 2015 (Act 895), which made provisions for consequential amendments to the Atomic Energy Commission Act, 2000 (Act 588), the Environmental Protection Agency Act, 1994 (Act 490), the Factories, Shops and Offices Act, 1970 (Act 328) and the Minerals and Mining Act, 2006 (Act 703).

As reflected in the "Assessment of National Laws in Relation to the Introduction of Nuclear Power", a preliminary assessment of several national laws that may affect the nuclear power programme was also conducted. It has been identified that the following laws will need to be amended: Environmental Protection Act, Ghana Ports and Harbours Authority Act, 1986, Ghana Shipping Act, 2003, Customs, Excise and Preventive Service (Management) Law of 1993.

The INIR team was informed that, as reflected in the Roadmap for Ghana Nuclear Power Programme, the assessment of national laws and the identification of required amendments will continue and is expected to be completed by the end of 2017. The INIR team noted that a plan for submitting such amendments to the national approval process has not yet been elaborated.

Areas for further action	**Significant**	No
	Minor	Assessment and plan for amendment of national laws

RECOMMENDATIONS

None

SUGGESTIONS

S-5.3.1 Ghana is encouraged to complete its assessment of the adequacy of other national laws that may affect the nuclear power programme and to prepare a plan for submitting required amendments to the national approval process.
GOOD PRACTICES
None

6. Safeguards **Condition 6.1: Terms of international safeguards agreement in place**			**Phase 1**
Summary of the condition to be demonstrated	(a) The Member State has a comprehensive safeguards agreement with associated subsidiary arrangements in force with the IAEA. (b) If the Member State has currently concluded a Small Quantities Protocol to its comprehensive safeguards agreement, a plan needs to be developed setting out the necessary steps to rescind the Small Quantities Protocol in a timely manner. (c) The Member State is aware of the requirements of the additional protocol; if the Member State has made the decision to ratify the additional protocol but has not already done so, a plan is in place for the timely ratification.		
Examples of how the condition may be demonstrated	(1) Plans for rescinding the Small Quantities Protocol or/and for ratification of the additional protocol, including the actions that need to be taken, clear assignment of responsibilities and understanding of the resources and the required timescales (2) Evidence that the need for outreach activities is recognized to ensure that all existing and future entities having to report to the State Authority for safeguards are aware of their roles and obligations		
Review observations Ghana has concluded a comprehensive safeguards agreement (CSA) with the IAEA that entered into force on 17 February 1975 (INFCIRC/226) and an additional protocol to the CSA that entered into force on 11 June 2004 (INFCIRC/226/Add. 2). Ghana rescinded its small quantities protocol on 11 June 2004. Integrated safeguards have been implemented in Ghana since 2011.			
Areas for further action	**Significant**	No	
	Minor	No	
RECOMMENDATIONS			
None			
SUGGESTIONS			
None			
GOOD PRACTICES			
None			

6. Safeguards Condition 6.2: Strengthening of the SSAC planned		Phase 1
Summary of the condition to be demonstrated	The Member State has a plan describing how the existing SSAC will be strengthened or adjusted to deal with the increase of activities and resources as well as the need for enhancement of capabilities.	
Examples of how the condition may be demonstrated	(1) Evidence that the NEPIO includes a representative knowledgeable in the requirements of the comprehensive safeguards agreement. (2) A plan produced by the NEPIO covering the enforcement of national legislation, policies and procedures relevant to safeguards; the development of the legislation itself is covered under infrastructure issue No. 5, legal framework. (3) Evidence that approaches undertaken by one or more States with existing nuclear power programmes have been reviewed and information gained has been adapted for the national context	

Review observations

The NRA Act (Act 895) assigns responsibility for safeguards implementation in Ghana to the NRA, including the establishment and maintenance of the SSAC. The NRA Act makes it obligatory for person(s) engaged in an activity specified in the safeguards agreement to submit to the NRA information and data required for Ghana to meet its reporting obligations. Ghana submits reports to the IAEA as required by its CSA and additional protocol.

In 2015, NRA established a Safeguards and Non-Proliferation Department which is charged with the responsibility of maintaining and ensuring the implementation of the SSAC. This department currently has five staff who, among other activities, are responsible for supporting safeguards implementation in Ghana, including facilitating national inspections and reporting to the IAEA. These staff are present during IAEA inspections or complementary access. The INIR team was informed that NRA is planning to strengthen its capability to deal with the expected increase of activities when an NPP becomes operational. The number of staff in the Safeguards and Non-Proliferation Department is expected to increase to 25.

Before the establishment of the NRA, GAEC was the main focal point for safeguards. Some GAEC staff from the research institute have safeguards experience and are still supporting the NRA in safeguards matters. The NRA has a multi-level safeguards training programme for its staff. The U.S. NRC is also providing assistance to the NRA by conducting trainings and supporting the development of regulations. Ghana will also seek collaboration, training and support from other countries that already operate nuclear power plants. Ghana is in the process of identifying countries with similar circumstances to gain further knowledge from their safeguards regulations and approaches.

Areas for further action	**Significant**	No
	Minor	No

RECOMMENDATIONS		
None		
SUGGESTIONS		
None		
GOOD PRACTICES		
None		
6. Safeguards **Condition 6.3: Recommendations from any previous reviews or audits being addressed**		**Phase 1**
Summary of the condition to be demonstrated	If any reviews or audits have been conducted on the existing safeguards provisions, there is evidence that the actions resulting from it are progressing.	
Examples of how the condition may be demonstrated	Action plans resulting from a review or audit with progress identified, indicating the required timescales, responsibilities and resources required.	
Review observations No reviews or audits have been undertaken in Ghana except for IAEA inspections.		
Areas for further action	**Significant**	No
	Minor	No
RECOMMENDATIONS		
None		
SUGGESTIONS		
None		
GOOD PRACTICES		
None		

7. Regulatory framework **Condition 7.1: Development of an adequate regulatory framework planned**		**Phase 1**
Summary of the condition to be demonstrated	The prospective senior managers of the regulatory body have been identified. There are plans to develop a regulatory framework for nuclear safety, nuclear security and safeguards that matches the overall plan for the NPP, and includes: (a) Designation of an effectively independent competent regulatory body with clear authority, adequate human and financial resources and strong government support; (b) Assignment of core safety, security and safeguards regulatory functions for developing regulations, review and assessment, authorization, inspection, enforcement and public information; (c) Authority and resources to obtain technical support as needed; (d) A clear definition of the relationship of the regulatory body to other organizations (e.g. TSOs and environmental agency); (e) Clearly defined responsibilities of licensees; (f) Authority to implement international obligations, including IAEA safeguards; (g) Authority to engage in international cooperation; (h) Provisions to protect proprietary, confidential and sensitive information; (i) Provisions for stakeholder involvement and communication with the public. There are agreed terms of reference of each regulator and clear definitions of roles of and interfaces with other regulators. There is recognition of the need for integrating existing security and radiation safety regulations with new regulations for NPPs. **Note:** Plans to develop competence are addressed under infrastructure issue No. 10, human resource development.	
Examples of how the condition may be demonstrated	(1) Evidence of what has been done, or is planned, to develop the experience of the senior regulators (2) Proposals on the overall approach to assessment, licensing, inspection and enforcement, among other things (3) Plans to develop the regulatory body for safety, security and safeguards (4) Plans to develop the required regulations (5) Evidence of interaction and cooperation with established regulatory organizations (6) Plans to enhance or develop appropriate TSOs (see also	

	infrastructure issue No. 10, human resource development) to the regulatory body (7) Plans to secure support from international regulatory organizations

Review observations

In August 2015, Ghana enacted the NRA Act (Act 895) that established the NRA with the powers to issue authorizations, conduct inspections and regulate nuclear installations and activities. The NRA Board of Directors was appointed in January 2016. Senior managers of the NRA have been appointed in compliance with the qualifications and responsibilities defined in the NRA Act. Staff have been transferred from GAEC to the NRA. The NRA is developing its skills and competences and making use of international cooperation. The NRA is also considering the support of a TSO. (Detailed plans for the further development of the NRA's human resources are discussed under infrastructure issue No. 10, Human Resource Development).

The NRA Act states that the Minister responsible for NRA, on the advice of the Board, may, by legislative instrument, make regulations for the implementation of the Act and that the NRA may develop guidelines and procedures and adopt standards, which are published in the gazette. The NRA Act does not specify the Minister responsible for the NRA, but the INIR team was informed that any policy directives which may be given by the Minister to the NRA Board are not expected to affect independent regulatory decision-making of the NRA (see infrastructure issue No. 5, Legal framework).

The Regulatory Strategy was developed by GNPPO in September 2014 in anticipation of the NRA Act, with the objective to guide the development of the regulatory infrastructure that would consider regulatory approaches such as issuance of regulations and guides; specification of safety, security and safeguards requirements; establishment of a procedure to issue, revise and revoke regulations and guides; and implementation of a programme for inspections and enforcement. The Regulatory Strategy refers to IAEA safety standards. Some of the actions identified in the Regulatory Strategy have been completed and the NRA intends to review and update the strategy as necessary and maintain it as a living document.

Existing guidance documents developed by the Ghana Radiation Protection Board (GRPB) cover radiation protection, transport of radioactive materials, industrial radiography and environmental assessment. A Nuclear Regulations Guidance Committee has been established within NRA. The NRA is managing the transition from existing regulations to the development of a new regulatory framework under the NRA Act. For this purpose, the NRA has produced an action plan for the development of regulations including those needed for a NPP ("Plans for Development of Regulations in Ghana"). The INIR team was informed that the NRA plans to update it periodically, taking into account any revisions to the Regulatory Strategy and prioritizing activities consistent with the project timeframe. The current action plan contains 19 actions for 2016–2017, 17 actions for 2018–2019 and 3 actions for 2020–2021. This plan and an estimate of the required funding will be submitted to the NRA Board for approval.

The transition from existing to new regulations is supported through international cooperation. NRA has and is developing collaborations with the U.S. Nuclear Regulatory Commission, IAEA and the Forum of Nuclear Regulatory Bodies in Africa (FNRBA), and has initiated actions to collaborate with the Canadian regulatory body, the Regulatory Cooperation Forum and the European Commission under the Instrument for Nuclear Safety Cooperation (INSC). The NRA is hosting an IAEA workshop on streamlining the process of developing and issuing regulations in 2017. Draft regulations related to safeguards, nuclear and radioactive waste management and radiation control

have been developed by the NRA.

No regulations for nuclear safety and nuclear security have been developed yet, but the need is included in the Regulatory Strategy and action plan. The INIR team was informed that the development of regulations on nuclear security will take into consideration IAEA nuclear security guidance, as identified in the Integrated Nuclear Security Support Plan (INSSP). The INIR team was informed that in response to a request made by the National Security Council, the NRA plans to address the issue of the protection of sensitive/confidential information. The Nuclear Security Committee established under the National Security Council will be consulted on the development of regulations, requirements or guidance on this issue.

The NRA Act includes provisions to educate the public and to establish mechanisms for stakeholder participation. In the action plan, it is planned that criteria for stakeholder participation in the regulatory process will be developed. The INIR team was informed that the Nuclear Regulations Guidance Committee has already approved a document addressing public and stakeholder engagement during the licensing process of a nuclear facility. The INIR team was informed that other national authorities (e.g. the National Disaster Management Organization (NADMO), the Nuclear Security Committee, the Environmental Protection Agency (EPA)) are part of the NRA Board. The Act empowers them to collaborate together regarding the development of regulations. Joint working groups are established to develop relevant regulations, and memoranda of understanding are already established or planned.

Areas for further action	**Significant**	No
	Minor	No

RECOMMENDATIONS

None

SUGGESTIONS

None

GOOD PRACTICES

None

8. Radiation protection **Condition 8.1: Enhancements to radiation protection programmes planned**	**Phase 1**
Summary of the condition to be demonstrated	The needed enhancements to the existing radiation protection programme to address NPP operation have been identified, including consideration of transport of radioactive materials and radioactive waste management. They consider both the increase in scale and the need to cover new technical issues. **Note:** This issue is closely linked to infrastructure issue No. 7, regulatory framework. In particular, the development of regulations and whether the existing regulatory body will expand its role or whether the infrastructure issues will be addressed by a separate organization.
Examples of how the condition may be demonstrated	(1) Evidence of discussions with specialists from other countries (2) Identification of the main areas requiring enhancement (3) Recognition that additional competences will be required to review proposed designs against the requirement to control contamination and reduce exposures to as low as reasonably achievable, also known as ALARA (4) Recognition that the programme for dose assessment will need to be significantly expanded (5) Plans for who will be responsible for the main elements of a radiation protection programme

Review observations

The NRA is responsible for the regulation of radiation protection and has established a Radiological and Non-Ionizing Applications Directorate. The staff of the directorate were mainly taken from the Radiation Protection Institute (RPI) of GAEC and have experience from activities related to the research reactor and other applications of radioactive sources in Ghana. The RPI provides services related to dosimetry, instrument calibration and radiation protection training. NRA is considering how to certify RPI as a provider of radiation protection services.

Currently the RPI provides dosimetry services to more than 1700 workers and provides instrument calibration services for about 60 instruments. The RPI recognizes that if the government decides to introduce nuclear power, they will need to expand their dosimetry service, develop internal dosimetry capability and consider the need for the additional instrument calibration services at the appropriate time.

With respect to training of radiation protection personnel, the INIR team was informed that the School of Nuclear and Allied Sciences produces an adequate number of graduates trained in radiation protection to meet the needs of a nuclear power programme. The RPI provides regular training in radiation protection to staff involved in the use of radioactive material and regularly reviews the demand as part of its business planning process.

The INIR team was informed that NRA is developing its regulations to include the radiation protection requirements for a nuclear power programme and has met with VRA to explain the radiation protection responsibilities that they would have as the owner/operator of a NPP.		
Areas for further action	**Significant**	No
	Minor	No
RECOMMENDATIONS		
None		
SUGGESTIONS		
None		
GOOD PRACTICES		
None		

9. Electrical grid **Condition 9.1: Electrical grid requirements considered**	**Phase 1**
Summary of the condition to be demonstrated	A preliminary study of the grid system has been conducted covering: (a) Capability and reliability to take the output from the NPP; (b) Ability to withstand loss of the output; (c) Reliability to minimize the risk of loss of power to the NPP from the grid.
Examples of how the condition may be demonstrated	(1) An analysis of the grid covering: (a) The expected grid capacity; (b) The historical stability and reliability of the electrical grid; (c) The historical and projected variation in energy demand. (2) Evidence of consideration of: (a) Available NPP designs to identify those with output consistent with required grid performance and reliability ('grid code'), with due consideration taken for safety aspects; (b) Potential NPP sites and their impact on grid operation; (c) The anticipated growth of grid capacity; (d) The potential for local or regional interconnectors to improve grid characteristics. (3) Preliminary plans to enhance the grid to meet NPP requirements.

Review observations

GRIDCo is responsible for the development and operation of Ghana's national electrical grid. Ghana's entire power protection system has been reviewed to improve power system reliability and stability.

A preliminary assessment was performed in 2016, which gathered historical data related to frequency variation, voltage variation, total installed capacity, generation mix, demand factor, capacity factor and generation units' performance. This assessment did not include a detailed analysis regarding the connection of a NPP to the grid, but recognized that the introduction of nuclear power in Ghana would likely require consideration of West African Power Pool interconnections and projected demand and capacity in its member countries. The INIR team was informed that a study of the grid system covering its capability and reliability to take the output from the NPP, its ability to withstand a loss of output from the NPP and its reliability to minimize the risk of loss of power supply to the NPP will be completed by the 3rd Quarter of 2017.

With regard to nuclear safety and security requirements, the INIR team was informed that the NRA will consider specific grid requirements as it develops the regulatory framework for nuclear power.

Areas for further action	**Significant**	Grid study related to the implementation of nuclear power
	Minor	No
RECOMMENDATIONS		
R-9.1.1 Ghana should complete its study of the national and West African grid systems, covering all relevant requirements for nuclear power.		
SUGGESTIONS		
None		
GOOD PRACTICES		
None		

10. Human resource development **Condition 10.1: Necessary knowledge and skills identified, and gaps in current capability assessed**	**Phase 1**
Summary of the condition to be demonstrated	A broad assessment of the typical staffing needs of each of the key organizations and their technical support has been completed together with an assessment of improvements required in the current capability of the country to meet the projected need. The assessment covers the full range of scientific, technical, managerial and administrative disciplines and considers: (a) Current human resource competences and capabilities; (b) Estimated required competence and capability; (c) Availability of domestic and foreign capacity for education and training; (d) Additional education, recruitment, training and experience that will be required (gap analysis), including specialist training in nuclear safety, nuclear security, safeguards, radiation protection, spent fuel and radioactive waste management, management systems and EPR; (e) Which facilities and programmes need to be established for education, training and experience building; (f) Which research capability needs to be developed; (g) A senior leaders development programme.
Examples of how the condition may be demonstrated	(1) An analysis identifying the competences and number of staff needed, covering all the future organizations. The analysis needs to include: (a) Bulk workforce needs per phase; (b) A breakdown by knowledge, skills and discipline per phase; (c) The flow of workforce to other projects (e.g. future NPPs). (2) An analysis of existing human resource capabilities and the ability to attract experienced staff from other countries. (3) An assessment of the capability of existing education and training facilities.

Review observations

Preliminary profiles of manpower needs for the three key organizations (the government, the owner/operator of the NPP and the regulatory body), including the breakdown of the specific knowledge, skills and disciplines required, have been developed. The analysis covers pre-project activities, project implementation, plant construction and commissioning, and plant operation and maintenance. The INIR team was informed that this work was carried out by a working group consisting of representatives from NPI, NRA, VRA, the Accra Technical University and the School of Nuclear and Allied Sciences with support from the Council for Technical and Vocational

Education and Training (COTVET), the National Council for Tertiary Education (NCTE) and the National Vocational Training Institute (NVTI). NPI intends to consider other scenarios and to discuss the work contained in the Human Resource Guidance document and the Human Resource Development Plan with a wide range of stakeholders and experts. An abridged version of the Human Resource Development Plan is to be prepared and used to inform decision-makers (see condition 10.2).

Existing industries such as the oil and gas, mining and conventional power industries—both in Ghana and the West African region—are potential sources of recruitment of staff with experience relevant to the nuclear power programme. However, those industries also constitute potential sources of competition. A detailed assessment of Ghana's ability to attract experienced staff from other countries has not yet been carried out, but Ghana recognizes that attracting such competencies and experience will require suitably competitive packages.

A number of universities, polytechnics and technical institutions offer academic and vocational programmes that provide resources for national and international industries. These institutions are overseen primarily by NCTE and COTVET.

The School of Nuclear and Allied Sciences (SNAS) of the University of Ghana offers postgraduate programmes in nuclear engineering, nuclear physics, medical physics, radiation protection and nuclear and radiochemistry. SNAS has been designated as an IAEA centre of excellence for some of these programmes. The majority of the graduates from SNAS are currently working in nuclear-related research, academic, medical and industrial organizations in the country. SNAS will continue to serve as a key source of human resource development for the nuclear power programme.

VRA has a well-established Academy that offers high-standard specialized engineering, management and technical training courses for their staff and personnel from other industries in many disciplines. The engineering programme, for example, covers areas such as power systems operation programmes, power systems maintenance programmes, short engineering programmes and occupational health and safety programmes. Other VRA programmes cover such areas as leadership, management and administration, finance and accounting, the institutionalized computer programme and support services. The Academy programmes, however, do not have nuclear content.

Separately from considerations related to nuclear power, Ghana has identified a number of areas requiring enhancement in education and training infrastructure. For instance, the National Science Technology and Innovation Policy (NSTIP) identified inadequate scientific expertise in the country, weak mechanisms for the management of science and technology as well as weak linkages between industry, science and technology. The Coordinated Programme for Economic and Social Development Policies (CPESDP) (2014–2020) noted that although some mid-level technicians are trained in polytechnics and vocational/technical schools, for a large segment of the labour force, skills acquisition continues to be dominated by informal apprenticeships which are not well regulated.

Addressing these areas would clearly be necessary to meet the high-level standards required by the nuclear power industry. GNPPO is engaged with the national organizations responsible for enhancing education and training, and the INIR team was informed that discussions on the needs of the nuclear power programme are ongoing.

Areas for further action	**Significant**	No
	Minor	No

RECOMMENDATIONS

None	
SUGGESTIONS	
None	
GOOD PRACTICES	
None	
10. Human resource development **Condition 10.2: Development of human resources planned**	**Phase 1**
Summary of the condition to be demonstrated	Outline plans have been agreed to: (a) Enhance national education and training; (b) Develop a detailed human resource development plan for each key organization; (c) Integrate the plans to develop a national strategy including the development of initial core leadership group.
Examples of how the condition may be demonstrated	(1) Plans to develop the human resources required including: (a) Identification of national organizations that could support human resource development; (b) Enhancement of education and training infrastructure; (c) Development of national competences (through schools, universities, institutes and industry); (d) Non-national human resources that are needed to augment national resources and how they will be secured; (e) International cooperation and vendor support; (f) Leadership development. (2) Strategies for the recruitment and retention of staff. (3) Recognition of the need for qualification and certification programmes for personnel. (4) Evidence that key stakeholder organizations have participated in the development and review of the plans.
Review observations GNPPO has studied a number of guidance documents on human resource development and has identified a number of potential mechanisms for acquiring the necessary competency for each phase of the nuclear power programme. These are highlighted in two draft documents: the Human Resource Guidance document and the Human Resource Development Plan. Potential mechanisms include: • Attracting expatriates who have worked in the nuclear sector abroad;	

- Attracting experienced foreign personnel either as employees or consultants to lead the development of the core national staff through coaching/mentoring and training;
- Recruiting experienced personnel from appropriate national industries such as the fossil fuel power generation, process/production and oil and gas industries who already have many of the required competencies to work in the nuclear industry;
- Secondment of professionals from the identified vendor country to help in building national capacity of the owner/operator and the regulator;
- Capacity-building agreements with other experienced nuclear countries; and
- Scholarships to selected students during their studies with subsequent employment and local or international on-the-job certification programmes.

The documents also note that it would be prudent to build some redundancy into the staff recruitment and training programme to allow for any losses to other countries/industries. It may also be necessary to consider time and resources for language training, depending on the source of the education and training programmes.

Government policies over the medium-term, as noted in the CPESDP, include improving academic and other infrastructural facilities in all public universities, introducing new and relevant career-oriented programmes into polytechnic education, designing programmes to strengthen the linkage between tertiary education and industry (including promoting industry-university collaborative programmes) and providing special incentives for students and graduates for science and technology.

NRA currently has 17 staff in its Nuclear Installations Directorate and is working to identify its human resource needs for Phase 2 and 3.

VRA has not started detailed planning of resources required for Phase 2 and 3, but has undertaken a number of activities to develop staff competence. One person from VRA attended an international nuclear infrastructure train-the-trainers course and transferred the knowledge gained to 30 staff from VRA through a workshop. The INIR team was informed that VRA plans to develop a specific nuclear power team drawn from its engineering services department, if the government decides to proceed with the nuclear power programme. In addition, the GNPPO is sending 3 people from VRA to Korea, for a 2-year education/training programme. Two staff from the NPI are receiving training in Russia.

With regard to specific programmes for potential leaders, NRA is considering, inter alia, the secondment of staff to existing nuclear regulators. GNPPO is considering capacity-building agreements to be established with experienced nuclear power countries.

The draft Human Resource Guidance document has undergone review and is awaiting approval. The draft Human Resource Development Plan document is yet to undergo review, and a workshop is planned to discuss the content of the draft and to formulate more specific plans appropriate to the Ghanaian context. The aim is to develop a summary document that could be submitted to the GNPPO Board for review and approval, and subsequently to the National Development Planning Commission for consideration as it looks to develop national human resource plans to support Ghana's long-term national development. The INIR team was also informed that preliminary information on human resource needs has already been provided to the National Development Planning Commission.

Areas for further action	**Significant**	National human resource development plan
	Minor	No

RECOMMENDATIONS
R-10.2.1 The GNPPO should complete its Phase 1 work on national human resource development planning and submit a summary document to the GNPPO Board.
SUGGESTIONS
None
GOOD PRACTICES
None

11. Stakeholder involvement **Condition 11.1: Open and transparent stakeholder involvement programme initiated**	**Phase 1**
Summary of the condition to be demonstrated	Stakeholder involvement strategy and plan, with the required resource and competence, is being implemented by the NEPIO, based on transparency and openness. The public and other relevant interested parties receive information about the benefits and risks of nuclear power, including the 'non-zero' potential for severe accidents.
Examples of how the condition may be demonstrated	(1) A clear mandate for the NEPIO to engage with stakeholders. (2) Actions to disseminate information in the context of the national energy outlook, policy and needs, pros and cons of all sources of energy, using a range of effective tools. (3) Evidence of a professional communication team available to the NEPIO, with appropriate financial resources. (4) Results of surveys to determine the public's knowledge and receptiveness to nuclear power. (5) Approaches to address public concerns including waste management and severe accidents. (6) Evidence of activities at local, regional and national level. (7) A plan for ongoing interaction with the public, in particular opinion leaders, media, local and national governmental officials, neighbouring countries. (8) Plans for regular opinion polls managed by specialist companies. (9) Training programme to enable identified spokespersons to interact with stakeholders.

Review observations

The membership of the GNPPO includes a wide range of national stakeholders. Ghana has developed a Stakeholder Engagement Strategy (SES) and a Communications Strategy. The SES identifies workshops, meetings, fora, seminars, lectures, serialized articles, talk shows and documentary videos as potential ways to engage stakeholders. The SES also outlines strategies for interacting with opinion leaders, media, policymakers, political parties, civil society and academia.

The Chairman and Deputy Chairman of the GNPPO are designated as Chief Communicators for the nuclear power programme in the Communications Strategy. The INIR team was informed that the SES has been finalized and submitted for signature to the Deputy Chairman of GNPPO. The Communications Strategy is still in draft and expected to be signed in the third quarter of 2017, following internal and external review.

The INIR team was informed that a stakeholder involvement plan (with identified activities, responsibilities, timelines, budget, etc.) has not yet been developed. Activities are being carried out by NPI and the different organizations represented in GNPPO on the basis of the SES. A plan with short-term (3 months) and medium-term (6 months) activities will be developed by the end of March

2017. A more comprehensive plan will be prepared after a survey planned for the second quarter of 2017 to determine the public's knowledge and receptiveness to nuclear power. The questions for the survey were designed with inputs from all the organizations represented in the GNPPO and are now undergoing review by the Ghana Statistical Service (GSS). GSS will lead the execution of the survey as they have the requisite infrastructure and capability for such processes.

The NPI has two centres with responsibilities related to stakeholder involvement: The Localization and Stakeholder Support Centre (LSSC) and the Public Relations and Information Centre (PRIC). These centres develop and disseminate information on the nuclear power programme, for example, via monthly email newsletters, the GNPPO website and social media platforms to enhance awareness, inform and update key stakeholders. The NRA has established a Stakeholder Mapping and Engagement Committee to identify its relevant stakeholders and to plan activities for engaging them at the local and national levels.

Stakeholder engagement events have been organized by members of the GNPPO including a Forum on Siting and Environmental issues at the Ghana Institution of Engineers and a media editors' forum on "Nuclear Power as a Source of Energy in Ghana". GNPPO members have also participated in non-nuclear specific forums, delivered presentations on the nuclear power programme and engaged relevant stakeholders (e.g. Council for Technical and Vocational Education and Training (COTVET), National Council for Tertiary Education (NCTE) and the National Vocational Training Institute (NVTI)) to discuss issues related to the development of human resources for the nuclear power programme.

Areas for further action	**Significant**	Stakeholder involvement plan Public survey
	Minor	No

RECOMMENDATIONS

R-11.1.1 The GNPPO should develop a plan to implement its Stakeholder Engagement Strategy with a schedule of identified activities, responsibilities and required resources.

R-11.1.2 Ghana should conduct a survey to determine the public's knowledge of and receptiveness to nuclear power.

SUGGESTIONS

None

GOOD PRACTICES

None

12. Site and supporting facilities **Condition 12.1: General survey of potential sites conducted, and candidate sites identified**	**Phase 1**
Summary of the condition to be demonstrated	Exclusion and avoidance criteria (covering safety, security, cost, socio-economic issues, engineering and environment) have been identified and regional analysis to identify candidate sites has been conducted. The analysis includes the impact of external hazards on security and emergency response capability. Consultations with stakeholders have been part of the process.
Examples of how the condition may be demonstrated	(1) A report covering: (a) Safety and security criteria for initial NPP site selection; (b) National criteria (e.g. socioeconomic and environmental); (c) Engineering and cost criteria. (2) An assessment report issued and approved identifying: (a) Regional analysis and identification of potential sites; (b) Screening of potential sites and selection of candidate sites. (3) Evidence that the resources used for NPP site selection are competent and have experience in NPP site selection. (4) Plans for the work that will be required in Phase 2 to select and justify the site. (5) Evidence that safety and security related activities conducted (e.g. site evaluation and environmental impact studies) are included within the framework of an effective management system.

Review observations

The GNPPO's Siting Charter document is a comprehensive activity guide for Ghana's NPP site selection process. The document details the major activities for each of eleven thematic areas that need to be undertaken. These areas include geology and seismology, meteorological and atmospheric dispersion, flooding, population and exclusion, emergency planning, human induced events, wildlife, archaeology and cultural preservation, water quality and availability, land use, and community impact. Detailed criteria for site selection and the site selection process are elaborated in the Quality Assurance Framework for Siting Activity document.

Two regions of interest (south-western and south-eastern Ghana) have been identified, as outlined in the Regional Analysis document. Further consideration of geological and seismological parameters contained in the Candidate Area Assessment document of the regions has led to the identification of nine candidate areas (five areas within the south-eastern catchment zone and the remaining four areas within the south-western catchment zone). The INIR team was informed that further data collection is ongoing related to various other parameters outlined in the Siting Charter document and that the analysis of this data is expected to lead to the identification of candidate sites by the end of 2017.

According to the Candidate Areas Assessment report, the geological and seismological assessment was carried out with the involvement of various stakeholders with relevant experience. The key stakeholder institutions involved include the Ghana Highways Authority, the Geological Survey Department, the Minerals Commission, the Earth Science Department of the University of Ghana and the Water Research Institute (WRI). The INIR team was informed that stakeholders who are directly involved in the output or activity and have relevant competency have been consulted for all eleven thematic areas and will continue to be involved in the siting process. Additional stakeholders will be consulted where necessary. It was also stated that international experts will be used where the expertise is not available in Ghana (e.g. for seismic hazard analysis).

The Quality Assurance Framework document outlines that the quality of the data to be collected should be commensurate with its end use. The document stipulates that data should be compiled, examined and analysed in an organized manner. A Standard Operating Procedure has been developed as part of data management; however, the INIR team noted that quality classification of different siting activities has not yet been conducted. The INIR team was informed that the siting team of GNPPO is considering the development of a standard Geographical Information System (GIS) to manage internally and externally generated data. The Roadmap for Ghana Nuclear Power Programme document highlights the site assessment and evaluation activities planned to be carried out in Phase 2.

Areas for further action	**Significant**	Candidate sites
	Minor	No

RECOMMENDATIONS

R-12.1.1 The GNPPO should complete its study to identify candidate sites.

SUGGESTIONS

None

GOOD PRACTICES

None

13. Environmental protection **Condition 13.1: Environmental requirements considered**			**Phase 1**
Summary of the condition to be demonstrated	The NEPIO has considered the main environmental requirements related to the siting of a NPP, including land use, water use, water quality and the impacts of low level radioactive effluents.		
Examples of how the condition may be demonstrated	(1) Identification of key requirements for siting and during construction (2) Evidence of discussions by specialists with countries operating nuclear power (3) Evidence that the non-radiological environmental issues: water use, transporting materials, disposal of hazardous waste, additional environmental monitoring requirements, construction impact, etc. have been considered and taken into account by the NEPIO		
Review observations Environmental requirements are among the eleven thematic areas identified for siting (see infrastructure issue No. 12, Site and supporting facilities). Discussions with relevant stakeholders (e.g. EPA, Ministry of Chieftaincy and Traditional Affairs, Lands Commission, NRA, Ports and Harbours Authority, Forestry Commission, Ministry of Fisheries and GAEC) have been conducted to identify specific environmental requirements for the site selection process for Ghana's first nuclear power plant. These environmental requirements include wildlife preservation, archaeological and cultural preservation, water quality and availability, land use and community impact. They will be addressed based on a set of exclusionary, discretionary and suitability criteria to satisfy regulatory requirements of both the EPA and the NRA. These considerations are reflected in the Siting Charter and the Quality Assurance Framework for Siting Activity documents.			
Areas for further action	**Significant**	No	
	Minor	No	
RECOMMENDATIONS			
None			
SUGGESTIONS			
None			
GOOD PRACTICES			
GP-13.1.1 The GNPPO established several working groups of relevant environmental stakeholders. This structured and collaborative approach ensures that the environmental protection criteria are comprehensive and provides a mechanism for the elaboration of detailed environmental protection requirements.			

13. Environmental protection **Condition 13.2: Framework for environmental protection reviewed**			**Phase 1**
Summary of the condition to be demonstrated	The NEPIO has reviewed the suitability of the State's existing framework for environmental protection and for meeting its international obligations.		
Examples of how the condition may be demonstrated	(1) Procedures for the elaboration, reporting and assessment of environmental studies for nuclear and other related facilities (2) Evidence of interactions by specialists with countries operating nuclear power		
Review observations The principal regulatory institution established for environmental protection in Ghana is the EPA. Ghana has adhered to several international conventions and has adopted a number of laws and policies that form the framework for environmental protection. The Siting and Environmental (S&E) and Legal workgroups of the GNPPO are currently reviewing these documents to ascertain whether any areas related to environmental protection need to be updated to fully cater for the introduction of nuclear power. In particular, S&E, NRA and EPA are reviewing the existing Environmental and Social Impact Assessment (ESIA) Guidelines in order to elaborate specific guidelines and procedures for the assessment of an NPP. This review is targeted for completion by the end of 2017. Existing regulations stipulate that the Environmental Impact Assessment (EIA) must identify whether any area outside Ghana is likely to be affected, and the INIR team was informed that Ghana plans to consult potentially affected neighbouring countries.			
Areas for further action	**Significant**	Existing environmental protection framework	
	Minor	No	
RECOMMENDATIONS			
R-13.2.1 The GNPPO should complete the review of Ghana's existing environmental protection framework.			
SUGGESTIONS			
None			
GOOD PRACTICES			
None			

14. Emergency planning **Condition 14.1: Requirements of and resources for developing an emergency response capability recognized**	**Phase 1**
Summary of the condition to be demonstrated	(a) The NEPIO is aware of the EPR arrangements and capabilities that will be required for the nuclear power programme. It has evaluated existing EPR arrangements and capabilities in the country and is aware of the major gaps that will need to be addressed. (b) The NEPIO has identified the main organizations and resources that will need to be involved in the establishment of adequate national EPR capabilities. (c) The lead for the execution of the action plan and the action plan coordination framework has been identified. **Notes:** (1) The process of developing adequate EPR will be initiated in Phase 2 and will be largely carried out in Phase 3. (2) The requirements of the Early Notification and Assistance Conventions are covered under issue No. 5, legal framework.
Examples of how the condition may be demonstrated	Report summarizing existing EPR arrangements and capabilities and identifying those to be enhanced and/or developed, as well as identifying the main organizations and resources that will need to be involved in the establishment of adequate national EPR capabilities.

Review observations

NADMO is responsible for emergency preparedness and response for all potential emergency situations. NADMO published its National Disaster Management Plan (NDMP) in 2010. The NDMP defines the all-hazards emergency management system and includes nuclear and radiological emergencies.

NADMO and GAEC developed the National Nuclear and Radiological Emergency Response Plan (NNRERP) to specifically address nuclear and radiological emergencies, and this has been approved by NADMO. The plan presents a general description of the roles and responsibilities of the ministries, other organizations and facilities involved in any given emergency response.

To accomplish the objectives of the NNRERP, the National Emergency Response Procedures in the event of a Nuclear or Radiological Accident (NERPNRA) document was developed for responders such as public information officers, radiological assessors, medical teams, law enforcement agencies and firefighters. It is an integrated compilation of detailed procedures intended to provide practical guidance to stakeholder organizations and institutions to enable them to effectively respond to a radiological emergency.

For nuclear and radiological matters, NADMO has established a Technical Committee with broad representation. The NNRERP and NERPNRA do not fully cover emergency preparedness concerns of NPPs, and therefore would need to be expanded. NADMO and its Technical Committee plan to address the needed expansion for the introduction of nuclear power together with a review of their existing plan against IAEA GSR Part 7. VRA, as the potential owner/operator, will join the Technical

Committee for nuclear and radiological matters. It already has procedures to deal with non-radiological emergencies and a VRA workshop on nuclear power infrastructure included consideration of EPR.

NADMO is considering updating the current NNRERP to include response to nuclear security events. However, the National Security Council has also developed the National Chemical Biological Radiological and Nuclear Emergencies Response Plan (NCBRN-ERP) with the support of the European Commission. The plan has not yet been tested.

The INIR team noted that there was potential for overlap and unclear responsibilities for nuclear security events involving nuclear or radiological material and was informed that the National Security Council will decide if they will set up a new secretariat for the NCBRN-ERP or make NADMO (which also reports to the National Security Council) responsible for its implementation. The National Security Council also plans to ensure the NCBRN-ERP and other plans including the NDMP and the NNRERP are consistent and that the interface between them is clear.

Areas for further action	**Significant**	No
	Minor	Relationship between the NCBRN-ERP and other emergency response plans

RECOMMENDATIONS

None

SUGGESTIONS

S-14.1.1 Ghana is encouraged to review and clarify, as necessary, the interfaces between the National Disaster Management Plan (NDMP), the National Nuclear and Radiological Emergency Response Plan (NNRERP) and the National Chemical, Biological, Radiological and Nuclear Emergencies Response Plan (NCBRN-ERP).

GOOD PRACTICES

None

14. Emergency planning **Condition 14.2: Recommendations from any previous reviews or audits being progressed**	**Phase 1**

Summary of the condition to be demonstrated	If any reviews or audits have been undertaken of the existing framework, there is evidence that the actions resulting from it are being progressed.
Examples of how the condition may be demonstrated	Presentation of any action plans resulting from a review/audit with progress identified

Review observations

The IAEA conducted an Emergency Preparedness Review (EPREV) mission in Ghana in 2015.

The EPREV Mission made fifteen recommendations and five suggestions that were all based on GSR Part 7. Ghana has prepared an action plan based on these recommendations. The following actions have been completed:

- The government acceded to the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency.
- A national training course for first responders was conducted with support from IAEA in November 2015.
- NADMO organized a series of training courses facilitated by the United States on the Incident Command System approach.

The INIR team was informed that a number of recommended actions from the EPREV Mission have not yet been implemented, as the 2016 budget for the relevant departments had been agreed prior to the development of the action plan. Now that the 2017 budget is available, NADMO intends to progress with the completion of the action plan. A meeting of the NADMO Technical Committee for nuclear and radiological matters is planned for the end of January to discuss the implementation of the action plan.

Areas for further action	**Significant**	No
	Minor	No

RECOMMENDATIONS

None

SUGGESTIONS

None

GOOD PRACTICES

None

15. Nuclear security **Condition 15.1: Nuclear security requirements recognized and the actions of all relevant organizations coordinated**	**Phase 1**
Summary of the condition to be demonstrated	The NEPIO recognizes the importance of nuclear security, based on a national threat assessment and principles of prevention, detection and response. All competent authorities that are involved in nuclear security have been identified and there is a coordinating body or mechanism established that brings together all of the organizations that have responsibility for nuclear security. **Note:** The need to establish legislation and a regulatory framework are addressed under issues No. 5 and 7, legal framework and regulatory framework, respectively.
Examples of how the condition may be demonstrated	(1) Evidence of familiarity with IAEA Nuclear Security Series publications and other States' practices (2) Clear identification of all organizations that have roles and responsibilities for nuclear security and of the work that will need to be carried out in the subsequent phases (3) Evidence that nuclear security considerations for siting have been defined and have been considered as part of the siting assessment (see infrastructure issue No. 12, site and supporting facilities) (4) Evidence that international cooperation and assistance is being used (5) Evidence that the need to address the interface with safety and safeguards is recognized

Review observations

Ghana is party to a number of international conventions related to nuclear security including the Convention on Physical Protection of Nuclear Material and its Amendment. The NRA Act (Act 895) includes a provision to determine the domestic threat related to nuclear and radioactive materials in the country and assess the vulnerability to each threat. The INIR team was informed that the national threat assessment is expected to be finalized by the end of 2017 by the National Security Council, the coordinating body for national security matters which is represented on the GNPPO Board.

The Nuclear Security Committee supports the National Security Council in coordinating nuclear security matters. The members of the Committee represent all relevant authorities involved in nuclear security. The Committee, which is chaired by the Director General of the NRA, meets periodically and operates under established procedures. The Committee coordinated the transport security arrangements for the GHARR-1 core conversion, including a table top exercise looking at routes and scenarios for the transport of nuclear material. The Committee was also involved in the investigations of several incidents involving radioactive sources, one of which related to an investigation jointly conducted with customs officials.

GNPPO has developed a security classification for documents and records. GNPPO is involved in international nuclear security cooperation with the IAEA and the U.S. Department of Energy. GNPPO members have participated in various regional and national training events on nuclear

security.		
Areas for further action	**Significant**	No
	Minor	No
RECOMMENDATIONS		
None		
SUGGESTIONS		
None		
GOOD PRACTICES		
None		

15. Nuclear security **Condition 15.2: Recommendations from any previous reviews or audits being progressed**	**Phase 1**
Summary of the condition to be demonstrated	If any reviews or audits have been undertaken of the existing framework, there is evidence that the actions resulting from it are progressing.
Examples of how the condition may be demonstrated	Presentation of any action plans resulting from a review or audit with progress identified.

Review observations

Three IAEA missions have been conducted:

- An International Nuclear Safety & Security Advisory Service (INSServ) in 2006;
- A Radiation Safety and Security of Radioactive Sources Infrastructure Appraisal (RASSIA) in 2006;
- An International Physical Protection Advisory Service (IPPAS) mission in 2007.

The findings from these missions are being addressed through the Integrated Nuclear Security Support Plan (INSSP) implementation, and a wide range of activities have already been conducted.

Areas for further action	**Significant**	No
	Minor	No
RECOMMENDATIONS		
None		

SUGGESTIONS
None
GOOD PRACTICES
None

16. Nuclear fuel cycle Condition 16.1: Options for nuclear fuel cycle (front end and back end) considered	Phase 1
Summary of the condition to be demonstrated	At a strategic level, options have been considered for the front end and back end of the fuel cycle. For the front-end, options for uranium sourcing and fuel manufacture and supply have been addressed. For the back end of the fuel cycle, spent fuel storage needs and capacities (on-site and off-site) and possible reprocessing have been considered.
Examples of how the condition may be demonstrated	(1) A document (a) Identifying available national natural resources and capacities for individual steps in the nuclear fuel cycle; (b) Identifying potential sources of supply and services; (c) Assessing available options for a national fuel cycle strategy taking account of non-proliferation issues. (2) A document clearly demonstrating that the NEPIO understands the long-term commitments related to the back-end of the nuclear fuel cycle and has considered the options and their implications. The document should address the need for adequate capacity for spent fuel storage at the reactor site, the possibility of interim storage of spent fuel at a dedicated facility and any plans for reprocessing. (3) Clear allocation of responsibilities for the development of the fuel cycle policy and strategy (front-end and back-end) to be undertaken during Phase 2.

Review observations

The GNPPO has drafted a Nuclear Fuel Cycle Strategy document, which briefly describes front-end and back-end options for the nuclear fuel cycle. The INIR team was informed that this document is undergoing an internal review involving the NPI, the NRA and the Ministry of Power, which will be followed by an external review.

The Nuclear Fuel Cycle Strategy document is planned to serve as a basis for the development of a nuclear fuel cycle policy. The INIR team was informed that the Policy document will define Ghana's short, medium and long term approach to the nuclear fuel cycle, where short term addresses the needs of the first NPP, medium becomes relevant if the nuclear power programme in Ghana and the region will expand and long term is the distant future, dependent on technical and economic development in the region. The nuclear fuel cycle policy is expected to be developed by the 3rd quarter of 2017. The NPI and the Nuclear Installations Directorate of the NRA are responsible for its development. After an internal and external review, the draft policy will be submitted for the approval of the GNPPO Board.

The INIR team was informed that for the front end of the nuclear fuel cycle, the preferred short term goal is to agree with a vendor for a supply of fresh fuel for the lifetime of the NPP.

In the medium term, the INIR team was informed that if the nuclear power programme expands,

Ghana would be interested in developing its own capacities for uranium mining and yellow cake production. It would revisit and reassess the results of past uranium prospecting, which indicated the presence of uranium in some rock formations. It would also investigate the potential presence and recoverability of uranium in waste resulting from other mining activities, and would explore the potential for agreements with West African countries to trade electricity for yellowcake.

In the long term, if there is significant use of nuclear power in West Africa, Ghana would consider developing the entire front end of the nuclear fuel cycle.

Regarding the back end of the nuclear fuel cycle, the INIR team was informed that, for the short term, Ghana is considering a fuel take-back policy with the reprocessing of spent fuel in the vendor country and the return of high level waste to Ghana. For the medium term, Ghana would consider national storage of spent fuel, while for the long term, spent fuel reprocessing in Ghana for the West African region would be considered.

The INIR team noted that Ghana is currently considering establishing a policy with a single front end and a single back end nuclear fuel cycle option for the first NPP. Exploring the inclusion of other options would better prepare the country for discussions with vendors.

Areas for further action	**Significant**	Nuclear fuel cycle options
	Minor	No

RECOMMENDATIONS

R-16.1.1 The GNPPO should consider a broader range of nuclear fuel cycle options for the first NPP as an input to the development of the national nuclear fuel cycle policy.

SUGGESTIONS

None

GOOD PRACTICES

None

17. Radioactive waste management Condition 17.1: The requirements for management of radioactive waste from NPPs recognized	Phase 1
Summary of the condition to be demonstrated	The NEPIO understands the significantly increased requirements for the processing, storage and disposal of high, intermediate, and low level radioactive waste from a nuclear power programme, and has developed options for the management of radioactive waste taking into account existing arrangements for the management of radioactive waste.
Examples of how the condition may be demonstrated	A document addressing possible approaches to the management of radioactive waste arising from NPP operation and decommissioning, the capabilities and resources needed, and the options and technologies for its processing, handling, storage and disposal. If reprocessing is being considered, this should include the management of high-level radioactive waste (HLW) arising. Regulatory framework and financing schemes are addressed under issues No. 7 and 4, regulatory framework, and funding and financing, respectively.

Review observations

Currently, the responsibility for the management of radioactive waste rests with GAEC. GAEC also operates the National Radioactive Waste Management Centre (NRWMC). According to the NRA Act (Act 895), the import of radioactive waste generated in another country is prohibited. Whenever possible, disused sealed sources are repatriated to the country of origin. For other radioactive waste, Ghana is pursuing the borehole disposal concept, designed for the disposal of small quantities of waste. The National Radioactive Waste Registry is used for keeping a national inventory.

The NPI drafted the Management of Spent Fuel and Radioactive Waste for a New Nuclear Power Programme (Ghana) document, outlining the nature and quantities of spent fuel and waste arising from the operation and decommissioning of a NPP and identifying options for management of different waste types. The NRA has prepared a Draft Regulation for the Management of Nuclear and Radioactive Waste, which is focused on the Borehole Disposal System (BDS), but the draft also identifies basic requirements for managing radioactive waste in the predisposal period as well as the operational and post-closure phases of a disposal facility.

The INIR team was informed that gaps and any needed improvements in the legal and regulatory framework related to radioactive waste management will be addressed, including the siting of radioactive waste management facilities. More detailed consideration of different options and technologies for radioactive waste management will be made once the NPP technology has been selected and the waste streams are better known.

The INIR team was informed that Ghana intends to develop a radioactive waste management policy that will include radioactive waste from the nuclear power programme. The draft documents “Policy and Strategy Guidance for Radioactive Waste Management” and “Management of Spent Fuel and Radioactive Waste for a New Nuclear Power Programme (Ghana)” will be used as a basis for this work, which will start in the middle of 2017 and will be performed by the NRA in collaboration with the EPA.

The INIR team was informed that Ghana is aware of the increased human resources needed for radioactive waste management if the nuclear power programme will proceed, and initial considerations for building capacity have already been made. The School of Nuclear and Allied Sciences is considering adding radioactive waste management to its programmes.

The INIR team was informed that the responsibility for radioactive waste management would rest with the operator of the NPP, while the NRA and EPA would be responsible for regulatory control. For the longer term, Ghana is considering the establishment of a radioactive waste management organization and will need to consider interfaces with and transfer of responsibilities from operating organizations.

Areas for further action	**Significant**	No
	Minor	No

RECOMMENDATIONS

None

SUGGESTIONS

None

GOOD PRACTICES

None

17. Radioactive waste management **Condition 17.2: Options for disposal of all radioactive waste categories understood**	**Phase 1**

Summary of the condition to be demonstrated	The NEPIO understands the options for disposal of each of the different waste categories. Although the specific routes for disposal of the different waste categories (including spent fuel if considered as waste) can be decided later, the need to select and plan for adequate options is recognized.
Examples of how the condition may be demonstrated	A document indicating that the NEPIO understands options for disposal of different radioactive waste categories and options for funding these activities.

Review observations

Options for disposal of different waste categories are described in several documents including the draft "Management of Spent Fuel and Radioactive Waste for a New Nuclear Power Programme (Ghana)", prepared by the NPI. The NRA Act (Act 895) requires operators of nuclear installations and radioactive waste management facilities to ensure that appropriate arrangements, including financial arrangements, are made for their decommissioning and the disposal of radioactive waste.

The INIR team was informed that Ghana plans to make further studies of technical options for the disposal of different waste types. They are studying the experience of other countries that are advanced in implementing disposal solutions like France, Finland and Sweden. Ghana is looking specifically at what type of waste it will produce and which type of disposal would be appropriate for

these wastes. Several staff members have visited facilities abroad and established contacts. During these visits they observed the type of reactors, the type of waste generated and the corresponding disposal solutions. Ghana is also considering options for funding waste management. The INIR team was informed that the future policy on radioactive waste management will elaborate on the funding mechanisms.		
Areas for further action	**Significant**	No
	Minor	No
RECOMMENDATIONS		
None		
SUGGESTIONS		
None		
GOOD PRACTICES		
None		

18. Industrial involvement **Condition 18.1: National policy with respect to industrial involvement developed**	**Phase 1**
Summary of the condition to be demonstrated	A policy for national involvement in the nuclear power programme, taking account of current industrial capability and technical services, and current and required quality standards and potential investment requirements have been developed. The policy may include short term and longer term targets for industrial involvement.
Examples of how the condition may be demonstrated	(1) A survey of companies with the potential to participate in the nuclear power programme for construction, equipment provision or support services, with a review of their ability to satisfy the requirements of a nuclear power programme (2) Meetings with or training of potential suppliers to explain standards and qualifications required, review the feasibility of involvement and identify required actions and funding requirements

Review observations

Ghana's Coordinated Programme of Economic and Social Development Policies (CPESDP) seeks to ensure proactive implementation of local content policy and to enact appropriate laws that will ensure that Ghanaians at all levels can participate fully in and directly benefit from industrial development. In this regard, several policies have been developed that could impact the nuclear power programme.

The National Energy Policy (NEP) outlines the government's policy direction for the development of local content and local participation in the energy sector. The Ministry of Energy has developed a local content and local participation policy framework through the Ghana National Petroleum Corporation exclusively for the emerging oil and gas industry. The VRA has established a local content policy for operation and maintenance at its facilities. A local content policy for the electricity supply industry has been drafted, which states that 60% of the materials and services needed in electric power projects should be obtained through local industry by 2025. None of these policies take into account the possibility of the introduction of nuclear power in Ghana.

The umbrella organization for industries in Ghana, the Association of Ghana Industries (AGI), serves on the GNPPO board. This is aimed at ensuring that a strong local industrial base is developed and supported by government policies.

The GNPPO's industrial involvement study includes a desktop survey of companies and their capabilities, a screening of the companies deemed to have requisite competency, site visits to identify companies for further validation of their suitability, and subsequent selection of potentially qualified local industry participants. To contribute to this survey, the AGI has provided a list of members and their capabilities for further evaluation. The Ghana Institution of Engineers has also recommended potentially suitable companies. Preliminary results from the desktop survey indicate that major areas of participation are expected to be in civil plant construction as well as the supply of equipment and spare parts. The outcome of this study will inform the development of a policy document regarding local industry involvement in the NPP project.

The INIR team was informed that this policy is expected to be completed by the 3rd quarter of 2018. This policy will not be integrated into the draft local content policy for the electricity supply industry

and will be issued as a separate policy, solely dedicated to the nuclear power programme. To determine the localization ratio for the nuclear power programme, the GNPPO plans to analyse potential local industry capacity at each possible entry level based on codes and standards employed by respective local industries, investment capability of all potential industries and the availability of human capacity to meet required project schedules. The INIR team noted that Ghana has not yet approached potential NPP vendors for information to support this analysis.		
Areas for further action	**Significant**	GNPPO Policy on Industrial Involvement
	Minor	NPP supplier quality assurance approaches
RECOMMENDATIONS		
R-18.1.1 The GNPPO should develop a policy for national industrial involvement in the nuclear power programme.		
SUGGESTIONS		
S-18.1.1 The GNPPO is encouraged to engage potential NPP suppliers to better understand where Ghanaian industry could participate and to develop awareness of the required quality standards and procedures for qualification of contractors.		
GOOD PRACTICES		
None		

19. Procurement **Condition 19.1: Requirements for purchasing NPP services recognized**		**Phase 1**
Summary of the condition to be demonstrated	Recognition of the requirements associated with purchasing services for pre-project activities.	
Examples of how the condition may be demonstrated	(1) Appropriate procurement of consulting services in Phase 1. (2) Evidence that the issues related to services for Phase 2 activities are recognized, allowing for both national and foreign suppliers.	

Review observations

Since the GNPPO is a governmental organization, the procurement process for any services must follow the guidelines stipulated by the Public Procurement Act 2003 (Act 663). This Act includes a provision for single-source procurement of goods, works and services under specific conditions.

The Public Procurement Act was reviewed as part of the assessment of national laws in relation to the introduction of nuclear power and was found to be satisfactory. The INIR team was informed that minor issues pertaining to governance and confidentiality of information were identified and will be considered in the development of procurement processes as elements of organization-specific management systems.

The INIR team was informed that the NPI has not placed any contracts yet, that the VRA has experience with national and international procurement, and that there are no concerns regarding procurement rules for Phase 2 activities.

Areas for further action	**Significant**	No
	Minor	No

RECOMMENDATIONS

None

SUGGESTIONS

None

GOOD PRACTICES

None

ATTACHMENT 2: LISTS OF THE INIR TEAM AND COUNTERPARTS

INIR MISSION REVIEW TEAM	
Anthony STOTT	Team Leader, IAEA
Sean DUNLOP	Mission Coordinator, IAEA
Abdellah CHAHID	IAEA
Irena MELE	IAEA
Fanny TONOS-PANIAGUA	IAEA
Eberhard GRAUF	International Expert
Stephen MORTIN	International Expert
Itimad SOUFI	International Expert
Loyiso TYABASHE	International Expert

PARTICIPANTS FROM GHANA			
	INFRASTRUCTURE ISSUE	**REPRESENTATIVE**	**RESPONSIBLE ORGANIZATION(S)**
1	**National position**	Benjamin NYARKO (Lead)	Ghana Atomic Energy Commission
		Robert SOGBADJI	Ministry of Power
		Daniel Agyemang WORDSON	Nuclear Power Institute
		Nii K. ALLOTEY	Nuclear Power Institute
		Mawunya DZOBO	Energy Commission
		Seth DEBRAH	School of Nuclear & Allied Sciences
		Charles ADDO	Volta River Authority
		Kwame DARKWA	Volta River Authority
		William Sam APPIAH	Ministry of Power
		Eric DADZIE	Cornerstone Capital Advisors Ltd

2	**Nuclear safety**	Stephen YAMOAH (Lead) Emmanuel AMPOMAH-AMOAKO Matthew ASAMOAH Rex Gyeabour ABREFAH Abdulai KHALILU-LANI Samuel LAMPTEY	Nuclear Power Institute Nuclear Regulatory Authority Nuclear Regulatory Authority Nuclear Regulatory Authority Volta River Authority Volta River Authority
3	**Management**	Charles KLUTSE (Lead) Nii K. ALLOTEY Robert SOGBADJI Charles ADDO Kwame DARKWA Selom DZIDE	Nuclear Power Institute Nuclear Power Institute Ministry of Power Volta River Authority Volta River Authority Nuclear Regulatory Authority
4	**Funding and financing**	Seth DEBRAH (Lead) Benjamin NYARKO Gordon DOE David Dorte OFOSU Robert SOGBADJI Nii K. ALLOTEY Isaac BEDU George DZOTEPE	School of Nuclear & Allied Sciences Ghana Atomic Energy Commission Cornerstone Capital Advisers AB & David/Ghana Infrastructure Investment Fund Ministry of Power Nuclear Power Institute Volta River Authority Volta River Authority

5	**Legal framework**	Margeret AHIADEKE (Lead) Sui Akwayena SEFAKOR Akua Adoma ADDAE Stephen YAMOAH Seyram DZIKUNU Ebenezer APPIAH-OPARE	Ghana Atomic Energy Commission Ghana Atomic Energy Commission Ghana Atomic Energy Commission Nuclear Power Institute BELA Law Firm Nuclear Regulatory Authority
6	**Safeguards**	Stephen YAMOAH (Lead) Joseph GBADAGO Moses ADDO Selom DZIDE Sylvester Attakorah BIRIKORANG Emmanuel AMPOMAH-AMOAKO	Nuclear Power Institute Ghana Atomic Energy Commission Ghana Atomic Energy Commission Nuclear Regulatory Authority Nuclear Regulatory Authority Nuclear Regulatory Authority
7	**Regulatory framework**	Geoffey EMI-REYNOLDS (Lead) Emmanuel AMPOMAH-AMOAKO Augustine FAANU Rex ABREFAH Sylvester Attakorah BIRIKORANG Juanita AYIVOR Innocent K. ABOH	Nuclear Regulatory Authority Nuclear Regulatory Authority Nuclear Regulatory Authority Nuclear Regulatory Authority Nuclear Regulatory Authority Nuclear Regulatory Authority Nuclear Regulatory Authority

8	**Radiation protection**	Selom DZIDE	Nuclear Regulatory Authority
		Emmanuel AMPOMAH-AMOAKO (Lead)	Nuclear Regulatory Authority
		Juanita AYIVOR	Nuclear Regulatory Authority
9	**Electrical grid**	Benjamin NTSIM (Lead)	Ghana Grid Company
		Frederick OKANG	Ghana Grid Company
		Ebenezer ESSIENYI	Ghana Grid Company
		Kasim ABUBAKAR	Ghana Grid Company
		Stephen YAMOAH	Nuclear Power Institute
		Isaac ENNISON	Nuclear Power Institute
		Alphonsine VOEGBORLO	Volta River Authority
		Randolf ESSANDOH	Volta River Authority
10	**Human resource development**	Vincent AGBODEMEGBE (Lead)	Nuclear Power Institute
		Stephen YAMOAH	Nuclear Power Institute
		Andrew NYAMFUL	Nuclear Power Institute
		Evelyn DONKOR	Council for Technical and Vocational Education and Training
		Emmanuel NEWMAN	Council for Technical and Vocational Education and Training
		Lloyd Sydney ABBEY	Accra Technical University
		Juanita AYIVOR	Nuclear Regulatory Authority
		Foster OPARE	Volta River Authority

11	**Stakeholder involvement**	George APPIAH (Lead)	Nuclear Power Institute
		Vincent AGBODEMEGBE	Nuclear Power Institute
		Elikem AHIALEY	Nuclear Power Institute
		Awua Kofi ADOLF	Ghana Atomic Energy Commission
		Shiela GBORMITTAH	Nuclear Regulatory Authority
		Bellona-Gerard VITTOR-QUAO	Volta River Authority
		Peter Takyi PEPRAH	Ghana Statistical Service
		Rockson R. GBANDE	National Commission for Civic Education
		Christabel ADDO	Ghana News Agency
12	**Site and supporting facilities**	Alberta BLAY (Lead)	Nuclear Power Institute
		Nii K. ALLOTEY	Nuclear Power Institute
		Alex BOATENG	Nuclear Power Institute
		Emmanuel Teye MENSAH	Ghana Atomic Energy Commission
		Owiredu GYAMPO	Ghana Atomic Energy Commission
		Peter DAVOR	Ghana Atomic Energy Commission
		Nicholas OPOKU	Geological Survey Department
		Saviour ALOMATU	Geological Survey Department
		Carlien BOU-CHEDID	Ghana Institution of Engineers
		Joseph ODDEI	Ghana Institution of Engineers
		Enyo MATREVI	Ghana Highway Authority

13	**Environmental protection**	Alberta BLAY (Lead)	Nuclear Power Institute
		Alex AGYENIM-BOATENG	Nuclear Power Institute
		Godfred ASUMADU-SAKYI	Nuclear Power Institute
		Owiredu GYAMPO	Ghana Atomic Energy Commission
		David SAKA	Ghana Atomic Energy Commission
		Joseph TANDOH	Ghana Atomic Energy Commission
		Celestina ALLOTEY	Golder Associates, Ghana
		Gabriel ENGMANN	Anglogold Ashanti Ltd.
		George ROCKSON	Zoomlion Ltd.
		Lovelace SARPONG	Environmental Protection Agency
		Kwabena BADU-YEBOAH	Environmental Protection Agency
14	**Emergency planning**	Joseph ANKRAH (Lead)	National Disaster Management Organization
		Cyril SCHANDORF	School of Nuclear & Allied Sciences
		Daniel WORDSON	Nuclear Power Institute
		Geoffrey EMI-REYNOLDS	Nuclear Regulatory Authority
		Perter DAVOR	Ghana Atomic Energy Commission
15	**Nuclear security**	William Kofi BAFFOE-MENSAH (Lead)	National Security Secretariat
		Stephen YAMOAH	Nuclear Power Institute
		Geoffrey EMI-REYNOLDS	Nuclear Regulatory Authority
		EmmanuelAMPOMAH-AMOAKO	Nuclear Regulatory Authority

16	**Nuclear fuel cycle**	Kofi TUFFOUR-ACHAMPONG (Lead) Isaac ENNISON Felix AMEYAW Robert SOGBADJI Emmanuel AMPOMAH-AMOAKO	Nuclear Power Institute Nuclear Power Institute Nuclear Power Institute Ministry of Power Nuclear Regulatory Authority
17	**Radioactive waste management**	Eric GLOVER (Lead) Godfred ASUMADU-SAKYI Kofi TUFFUOR-ACHAMPONG Celestina ALLOTEY Gabriel ENGMANN George ROCKSON Lovelace SARPONG Kwabena BADU-YEBOAH	Ghana Atomic Energy Commission Nuclear Power Institute Nuclear Power Institute Golder Associates, Ghana Anglogold Ashanti Ltd. Zoomlion Ltd. Environmental Protection Agency Environmental Protection Agency
18	**Industrial involvement**	Nii K. ALLOTEY (Lead) Vincent AGBODEMEGBE Alexander NATHAN Rockson DOGBEGA Jonathan AMOAKO-BAAH William ANIGYEI	Nuclear Power Institute Nuclear Power Institute Association of Ghana Industries Berock Ventures Limited Volta River Authority Ghana Institution of Engineers

19	**Procurement**	Isaac BEDU (Lead)	Volta River Authority
		George DZOTEPE	Volta River Authority
		Seth DEBRAH	School of Nuclear & Allied Sciences
		Sui Akwayena SEFAKOR	Ghana Atomic Energy Commission
		Nii K. ALLOTEY	Nuclear Power Institute

ATTACHMENT 3: REFERENCES

Documents Provided by Ghana

Government documents

1. Government of Ghana, Criminal Code Act, 1960 (Act 29), Ghana.
2. Government of Ghana, Administration of Lands Act 1962, (Act 123), Ghana.
3. Government of Ghana, Ghana Atomic Energy Commission Act 1963 (Act 204), Ghana.
4. Government of Ghana, State Lands Act 1962, (Act 125), Ghana.
5. Government of Ghana, Factories, Shops and Offices Act, 1970 (Act 328), Ghana.
6. Government of Ghana, Ghana Ports and Harbours Authority Act 1986, PNDC Law 186, Ghana.
7. Government of Ghana, The Constitution of the Republic of Ghana, 1992, Ghana.
8. Government of Ghana, Customs, Excise and Preventive Service Law of 1993, PNDC Law 330, Ghana.
9. Government of Ghana, National Council for Tertiary Education, 1993 (Act 454), Ghana.
10. Radiation Protection Instrument, LI 1559, 1993, Radiation Protection Board, Ghana.
11. Government of Ghana, Environmental Protection Agency Act 1994 (Act 490), Ghana.
12. National Environmental Action Plan, Environmental Protection Council, Ghana, 1994.
13. Radiation Protection and Safety Guide GRPB-G1: Qualification and Certification of Radiation Protection Personnel, Radiation Protection Board, November 1995.
14. Radiation Protection and Safety Guide GRPB-G2: Notification and Authorization by Registration or Licensing, Exemption and Exclusion, Radiation Protection Board, November 1995.
15. Government of Ghana, National Disaster Management Organization Act 1996 (Act 517), Ghana.
16. Government of Ghana, Water Resources Act 1996 (Act 522), Ghana.
17. Government of Ghana, Security and Intelligence Agencies Act, 1996 (Act 526), Ghana.
18. Government of Ghana, Energy Commission Act 1997 (Act 541), Ghana.
19. Environmental Assessment Regulations, LI 1652, Environmental Protection Agency, 1999, Ghana.

20. National Land Policy, Ministry of Lands and Natural Resources, Ghana, 1999.

21. Government of Ghana, Ghana Atomic Energy Commission Act 2000 (Act 588), Ghana.

22. Water Use Regulation, LI 1692, Water Resource Commission, 2001, Ghana.

23. Radiation Protection and Safety Guide GRPB-G6: Safe Transport of Radioactive Materials, Radiation Protection Board, June 2002.

24. Radiation Protection and Safety Guide GRPB-G7: Enforcement of Regulations, Radiation Protection Board, June 2002.

25. Radiation Protection and Safety Guide GRPB-G8: Occupational Radiation Protection, Radiation Protection Board, June 2002.

26. Radiation Protection and Safety Guide GRPB-G9: Medical Exposure, Radiation Protection Board, June 2002.

27. Government of Ghana, Ghana Shipping Act 2003, (Act 645), Ghana.

28. Government of Ghana, Labour Act 2003 (Act 651), Ghana.

29. Government of Ghana, Public Procurement Act 2003 (Act 663), Ghana.

30. Radiation Protection and Safety Guide GRPB-G10: Safe Application of Industrial Radiography, Radiation Protection Board, June 2003.

31. Government of Ghana, Road Traffic Act, 2004 (Act 683), Ghana.

32. Government of Ghana, Maritime Security Act, 2004 (Act 675), Ghana.

33. Trade Sector Support Programme (TSSP), Ministry of Trade & Industry, 2005.

34. Government of Ghana, Minerals and Mining Act 2006 (Act 703), Ghana.

35. Government of Ghana, Council for Technical and Vocational Education and Training Act 2006 (Act 718), Ghana.

36. Strategic National Energy Plan, 2006-2020, Energy Commission, Ghana, July 2006.

37. National Water Policy, Ministry of Water, Works & Housing, June 2007.

38. Government of Ghana, Anti-Money Laundering Act, 2008 (Act 789), Ghana.

39. Government of Ghana, Anti-Terrorism Act, 2008 (Act 762), Ghana.

40. National Science, Technology & Innovation Policy (Draft), MESTI, September 2009.

41. National Electricity Grid Code, Energy Commission, Ghana, October 2009.

42. National Emergency Response Procedures in the Event of Nuclear or Radiological Accident, NADMO & GAEC, January 2010.

43. National Energy Policy, Ministry of Energy, Ghana, February 2010.

44. Local Content and Local Participation in Petroleum Activities – Policy Framework, February 2010.

45. Education Strategic Plan – Strategies and Workplan, Ministry of Education, 2010.

46. Ghana Industrial Policy, Ministry of Trade & Industry, 2010.

47. Industrial Sector Support Programme (ISSP), Ministry of Trade & Industry, 2010.

48. National Nuclear and Radiological Emergency Response Plan, NADMO & GAEC, 2010.

49. National Disaster Management Plan, NADMO, 2010 (not attached).

50. EPA Energy Sector Guidelines Development, Volume Report 2, 2011, Ghana.

51. Generation Master Plan Study for Ghana, Final Report, GRIDCo, November, 2011.

52. Government of Ghana, Renewable Energy Act, 2011 (Act 832), Ghana.

53. Government of Ghana, Criminal Offences Act, 2012 (Act 849), Ghana.

54. National Environmental Policy, Environmental Protection Agency, Ghana, 2012.

55. Ghana – Integrated Nuclear Security Support Mission Report, 2013 (not attached, classified).

56. Ghana – Integrated Nuclear Security Support Plan - 2013 (not attached, classified).

57. Coordinated Programme for Economic and Social Development Policies (2014-2020), An Agenda for Transformation, December 2014.

58. Government of Ghana, National Disaster Management Organization Bill 2015, Ghana.

59. Basic Radiation Control Regulations (Draft), 2015.

60. Ghana – EPREV Mission Report, 2015 (not attached, classified).

61. Ghana – EPREV Action Plan, 2015 (not attached, classified).

62. Ghana Country Report: Ghana's Intended Nationally Determined Contribution, 2015.

63. Government of Ghana, Customs Act, 2015 (Act 891), Ghana.

64. Government of Ghana, Nuclear Regulatory Authority Act 2015 (Act 895), Ghana.

65. National Chemical, Biological, Radiological and Nuclear Emergency Response Plan, National Security Council (not attached, classified).

66. Local Content Policy for Electricity Supply Industry, Ministry of Power, January 2016.

67. Nuclear Regulatory Authority Safeguards Regulation (Draft), 2016.

68. Regulations for Nuclear and Radioactive Waste Management (Draft), 2016, Nuclear Regulatory Authority, Ghana.

69. Government of Ghana, Public Procurement (Amendment) Act, 2016 (Act 914), Ghana.

GNPPO documents & records

70. NPID-128000-IFD-002, Sustainable Energy Development Plan, 2006 – 2020 - Ghana Country Study, 2007.

71. NPID-300000-OLT-002, Letter to IAEA on Formation of GNPPO, GNPPO, November 2012.

72. NPID-318100-DSG-030, Document Numbering System, GNPPO, Rev.0, June 2013.

73. NPID-300000-OLT-001, Official Notice to IAEA, GNPPO, August 2013.

74. NPID-12100-POD-019, Siting Charter, GNPPO, Rev. 0, December 2013.

75. NPID-12400-STG-033, Siting Strategy, GNPPO, Rev. 0, March 2014.

76. NPID-12300-ANL-033, Regional Analysis, GNPPO, Rev. 0, April 2014.

77. NPID-120000-MIN-001, GNPPO Minutes, April 2014.

78. NPID-31100-POD-001, Plan of Action for Nuclear Reactor Technology Assessment in Ghana, GNPPO, Rev. 0, July 2014.

79. NPID-127540-CFR-002, Siting & Environmental Stakeholder Forum Report, GNPPO, Rev. 0, July 2014.

80. NPID-11521-STG-001, Regulatory Strategy, GNPPO, Rev. 0, September 2014.

81. NPID-120000-RPT-002, RPI-NPI Editor's Forum Report, September 2014.

82. NPID-12000-IFD-002, Data Information Document, GNPPO, Rev. 0, October 2014.

83. NPID-120000-MIN-002, GNPPO Minutes, January 2015.

84. NPID-12000-CFR-001, Geology & Seismology Stakeholder Forum Report, May 2015.

85. NPID-120000-MIN-007, Siting Report on Russian Fellowship, May 2015.

86. NPID-300000-MIN-003, NPC – Regulatory Group Minutes, June 2015.

87. NPID-120000-MIN-004, NPC – Clime Investments Meeting Minutes, June 2015

88. NPID-120000-RPT-003, GIIF Funding Proposal, GNPPO, October 2015

89. NPID-127610-QST-001, Survey on Quality Management System, GNPPO, Rev. D2, October 2015.

90. NPID-120000-QST-002, Survey on Industrial Perception and Interest in Ghana's Nuclear Power Programme, GNPPO, Rev. D2, October 2015.

91. NPID-120000-QST-003, Survey on Public Perception and Interest in Ghana's Nuclear Power Programme, GNPPO, Rev. D2, October 2015.

92. NPID-305100-STG-003, Budget and Funding Sources for Ghana's Nuclear Power Programme, GNPPO, Rev. 0, December 2015.

93. NPID-305100-STG-007, Stakeholder Engagement Strategy, GNPPO, Rev. D2, December 2015.

94. NPID-120000-STG-001, The Roadmap for Ghana Nuclear Power Programme, GNPPO, Rev. 0, December 2015.

95. NPID-10000-TEC-001, Quality Assurance Framework for Siting Activities, GNPPO, Rev. 0, December 2015.

96. NPID-120000-MIN-003, GNPPO Minutes, December 2015.

97. NPID-120000-CCP-001, GNPPO Concept and Working Document, GNPPO, Rev. 0, January 2016.

98. NPID-318100-DSG-033, Document Review Process, GNPPO, Rev. D1, January 2016.

99. NPID-305100-STG-005, Financing, Ownership and Procurement Options for Ghana Nuclear Power Project, GNPPO, Rev. D1, February 2016.

100. NPID-10000-RPT-002, Geology & Seismology 2nd Stakeholder Forum Report, February 2016.

101. NPID-127540-DSG-001, Industrial Involvement Guidance Document, Rev. D1, February 2016.

102. NPID-128000-STG-003, Spent Fuel & Radioactive Waste Management Options, GNPPO, Rev. D1, March 2016.

103. NPID-305100-STG-004, Nuclear Energy Policy, GNPPO, Rev. D1, February 2016.

104. NPID-12000-IFD-002, Candidate Area Assessment: Geology and Seismology Considerations, GNPPO, Rev. D1, March 2016.

105. NPID-120000-MIN-006, 1st Energy Planning Group Meeting Minutes, March 2016.

106. NPID-300000-TNT-001, Summary of Bilateral Cooperation on Ghana's Nuclear Power Programme, 2016.

107. NPID-120000-TNT-008, TC Programmes with IAEA on Nuclear Power, 2016.

108. NPID-12000-NWT-001, GNPPO Newsletters, GNPPO, June, 2016.

109. NPID-10000-RPT-003, Report on Interregional Training Course: Train the Trainer for Embarking Countries – Phase 1 of the Milestones Approach, June 2016.

110. NPID-127540-NWL-002-005, GNPPO Newsletters, GNPPO, July-Oct, 2016.

111. NPID-120000-TNT-001, Flow Chart for Siting Activity Processes, July 2016.

112. NPID-313000-MAN-001, Standard Operating Procedure for Field Data Collection, Rev. 0, July 2016.

113. NPID-313000-MAN-002, Standard Operating Procedure for Existing Data Collection, Rev. 0, July 2016.

114. NPID-120000-RPT-001, US NRC – NRA Safeguards Regulation Drafting Workshop Report (Draft), July 2016.

115. NPID-127540-TNT-005, US NRC -Ghana Nuclear Regulatory Authority Action Plan, August 2016.

116. NPID-127540-STG-002, Communication Strategy, GNPPO, Rev. D1, September 2016.

117. NPID-120000-CFR-001, Ghana Report on 60th IAEA General Conference, September 2016.

118. NPID-31100-TEC-003, Guidelines for Assessing Nuclear Power Technologies for Commercial Operation in Ghana, Rev. D1, September 2016.

119. NPID-127540-MEM-002, NRA Action Plan on IAEA 60th General Conference, September 2016.

120. NPID-12000-IFD-002, Human Resource Development Plan, GNPPO, Rev. D1, October 2016.

121. NPID-305100-STG-006, Human Resource Development Guidance Document, GNPPO, Rev. D3, October 2016.

122. NPID-127560-TEC-001, Ghana Grid Reinforcement Projects, Rev. D1, October 2016.

123. NPID-127550-DSG-001, Policy and Strategy Guidance for Radioactive Waste Management, GNPPO, Rev. D1, October 2016.

124. NPID-128000-STG-002, Nuclear Fuel Cycle Strategy, GNPPO, Rev. D2, October 2016.

125. NPID-127540-TNT-001, 2017 Ghana NPP TC Programme Status, October 2016

126. NPID-318100-DSG-032, Security Classifications for Documents and Records, GNPPO, Rev. 0, October 2016.

127. NPID-127560-TEC-002, Assessment of the Ghanaian and West African Grid Networks for Nuclear Power Operation, GNPPO, Rev. D1, November 2016.

128. NPID-312000-DSG-001, Assessment of National Laws in Relation to the Introduction of Nuclear Power, GNPPO, Rev. D1, November 2016.

129. NPID-312000-DSG-001, Management System Map, Rev. D1, November 2016.

130. NPID-310000-STG-001, Guidelines for GNPPO Management System, GNPPO, Rev. D3, November 2016.

131. NPID-312000-DSG-002, GNPPO Guidelines on the Identification of Processes, GNPPO, Rev. D1, November 2016.

132. NPID-127540-STG-003, Industrial Involvement Plan, GNPPO, Rev. D1, November 2016.

133. NPID-127560-ANL-001, Macro-economic Benefits of Ghana's Nuclear Energy Programme: an ex ante analysis, GNPPO, Rev. D1, November 2016.

134. NPID-120000-RPT-002, VRA Training on the Trainer Phase 1 Workshop Report, November 2016.

135. NPID-127540-TNT-004, NRA Plans for Development of Regulations, 2016.

136. NPID-127540-TNT-005, NRA Organizational Structure – Startup & Officers, 2016.

Other Documents

137. IAEA Information Circular, INFCIRC/226/Add. 1, November 1998.

138. IAEA Information Circular, INFCIRC/226/Add. 2, October 2004.

139. Report to advise Government on the Potential Use of Nuclear Energy for Power Generation in Ghana, December 2007.

140. Ghana Atomic Energy Commission, Integrated Safety Assessment of Research Reactors (INSARR), Ghana Country Report, 2009.

141. IAEA Information Circular, INFCIRC/226/Mod.1, March 2012, Ghana.

142. Ghana Atomic Energy Commission, GAEC Corporate Strategic Plan 2012-2016, 2012.

143. VRA Local Content Policy Document, Volta River Authority, April 2012.

144. VRA-NPC Nuclear Feasibility Letter, January 2015.

145. National Infrastructure Plan Brochure, Long Term Development Plan, National Development Planning Commission, 2015.

146. Ghana Infrastructure Development Initiative (GIDI) Brochure, December 2015.

147. IAEA End-of-Mission Report: Stakeholder Involvement and Nuclear Power Communications, April 2016.

148. IAEA End-of-Mission Report: Management System Development Workshop for Nuclear Power, May 2016.

149. Scholarship Letter from KEPCO International Nuclear Graduate School, September 2016.

150. Information Copy of VRA Consent Letter to Ministry of Power, October 2016.

151. IAEA, Available Online [https://ola.iaea.org/ola/FactSheets/ CountryDetails.asp?country =GH, accessed November 24, 2016].

152. School of Nuclear & Allied Sciences (SNAS), Brochure on SNAS.

153. Volta River Authority Academy Brochure, Akuse, Eastern Region, Ghana.

154. Presentation on the topic, "After Nuclear Bill How Prepared is Ghana for Nuclear Power".

155. Presentation on the topic "Developing National Energy Strategy for Introduction of Nuclear Power: Ghana Case Study", Presentation at 3rd African Regional Nuclear Power Conf.

156. Presentation on the topic, "Summary of key points from each session", Presentation at 3rd African Regional Nuclear Power Conf."

157. Presentation on the topic, "Ghana's Achievements in the Nuclear Field and Establishment of Nuclear Security Regime".

158. Presentation on the topic, "Nuclear Security Education in Ghana Plan of Action and Outlook".

159. Presentation on the topic, "Nuclear as an Alternative Energy Source for Sustainable Economic Development".

160. Presentation on the topic, "Nuclear Energy: Solution to Africa's Energy Needs?"

161. Presentation on the topic "Nuclear Power, a Lawyer's Perspective".

162. Presentation on the topic, "Nuclear Power, Ghana at the Crossroads".

163. Presentation on the topic, "Nuclear Security Education in Ghana".

164. Example Courses Documents Folder.

165. Sample Course Notes on Siting by US NRC Folder.

IAEA Documents

1. Considerations to Launch a Nuclear Power Programme, GOV/INF/2007/2/COLOUR, IAEA, Vienna (2007).
2. Milestones in the Development of a National Infrastructure for Nuclear Power, Nuclear Energy Series No. NG-G-3.1 (Rev. 1), IAEA, Vienna (2015).
3. Evaluation of the Status of National Nuclear Infrastructure Development, Nuclear Energy Series No. NG-T-3.2 (Rev. 1), IAEA, Vienna (2016).
4. INIR, Integrated Nuclear Infrastructure Review Missions – Guidance on Preparing and Conducting INIR Missions. (Rev.1), IAEA, Vienna (2011).

5. Establishing the Safety Infrastructure for a Nuclear Power Programme, Safety Standards Series No. SSG-16, IAEA, Vienna (2012).

6. Introducing Nuclear Power Plants into Electrical Power Systems of Limited Capacity: Problems and Remedial Measures, Technical Report Series TRS No. 271, IAEA, 1987.

7. Methodology for the Systematic Assessment of the Regulatory Competence Needs (SARCoN) for Regulatory Bodies of Nuclear Installations Evaluation of the Status of National Infrastructure Development, TECDOC-1757, IAEA, Vienna 2015.

8. Fundamental Safety Principles (Safety Standards No. SF-1, IAEA, Vienna (2006) and applicable IAEA Safety Standards.

9. IAEA Expert Mission reports.

ATTACHMENT 4: ACRONYMS

AGI	Association of Ghana Industries
BDS	Borehole disposal system
BOOT	Build-own-operate-transfer
CEO	Chief executive officer
COTVET	Council for Technical and Vocational Education and Training
CPESDP	Coordinated Programme of Economic and Social Development Policies
CSA	Comprehensive safeguards agreement
EIA	Environmental impact assessment
EPA	Environmental Protection Agency
EPC	Engineering, procurement and construction
EPREV	Emergency Preparedness Review
ESIA	Environmental and social impact assessment
FNRBA	Forum of Nuclear Regulatory Bodies in Africa
GAEC	Ghana Atomic Energy Commission
GHARR-1	Ghana Research Reactor-1
GIIF	Ghana Infrastructure Investment Fund
GIMPA	Ghana Institute of Management and Public Administration
GIS	Geographical information system
GNPPO	Ghana Nuclear Power Programme Organisation
GRIDCo	Ghana Grid Company
GRPB	Ghana Radiation Protection Board
GSS	Ghana Statistical Service
HLW	High-level radioactive waste
IAEA	International Atomic Energy Agency
INIR	Integrated Nuclear Infrastructure Review

INSC	Instrument for Nuclear Safety Cooperation
INSServ	International Nuclear Safety & Security Advisory Service
INSSP	Integrated Nuclear Security Support Plan
IPPAS	International Physical Protection Advisory Service
KEPCO	Korea Electric Power Corporation
LSSC	Localization and Stakeholder Support Centre
MESTI	Ministry of Environment, Science, Technology and Innovation
MWe	Megawatt electric
NADMO	National Disaster Management Organization
NCBRN-ERP	National Chemical, Biological, Radiological and Nuclear Emergencies Response Plan
NCTE	National Council for Tertiary Education
NDMP	National Disaster Management Plan
NEP	National Energy Policy
NEPIO	Nuclear Energy Programme Implementing Organization
NERPNRA	National Emergency Response Procedures in the event of a Nuclear or Radiological Accident
NNRERP	National Nuclear and Radiological Emergency Response Plan
NPI	Nuclear Power Institute
NPMC	Nuclear Programme Management Centre
NPP	Nuclear power plant
NRA	Nuclear Regulatory Authority
NRWMC	National Radioactive Waste Management Centre
NVTI	National Vocational Training Institute
OHSAS	Occupational Health and Safety Assessment Series
PPA	Power purchase agreement
PPP	Public-private partnership
PRIC	Public Relations and Information Centre

PUI	Peaceful Uses Initiative
RASSIA	Radiation Safety and Security of Radioactive Sources Infrastructure Appraisal
RPI	Radiation Protection Institute
S&E	Siting and Environmental Workgroup
SER	Self-evaluation report
SES	Stakeholder Engagement Strategy
SNAS	School of Nuclear and Allied Sciences
SNEP	Strategic National Energy Plan
SSAC	State system of accounting for and control of nuclear material
TC	Technical cooperation
TSO	Technical support organization
VRA	Volta River Authority
WRI	Water Research Institute