International Journal of Nuclear Security

Volume 7 | Number 1 Article 15

4-28-2022

An Overview of Approaches to Nuclear Security in Ghana

Raymond Agalga
Ghana Atomic Energy Commission

Paul Atta Amoah
Ghana Atomic Energy Commission

Daniel Nii Adjei
Ghana Atomic Energy Commission

Daniel Frederick Charles
Ghana Atomic Energy Commission

Emmanuel Ofori Darko
Ghana Atomic Energy Commission

Recommended Citation

Agalga, Raymond; Amoah, Paul Atta; Adjei, Daniel Nii; Frederick Charles, Daniel; and Darko, Emmanuel Ofori (2022) "An Overview of Approaches to Nuclear Security in Ghana," *International Journal of Nuclear Security*: Vol. 7: No. 1, Article 15.
https://doi.org/10.7290/ijns07p55h
Available at: https://trace.tennessee.edu/ijns/vol7/iss1/15

International Journal of Nuclear Security, Vol.7, No.1, 2022

An Overview of Approaches to Nuclear Security in Ghana

Raymond Agalga[1], Paul Atta Amoah[1], Daniel Nii Adjei[1], Daniel Frederick Charles[1], and Emmanuel Ofori-Darko[2]
[1]Nuclear Safety and Security Centre, Radiation Protection Institute, Ghana Atomic Energy Commission, Accra
[2]Radiation Protection Institute, Ghana Atomic Energy Commission, Accra

Abstract

Ghana has significantly improved its nuclear security infrastructure over the years. However, as threats increase by the day and new applications of nuclear and radiological technology are designed and implemented, Ghana must develop a rigid and comprehensive approach to mitigating the negative impacts on its nuclear security while improving prevention, detection, and deterrence of nuclear and radiological terrorism within its geographical space. This paper overviews the approaches adopted by Ghana to build a strong nuclear security regime within the past decade. These include improving legal frameworks for nuclear security by establishing an independent Nuclear Regulatory Authority; assessing nuclear security culture in facilities; strengthening nuclear security capabilities at facilities that hold radioactive materials by improving physical protection systems for deterrence and detection; and building strong and effective collaboration and cooperation with various stakeholders, both locally and internationally, to distribute responsibility and provide technical and logistic support to build a stronger nuclear security regime. Ghana also identified developments in human capacity in areas of nuclear security as a relevant approach to improving its nuclear security and has thus collaborated with the IAEA and the University of Ghana to establish a graduate school for training Ghanaians and Africans in nuclear-related disciplines.

Keywords: Nuclear Security, Cooperation, Nuclear Security Regime, Ghana

I. Introduction

Nuclear security is an ever-growing concern. This is due to the "growing threat from sub-national groups and terrorist networks that could exploit the benefits of greater openness and connectivity of the international community for criminal purposes" **[*1*]**. Protection of nuclear and radioactive materials and their associated facilities and activities "is indeed one of the most effective ways of preventing the

doi: 10.7290/ijns07p55h

International Journal of Nuclear Security, Vol.7, No.1, 2022

catastrophic consequences that could result from terrorists gaining access to a nuclear explosive device" **[*1*]**.

Between 2010 and 2016, four Nuclear Security Summits (NSS) were held, initiated by U.S. President Barack Obama. The Nuclear Security Summits were a series of international conferences that specifically addressed the threat to nuclear and other radiological materials from non-state actors. According to Amandeep Gill, the success of these summits in dealing with the threat of nuclear terrorism taught us valuable lessons for now and the future **[*2*]**.

The first Summit was held in Washington, D.C. in 2010. In total, 47 countries and 3 international organizations took part in the two-day summit. Among others, the summit recognized that highly enriched uranium (HEU) and separated plutonium require specific safeguards, and recommended the conversion of reactors from HEU to LEU fuel.

In March 2012, 53 countries and four international organizations gathered in Seoul for the second Nuclear Security Summit. This was held as a follow-up to the Washington summit and was critical for both institutionalizing and expanding upon the nuclear security gains of the April 2010 Summit. The Seoul summit reaffirmed "the fundamental responsibility of States to maintain effective security of other radioactive materials on par with a similar responsibility for nuclear material and nuclear facilities" **[*3*]**. The summit also resolved to reduce the global stockpile of HEU by urging member states to minimize use of HEU, and to consider converting noncommercial reactors from HEU to LEU fuel. It also emphasized the need for states "to develop national capabilities to combat illicit nuclear trafficking" by "utilizing nuclear forensics, investing in the promotion of a strong nuclear security culture, and preventing non-state actors from obtaining" nuclear materials and radioactive materials by properly transporting, accounting for, consolidating, and storing these materials **[*4*]**.

The third Nuclear Security Summit was organized March 24-25, 2014, in the Hague, Netherlands. All 53 countries and four international organizations who met in 2012 were present at this third summit. Key takeaways from the summit included the recognition that there are "a range of voluntary measures States may consider taking to show that they have established effective security of their nuclear materials and facilities while protecting sensitive information. Such measures include exchanging good practices, inviting IAEA review and advisory services, and following through on recommendations," as well as further development of training personnel involved in nuclear security **[*4*]**.

From March 31 to April 1, 2016, the fourth and final summit was held in Washington, D.C. The fourth summit agreed upon Action Plans—steps for bolstering the global institutions those countries have united to support (i.e., the United Nations, the IAEA, INTERPOL, the GICNT, and the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction). Following four successful Nuclear Security Summits, it has become clearer that a global effort for nuclear security is needed to protect and secure radioactive materials and their associated facilities and activities globally.

Nuclear and radiological terrorism remains a real, serious, and urgent danger to global security **[*5*]**. In September 2001, the terrorist strikes on the United States demonstrated that terrorist organizations, if well-coordinated and funded, could also assail a nuclear facility **[*1, 6*]**. According to the International Atomic Energy Agency (IAEA), member states should use "proper material control and accounting measures," encourage cooperation between "law enforcement and intelligence agencies in conducting accurate threat assessment," establish "robust physical protection systems for materials and facilities," create "an authoritative and independent regulatory body," and promote "a nuclear security culture in all organizations that deal with nuclear materials" **[*1, 7*]**. Each state gets to decide how to protect its own nuclear resources and how to put these goals into action. Simultaneously, the international community has agreed upon some legal blueprints for building international nuclear security—for example, the

doi: 10.7290/ijns07p55h

International Journal of Nuclear Security, Vol.7, No.1, 2022

Convention on the Physical Protection of Nuclear Material **[*8*]**, the International Convention for the Suppression of Acts of Nuclear Terrorism **[*9*]**, and UN Security Council resolutions 1373 **[*10*]** and 1540 **[*11*] [*1*]**.

In Africa, inadequate prevention, detection, and response mechanisms to malicious acts involving nuclear or other radioactive materials have been identified as priorities. Together with the IAEA, African Member States of the IAEA have taken steps to enhance their systems for safeguarding nuclear and other radioactive materials during use, storage, and transportation, as well as preventing criminal trafficking of such materials. According to the Africa Regional Cooperative Agreement for Research, Development and Training related to Nuclear Science and Technology (AFRA), nuclear security is a global issue of regional significance and a priority for enhanced regional cooperation **[*12*]**. Thus, cooperation in the area of nuclear security between AFRA Member States and the IAEA has increased consistently since 2002. This paper looks at Ghana's approach to advancing its nuclear security infrastructure.

II. Overview of Ghana's Peaceful Applications of Nuclear Technology

The peaceful application of radioactive materials in Ghana began in 1952 with research involving radioactive materials at the University College of Gold Coast, now University of Ghana, Legon **[*13*]**. The use of radioactive materials has since increased, with numerous economic benefits deriving from peaceful application of radioactive materials. They are used for "diagnostic and therapeutic procedures in medicine, measurement and processing techniques in industry, irradiation techniques for food preservation, and sterilization of medical products," as well as for teaching and research **[*14*]**. Most of these radioactive materials are in the form of sealed radioactive sources. Ghana Atomic Energy Commission (GAEC) is currently the lead agency when it comes to issues involving peaceful use of nuclear technology in Ghana.

Currently, GAEC has a research reactor to study neutron activation analysis and reactor physics, a wet source storage gamma irradiator (Category I) for industrial sterilization and irradiation of food products, a secondary standard dosimetry laboratory for calibration of radiation measuring devices, and the only radioactive waste management facility in Ghana for temporal storage of disused and orphaned radioactive sources in Ghana. There are also two radiotherapy facilities that employ radio isotopes in treating cancer in Ghana.

The increase in peaceful uses of nuclear materials and radioactive substances for health, agriculture, industry, and research made it imperative to put in place the necessary structures. This nuclear security architecture ensures that these materials and facilities are well regulated for the safety of people and the environment and for the physical protection of materials and substances in line with international legal instruments. Until 2015, the Radiation Protection Board (RPB), established under GAEC in 1993 by Provisional National Defense Council (PNDC) Law 308 and empowered with the Legislative Instrument (LI) 1559, acted as the regulatory authority in Ghana. The establishment of the RPB instituted a regime of licensing, registration, and inspection of all radioactive materials and facilities in Ghana. RPB enforced the code of practices ensuring radiation safety in Ghana. In 2015, Ghana passed the Nuclear Regulatory Authority Act (Act 895), establishing an independent regulatory authority to replace the Radiation Protection Board.

III. Strengthening the Legal and Regulatory Regime

The Nuclear Regulatory Authority Act (Act 895) revoked the Radiation Protection Instrument, LI 1559, which established the Radiation Protection Board under GAEC by PNDC Law 308 in 1993. It established in its place a new body, the Nuclear Regulatory Authority (NRA), as the statutory nuclear regulatory authority in Ghana, independent of GAEC. Act 895 covers the regulation and management of activities

doi: 10.7290/ijns07p55h

International Journal of Nuclear Security, Vol.7, No.1, 2022

and practices for the peaceful uses of nuclear energy and nuclear and radioactive materials. The NRA's statutory functions include the establishment of regulations, authorization through registration and licensing, inspection, and enforcement **[*15*]**.

Regulations are being developed in line with IAEA requirements. Currently, the NRA has draft regulations on nuclear and other radioactive material security, consolidating the Regulations on Radioactive Sources; Regulations on Nuclear Materials and Facilities; Regulations on Transport of Nuclear Materials and Radioactive sources; Emergency Preparedness & Response for Authorized Persons; Safeguards Regulations; Licensing of Nuclear Installations; and Management System Requirements for Authorized Persons and Regulations on Siting of Nuclear Installations **[*16*]**. The law also "specifies the key functions and activities that are very important for [an] effective regulatory system, including notification, authorization, inspection, and enforcement" **[*17*]**. The law prohibits regulated activities from being conducted by anyone in Ghana unless they are authorized by the Regulatory Authority. It also penalizes non-compliance with the law and makes room for financial arrangements to fund the Authority for effective implementation of the NRA activities.

The Nuclear Regulatory Authority Act (Act 895) requires the NRA to "establish and maintain a national system for registering, licensing, and accounting for nuclear materials and radiation sources" **[*15*]**. The IAEA developed software, the Regulatory Authority Information System (RAIS), which is therefore being used by the NRA to maintain an inventory of radioactive materials in use within the country and to develop prospective radioactive waste—including disused sealed sources—describing their location, physical and chemical form, and radiological properties that will be generated.

IV. Collaboration between National Stakeholders

Nuclear security is a multi-sectorial activity that requires input from several national stakeholders. In Ghana, a national nuclear security committee has been formed and is facilitated by the NRA. The committee meets regularly to deliberate on issues relating to nuclear security and to foster cooperation and collaboration in such areas within the country. This committee has representatives from governmental agencies, such as the Customs Excise and Prevention Services, the National Security Council, the Bureau of National Investigations, the National Disaster Management Organization, and Fire Services. Representatives of these state organizations are trained in nuclear security, nuclear safety, radiation detection, and protection procedures through national and IAEA-organized training courses to help prevent unauthorized removal or trafficking of radioactive sources and nuclear materials in the country.

The Nuclear Regulatory Authority and the Ghana Atomic Energy Commission also have the Memorandum of Agreements with various governmental and non-governmental agencies to help in the performance of their duties. Some of these agencies include the African Centre for Science and International Security (AFRICSIS), Ghana Ports and Harbours Authority, Ghana Civil Aviation Authority, Ghana Airports Company, and Ghana Immigration Service. Through these agreements, various collaborative projects and programs aimed at educating and improving the nuclear security regime of the country have been achieved. AFRICSIS has organized various national and international seminars and workshops for staff of the Nuclear Regulatory Authority and the Ghanta Atomic Energy Commission who are engaged in nuclear security and the protection of radioactive material and their associated facilities and activities. These include: Professional Development Course on Introduction to Nuclear Security and Safeguards for Sub-Saharan Africa; Workshop on Nuclear Security for Media Practitioners in Africa; and Nuclear Nonproliferation and Security for Women in STEM.

The Government of the Republic of Ghana approves of the peaceful application of nuclear materials and nuclear technology. It thus supports the provision of higher-level education and training in relevant nuclear-related disciplines. In Ghana, the GAEC, in collaboration with the University of Ghana, Legon,

doi: 10.7290/ijns07p55h

has established the Graduate School of Nuclear and Allied Sciences (SNAS). The school runs graduate degree programs (i.e., Master of Philosophy and Doctor of Philosophy) in various fields of nuclear science, including nuclear physics, nuclear engineering, radiation protection, nuclear agriculture, nuclear technology applications in petroleum and mining industries, nuclear and environmental protection, and nuclear, radiochemistry, and medical physics, as well as a post-graduate certificate course in radiation protection and safety of radiation sources. The school is an IAEA African Regional Designated Centre (RDC) for Professional Training and Higher Education in Nuclear Science and Technology **[*18*]**. SNAS is awaiting final approval from the National Accreditation Board to begin the Master of Philosophy and Doctor of Philosophy degree programs in Health Physics and Radiation Protection, which is infused with some nuclear security courses. The courses started in the 2020/2021 academic year. Staff of the GAEC and GNRA also continuously participate in IAEA training programs in various nuclear fields.

V. Collaboration between International Stakeholders

Ghana collaborates with international organizations and countries to help build the capacity of Ghanaians in the field of nuclear security. In particular, Ghana has collaborative agreements with the International Atomic Energy Agency (IAEA), the Office of Radiological Security in the United States of America, ROSATOM of the Russian Federation, Argonne National Laboratory in the United States of America, the Abdus Salam International Centre for Theoretical Physics (ICTP), and United Nations Development Programme, among others. Through these international collaborations, staff of the Ghana Atomic Energy Commission and the Nuclear Regulatory Authority, as well as license holders and other frontline agencies, have received various trainings and capacity building workshops in nuclear security **[*18*]**. This includes assistance in the capacity building of NRA staff to draft appropriate regulations and guidance documents based on Act 895.

In 2017, through international collaborations with the Government of the People's Republic of China and the U.S. Department of State, Ghana successfully completed the core conversion of its Miniature Neutron Source Reactor (GHARR-1) from HEU to LEU. This was done pursuant to recommendations from the first and second Nuclear Security Summits held in 2010 and 2012 in Washington and Seoul respectively, which sought to reduce global stock of HEU by converting all HEU research reactors to LEU. Ghana is the first country within the African region to convert its MNSR from using HEU fuel to LEU fuel **[*3*]**.

Furthermore, Ghana, with support from various international organizations, regularly undertakes capacity building programs for key personnel involved in nuclear security-related matters in the country. Currently, the IAEA, through its technical cooperation program, is assisting in the human resource development and expert advice in implementing the BOSS disposal system. The Canadian government has also provided funds to assist in the site characterization activities, conditioning of the DSRSs, and construction of the disposal borehole.

VI. Improving Nuclear Security at Nuclear Installations

The nation's commitment to improving the security of facilities holding nuclear and radioactive materials has increased over the past few years. Following a successful International Nuclear Security Advisory Service (INSServ) and International Physical Protection Advisory Service (IPPAS) Mission in 2006 and 2007 respectively, Ghana has undertaken the upgrade of the physical protection system at some of its facilities at the Ghana Atomic Energy Commission (GAEC), the Gamma Irradiation Facility (GIF), the Ghana Research Reactor-1 (GHARR-1), the Centralized Radioactive Waste Storage facility, the National Radiotherapy Centres at Korle Bu and Komfo Anokye Teaching Hospitals, and scanners at the major sea ports (i.e., Tema and Takoradi). This greatly enhanced the existing security at these facilities and gave the security personnel and management the needed information to make key decisions on a daily basis. Currently, these facilities are undergoing a second phase of upgrades to allow all protected facilities to be

doi: 10.7290/ijns07p55h

integrated into a unified physical protection system with a Central Alarm Station (CAS). The upgrades include the installation of security doors, locks and key-safes, motion sensors, and CCTV cameras with DVR for alarm assessment. The CAS will monitor all security cameras on site at all times and record video signals enabling ready assessment of events and alarms. These upgrades will increase detection and assessment capabilities while restricting access to the more sensitive areas.

In line with efforts to account for and regulate radioactive sources operating in the country before establishing a functioning regulatory body in the early 1990s, Ghana, with support from the Office for Radiological Security (ORS) in the United States, successfully implemented a two-year "Search and Secure Project" from 2014 to 2016. Utilizing local expertise from the Ghana Atomic Energy Commission and equipment provided by the European Union and the IAEA, all facilities that utilize radioactive sources were visited to ensure all the radioactive sources, including legacy sources in use or temporary storage, are properly accounted for.

VII. Radioactive Waste Management

A radioactive waste management facility has been established within the premises of the Ghana Atomic Energy Commission. This is the only authorized radioactive waste management facility in Ghana. The facility is managed by the Radioactive Waste Management Centre (RWMC). This Centre provides the technical services of collection, transportation, characterization, and storage of disused radioactive waste materials in Ghana. Currently, the Centre intends to use the IAEA's developed Borehole Disposal of Spent Sources (BOSS) system to dispose of its disused sealed radioactive sources (DSRSs) in storage.

VIII. Strengthening Nuclear Security Capabilities

Ghana is pursuing measures to include nuclear power in its energy mix with the establishment of the Ghana Nuclear Power Programme Organization (GNPPO) and the Nuclear Power Institute (NPI) at the Ghana Atomic Energy Commission. The IAEA Milestone Approach for Nuclear Power Development has been used to build a national plan for Ghana's nuclear program. In addition to the national plan, Ghana has defined Actions for each of the 19 infrastructural challenges that span the three phases. The Ghana Nuclear Power Programme Organization (GNPPO) has also been established to coordinate the actions of all stakeholders involved in the development and implementation of Ghana's nuclear power program.

IX. Conclusion

Nuclear security is a global effort and a national responsibility. Efforts have been made to improve the national nuclear security system in Ghana over the past decade. Ghana's commitment to improving its national security systems has led to the upgrade of the physical protection system of some key nuclear facilities and radioactive sources. The Ghana Atomic Energy Commission and the Nuclear Regulatory Authority is collaborating with all relevant national stakeholders to ensure the effective operation of a competent nuclear security system. Ghana remains committed to improving its national nuclear security system under the major themes of improving legal frameworks for nuclear security, enhancing nuclear security culture, strengthening nuclear security capabilities at facilities holding radioactive materials, collaborating and cooperating, and building human resource capacity.

X. Works Cited

1. P. Podvig, Global Nuclear Security Building Greater Accountability and Cooperation (2011), (available at http://www.unidir.org/files/publications/pdfs/global-nuclear-security-building-greater-accountability-and-cooperation-383.pdf).

doi: 10.7290/ijns07p55h

2. A. S. Gill, *Nuclear Security Summits: A History* (Palgrave Macmillan, Cham, Switzerland, 2020; https://doi.org/10.1007/978-3-030-28038-3_4).

3. A. S. Gill, thesis, King's College London, London (2016).

4. Nuclear Nonproliferation: U.S. Negative Security Assurances at a Glance. *Arms Control Assoc.* (2018), (available at https://www.armscontrol.org/taxonomy/term/135?page=1).

5. M. Cooper, Nuclear Safety and Nuclear Economics: Historically, Accidents Dim the Prospects for Nuclear Reactor Construction; Fukushima Will Have A Major Impact (2011).

6. M. Bunn, T. Bielefeld, (Tucson, 2007; https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.417.5297&rep=rep1&type=pdf).

7. *Physical Protection of Nuclear Material and Nuclear Facilities (Implementation of INFCIRC/225/Revision 5)* (International Atomic Energy Agency (IAEA), Vienna, 2018; https://www.iaea.org/publications/11092/physical-protection-of-nuclear-material-and-nuclear-facilities-implementation-of-infcirc/225/revision-5), *Implementing Guides*.

8. *The Convention on the Physical Protection of Nuclear Material and its Amendment (INFCIRC/274/Rev.1/Mod.1)* (International Atomic Energy Agency (IAEA), Vienna, 2016), *Nuclear Security Series*.

9. "International Convention for the Suppression of Acts of Nuclear Terrorism," *Treaty Series* (A/RES/59/290, United Nations General Assembly, New York, 2005), (available at https://treaties.un.org/pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XVIII-15&chapter=18&Temp=mtdsg3&clang=_en).

10. "Resolution 1373 (2001) on threats to international peace and security caused by terrorist acts" (S/RES/1373 (2001), United Nations Security Council, 2001), (available at https://www.unodc.org/pdf/crime/terrorism/res_1373_english.pdf).

11. "Resolution 1540 (2004) concerning weapons of massive destruction" (S/RES/1540 (2004), United Nations Security Council, 2004), (available at https://www.un.org/ga/search/view_doc.asp?symbol=S/RES/1540%20(2004)).

12. Enhancing nuclear security training and cooperation in Africa (2009), (available at https://www.iaea.org/sites/default/files/documents/tc/AFRA-Nuc-Security.pdf).

13. Ghana Atomic Energy Commission: At a Glance (1997), (available at https://inis.iaea.org/collection/NCLCollectionStore/_Public/29/061/29061226.pdf).

14. E. T. Glover, E. O. Darko, J. J. Fletcher, "Establishing a Central Waste Processing and Storage Facility in Ghana" (IAEA-CN-87/37P, International Atomic Energy Agency, 2001), pp. 146–148.

15. "Nuclear Regulatory Authority Act, 2015" (Act 895, Parliament of the Republic of Ghana, 2015), (available at https://bcp.gov.gh/acc/registry/docs/Nuclear%20Regulatory%20Authority%20Act,%202015%20(ACT%20895).pdf).

16. I. Bolshinsky, J. Dewes, K. Gaines, D. Browning, International MNSR Training Center in Ghana Provides HEU Removal Expertise. *DNN Sentin.* **4** (2018) (available at https://www.osti.gov/pages/biblio/1558490).

17. E. T. Glover, Implementation of the Borehole Disposal System for Disused Sealed Radioactive Sources in Ghana (2016), (available at https://gnssn.iaea.org/meetings/wasteconference2016/Shared%20Documents/Session%203a%20-%20DSRS/Oral/Presentations%20PPT/03a-01-57_Glover_PPT.pdf).

18. "African Regional Cooperative Agreement for Research, Development and Training related to Nuclear Science and Technology: Fostering Nuclear Science and Technology for African Development" (African Regional Cooperative Agreement (AFRA), 2019), (available at https://www.iaea.org/sites/default/files/20/01/afra-brochure-2019.pdf).

doi: 10.7290/ijns07p55h