

THE ESTABLISHMENT AND MAINTENANCE OF EFFECTIVE SAFETY AND SECURITY SYSTEMS FOR DISUSED SEALED RADIOACTIVE SOURCES IN GHANA: ACCOMPLISHMENTS, KNOWLEDGE MANAGEMENT, CHALLENGES AND FUTURE PROJECTIONS

G. GBEDDY

Radiation Protection Institute, Ghana Atomic Energy Commission

Accra, Ghana

Email: g.gbeddy@gaecgh.org

E.T. GLOVER, Y. ADJEI-KYEREME, E. AKORTIA, P. ESSEL, E.O. SARFO, E.M. AMEHO, E.A. ABERIKAE

Radiation Protection Institute, Ghana Atomic Energy Commission

Accra, Ghana

Abstract

Ghana has benefited immensely from the application of radioactive sources. The establishment of the Nuclear Regulatory Authority by Parliamentary Act 895 in 2015 has brought clarity and collaboration between key stakeholders namely Ministry of Interior and National Security, Regulator and Operator for safe and secure management of radioactive sources. This paper highlights the accomplishments and challenges in establishing and maintaining secure and safe systems for radioactive sources in Ghana. Ghana as an oasis of peace has deployed sound radiation safety principles, requisite physical infrastructure and multi-barrier security systems for constant protection and control of radioactive sources. With the IAEA playing a pivotal role, a centralized storage has been established for disused sealed radioactive sources. Though there are challenges which need to be addressed, Ghana is poised to be the nation of excellence in the safe and secure management of sources based on sound knowledge management and allocation of requisite resources.

1. INTRODUCTION

Ghana has benefited significantly from the peaceful application of nuclear science and technology since 1950. In particular, vital sectors of the economy such as agriculture, medicine, industry, education and research have utilized radioactive sources. The quantum of radioactive sources in the country commensurate with the level of economic growth. In order to enhance the safety and security of radioactive sources after their intended application, the Centralized Disused Sealed Radioactive Source Storage Facility (CDSRSSF) was established in Ghana [1]. Ghana is an oasis of peaceful democracy in the West African sub-region and, thus surrounded by politically unstable countries with high probability of infiltration by militant groups if the necessary security measures are not deployed. In this regard, the establishment of the CDSRSSF with all the requisite safety and security systems has contributed significantly to the sustainable management of disused sealed radioactive sources (DSRS) in Ghana.

The establishment of the Nuclear Regulatory Authority (NRA) by an Act of Parliament (895) on 14th August 2015 with a clear delineation of roles with respect to licensing, authorization, regular safety and security compliance inspection, and decommissioning of radioactive sources in Ghana is a major milestone. The operations of the NRA has fostered a better understanding and stronger collaboration between the Regulator, Ministries of Interior and National Security, Environmental Protection Agency (EPA) and the Operator of the CDSRSSF [2]. The internal security systems of the CDSRSSF is complimented with the deployment of a national closed-circuit television (CCTV) system at the Ghana Atomic Energy Commission (GAEC) site.

In order to produce the requisite human resource to support the tasks of the Nuclear Regulatory Authority (NRA) and CDSRSSF, GAEC in collaboration with the University of Ghana and the IAEA has established the Graduate School of Nuclear And Allied Sciences (SNAS). The establishment of SNAS has facilitated sustained nuclear knowledge management in Ghana. Secondly, SNAS has promoted cooperation and exchange of knowledge among competent authorities and key stakeholders at both national and international levels. Ghana is

therefore, poised to play a pivotal role now and in the future with respect to the safety and security of DSRS. Therefore, this paper highlights the establishment, accomplishments, knowledge management, challenges and future projections in terms of the safety and security of DSRS in Ghana.

2. SAFETY MEASURES

In order to ensure sustainable protection of the environment and people from the harmful effects of potential radiation associated with radioactive sources, and in compliance with local and international regulations, GAEC through the Radioactive Waste Management Centre (RWMC) has adopted internationally accepted best practices with respect to radiation safety. Initial safety of the radioactive sources resides with the generator until it is declared as disused and legally transferred to the RWMC [1]. DSRSs that met the waste acceptance criteria of the RWMC are accepted for safe management. The CDSRSSF is designated as a controlled radiological area. A robust indoor area radiation system using rad-DX 84 as shown in Fig. 1 is installed on the wall of the Facility. The system can be monitored and controlled remotely with the DX-Dashboard software on any PC or Tablet. In addition to the application of radiation protection or ALARA principle, personnel at the Facility are provided with personal dosimeters (TLD badges) and electronic dosimeters, which the Radiation Safety Officer (RSO) ensures are worn and used appropriately before any radiological activity is conducted.



Fig. 1. Indoor area radiation monitor (rad-DX 84)

A lead apron is also available for shielding personnel from high dose radioactive sources. Moreover, a hand and foot contamination monitor provided generously by the IAEA is installed at the Facility for monitoring potential radiation exposures to the extremities of the body. The thickness of the Facility walls shields potential radiation from the varied categories of DSRS from posing radiological hazard to the workers, public and the environment. Radiation and contamination monitoring as well as airborne radioactivity measurement of the Facility are conducted regularly using hand-held and installed radiation monitors provided by the IAEA to ensure compliance with the operational permit granted by the NRA. The RWMC is currently implementing a borehole disposal system (BDS) as the 'grave' option for the safe disposal of DSRS in Ghana in order to avoid placing unnecessary burden on future generations [3].

3. SECURITY SYSTEMS

The new CDSRSSF (see Fig. 2) was constructed with the aid of the United States Department of Energy’s National Nuclear Security Administration (NNSA) Office of Global Threat Reduction Initiative (GTRI) to enhance the security of the increasing number of DSRS in Ghana’s inventory. Considering the highly volatile political atmosphere of the West African sub-region, the security of the DSRS cannot be taken for granted. In this regard, a security in-depth system (see Fig. 3) has been installed at the Facility and this includes alarm triggered biometric, key and passcode access. CCTV devices are installed within and outside the Facility to ensure constant monitoring and control of the Facility [4]. The Facility has been equipped with solar powered back-up energy in January 2022 as shown in Fig. 4. The Regulator and RWMC ensure accountability of DSRSs and orphan sources in Ghana by maintaining a computerized national registry. The Facility was constructed using re-enforced concrete walls of appropriate thickness thereby making it more difficult for breakdown and intrusion, more resistant to fire, earthquake and moisture thereby offering greater physical protection to the DSRS.



Fig. 2. Transformation of radioactive storage facility



Fig. 3. Security systems inside the radioactive source storage facility

The outside security of the CDSRSSF and GAEC site is enhanced through the deployment of CCTV system as indicated in Fig. 4 by the Ministry of Interior and National security. This will facilitate constant monitoring of the entire GAEC site against any potential sabotage and malicious acts.



Fig. 4. Outside security features of the CDSRSSF and GAEC site

In prior preparation for the full deployment of the DBS in Ghana, categories 3 to 5 sources have been conditioned and placed securely in a retrievable manner inside concrete drums as shown in Fig. 5.



Fig. 5. Concrete drum containing conditioned sources

4. KNOWLEDGE MANAGEMENT, EDUCATION AND TRAINING

Comprehensive knowledge management is pivotal to the provision of sustainable safety and security for radioactive sources. In this regard, appropriate education and constant training are key to achieving desired knowledge on modern management practices of DSRS by producing well-trained human resource. It is in this context that GAEC in collaboration with the IAEA and Ghana's premier university has established the Graduate School of Nuclear and Allied Sciences (SNAS). SNAS through its various post-graduate programmes in radiation protection, nuclear and environmental protection, and post-graduate education certificate in radiation

protection and safety of radioactive sources (PGEC) has produced the requisite human resource to operate the CDSRSSF safely and securely. Participation in various IAEA organized inter-regional, AFRA regional and Joint ICTP training programmes have contributed significantly to knowledge and skills refreshment and updating of personnel in radiation safety and security.

5. CHALLENGES

One major challenge confronting the sustainable provision of security for DSRS under storage in Ghana is the lack of reliable national electrical supply and non-availability of stand-by generators to power the security systems such as CCTVs that are not supported by solar power. Moreover, the only lead apron available for shielding personnel from excessive radiation is very old and may not provide maximum protection from high radiation hazard.

6. FUTURE PROJECTIONS

It is highly anticipated that the security and safety of DSRS in Ghana will be enhanced to meet both local and international regulatory standards thereby positioning Ghana as the Centre of excellence in Africa and beyond. This will engender the needed support from the public for the usage of radioactive sources in Ghana as well as future incorporation of nuclear power into the energy mix.

7. CONCLUSION

Ghana has put in place the requisite regulatory framework and infrastructure to offer effective safety and security for radioactive sources in Ghana. Moreover, appropriate knowledge management system have been adopted and implemented to ensure that qualified human resources are produced for the sustainable management of DSRS. There is effective collaboration between various key stakeholders notably the Regulator, the Ministry of Interior and National Security, and the Operator of CDSRSSF for sustained safety and security of sources. The essential role-played by the IAEA in various facets such as provision of requisite equipment, training and education in the safety and security of sources cannot be underestimated. Ghana is well positioned as a major hub of excellence in the provision of safe and secure management of sources from cradle to the grave.

8. REFERENCES

1. Glover, E.T. and J.J. Fletcher, *National waste management infrastructure for the safe management of radioactive waste in Ghana*, in *WM'00 Conference*. 2000: Tucson, AZ.
2. GoG, *Nuclear Regulatory Authority Act, 2015 (ACT 895)*. 2015. p. 49.
3. Akortia, E., et al., *Geological interactions and radio-chemical risks of primordial radionuclides ^{40}K , ^{226}Ra , and ^{232}Th in soil and groundwater from potential radioactive waste disposal site in Ghana*. *Journal of Radioanalytical and Nuclear Chemistry*, 2021. **328**(2): p. 577-589.
4. IAEA, *Management of disused sealed radioactive sources*. 2014, International Atomic Energy Agency: Vienna, Austria. p. 183.