MANAGEMENT OF NORM WASTE IN GHANA: BUILDING HUMAN RESOURCE CAPACITY AND LOGISTICS

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ABSTRACT

NORM are primarily daughters of uranium (U-238) and thorium (Th-232), naturally present in subsurface geologic formations. As a result, oil and gas extraction; mining and processing of phosphate minerals, mineral sands, gold bearing rocks, coal and hydrocarbons are the major sources of NORM. When NORM concentration in the various by-products of its emission sources accumulate beyond regulatory level, they are referred to as NORM waste. There is a growing concern in Ghana regarding management of NORM waste as the country is a major gold, oil and gas producer. The Radioactive Waste Management Center (RWMC) of the Radiation Protection Institute (RPI) of Ghana undertakes routine safety assessment and sensitization program as part of it radioactive waste management activities at major sites including the gold mines. The main objective is to assure safety of workers as well as members of the general public from the potential harmful effects of NORM. Other objectives include: to ensure concentrations are within acceptable limits, to generate national data of NORM and identify hotspots. To this end, activities of RWMC need to be enhanced and expanded to cover wider spectrum of operations, acquire the required tools and resources to train and develop human resource for the country.

INTRODUCTION

Naturally occurring radioactive materials simply known as NORM are radiation sources that do not contain significant radionuclides other than those that occur naturally in the environment. NORM are typically daughters of Uranium-238 and Thorium-232 present in geological formation. Oil and gas extraction; mining and processing of phosphate minerals, mineral sands, gold bearing rocks, coal and hydrocarbons are the major sources of NORM [1].

NORM are ubiquitous in the environment [1, 2] due to their presence in sands/sandstones for building and as particulates in the atmosphere. Because trace amounts of uranium, thorium and other radioisotopes are naturally found in carbon-based materials, burning of coal and petroleum generate NORM and their residues become NORM waste.

Concentration of NORM in most natural substances are usually trace/low levels [2]. However, earth exploratory operations such as oil and gas and mineral mining have the potential of concentrating NORM in the product, by-product as well as in the waste streams of these operations [2, 3]. The generation of NORM in such operations can lead to exposures to both workers and members of the general public which may lead to health and environmental hazards.

In Ghana, the Radioactive Waste Management Centre (RWMC), of the Radiation Protection Institute (RPI), is mandated to manage radioactive waste generated in the country. Radioactive waste currently under management are mainly disused sealed radioactive sources (DSRS) generated by the mines, hospitals, civil construction and other firms where radiation sources are applied. Activities of RWMC and its facility are regulated and licensed by the Nuclear Regulatory Authority (NRA) of Ghana.

DSRSs retrieved from end-users undergo pre-disposal processes such as characterization, logging (manually and electronically), conditioning and storage in waiting for final disposal in a geological repository known as the borehole disposal system.

There is a growing concern in Ghana regarding management of NORM waste as the country is a major gold, oil and gas producer [7, 8, 9]. These are well known sources of NORM and NORM waste [1]. There about 23 large-scale mining companies producing gold, diamond, bauxite and manganese, with over 300 registered small scale mining groups and 90 mine support service companies in the country [7]. . Whilst there are regulations and management system for DSRSs, there is none for NORM waste management in Ghana.

The RPI is putting mechanisms in place to fill the regulation void by developing a robust safety assessment program for NORM; and modalities for managing NORM waste. In view of the fact that the RWMC has qualified staff, logistics and facility for radioactive waste management, the RPI considers sensitization (of the general public and occupationally exposed people) and continuous human resource capacity building as important components of NORM waste management program in the country.

This presentation is a summary of the strategic plan of the RPI of Ghana towards NORM assessment and NORM waste management whilst at the same time use the CN287 conference platform to build a network for knowledge and skills sharing that will augment efforts at RPI to deal effectively with current and future challenges regarding NORM.

METHODOLOGY

There are four-way approach to accomplishing the RPI's strategic plan regarding safety and human resource development within the context of NORM waste management.

First approach is to have a memorandum of understanding (MOU) between major stakeholder i.e. regulators (EPA), and generators (oil & gas and gold extraction companies). The ultimate product of such MOU is regulations for NORM generation and NORM waste management in Ghana.
Figures 1 and 2 illustrate mining and oil and gas extraction fields in Ghana.

Second approach is to design and implement a safety assessment program for all NORM generating sites in Ghana.
The RPI through the RWMC, will develop safety assessment program that will be implemented along with the existing safety assessment for DSRSs. Coverage include:

- NORM assessment in the mines,
- NORM assessment in the oil & gas fields,
- Radiological effects of exposure to NORM and
- Identification of radionuclides in water, scales and sludge from the major sources.

Third approach involves training and sensitization of stake holders and the general public about potential harmful effects of exposure to NORM.
This approach will be led by the Radiation Protection Training and Consultancy Centre (RPTCC) of the RPI in collaboration with the RWMC. Robust training modules for occupationally exposed people and people living/working around major NORM sources are being designed. The module include precautionary measures (safeguards) and best practices.

FIG. 1. Geographical map of Ghana showing existing and new (projects) mining sites
(Source: Cardinal Resources Limited [14])

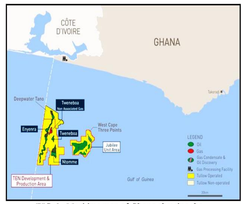

FIG. 2. Maritime map of Ghana showing the three offshore oil fields (courtesy: Tullow Oil)

Fourth and final approach is NORM waste management
A number of waste management methods are being considered by the RPI as alternative to land spreading to curtail the potential of over-exposure by people. The following methods are being considered:

I. Recycling and re-use of NORM residues as building materials (following dilution, isolation and dispersion of the NORM residues)
II. Disposal via shallow concrete cells until NORM decays to acceptable levels
III. Waste characterization (research). This involves determination of:

- Density and composition of the waste
- Water absorptivity
- Sample shape/form (complex object geometry)
- Measurement geometry (distance, time, shielding)
- NORM distribution (inhomogeneity)
- Instrument capabilities (technical suitability)
- Measurement sensitivity and uncertainty

Instrumentation

Instruments for detection and identification of radionuclides, measurements of their concentrations in various matrices and storage of personal doses:

- Canberra-Radiagem 2000
- Radionuclide identifier (ATOMTEX IP 54)
- Personal dosimeter badge (thermo luminescent dosimeter, TLD)
- HPGe neutron and gamma detectors
- Alpha and beta detectors
- 2x2 NaI detector

Where and what to measure

- Background
- Personal doses (exposure)
- Underground and basements of mines and oil and gas industries
- Storerooms
- Equipment
- Sludge and scales
- Land-spreading sites
- Radon gas – habited indoor and ambient
- Airborne dust

RESULTS

In addition to qualified human resource and logistics which are essential for academic and research activities at the RPI, a comprehensive working document in the form of quality management system for NORM is being developed to guide operations of all stakeholders in the country.

Furthermore, safety culture, precautionary measures and awareness are being created, notwithstanding the economic benefit for the country. Figure 3 illustrates the input (approach) and output (activities) as well as outcome (expected results) with respect to the NORM waste management program in Ghana.

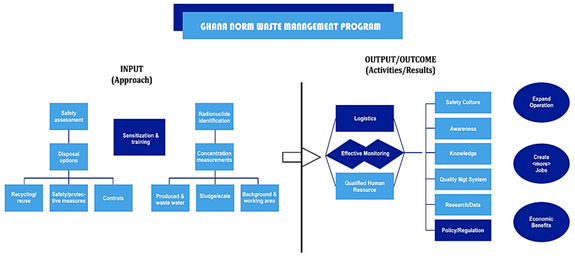

FIG. 3. Input and output of NORM waste management in Ghana

The strategic plan of the Radiation Protection Institute, RPI, regarding NORM waste management in Ghana has been discussed. The Institute through its two Centres: the Radioactive Waste Management Centre and the Radiation Protection Training and Consultancy Centre will embark on a comprehensive NORM waste management program across the length and breadth of the country, targeting major sources such as the mines and the oil and gas production fields.

Ultimately, the following will be created:

- Safety culture,
- Map of hotspots,
- Awareness and
- Qualified human resource.

CONCLUSION

The strategic plan of the Radiation Protection Institute, RPI, regarding NORM waste management in Ghana has been discussed. The Institute through its two Centers: the Radioactive Waste Management Centre and the Radiation Protection Training and Consultancy Centre will embark on a comprehensive NORM waste management program across the length and breadth of the country, targeting major sources such as the mines and the oil and gas production fields.

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Map of hotspots,
Awareness and
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