Analysis of Radioactive Waste and Status of its Management in Kenya

James Keter Chumba* and Chang-Lak Kim
KEPCO International Nuclear Graduate School, 1456-1 Shinam-ri Seosaeng-myeon Ulju-gun, Ulsan
**Corresponding author: chumba2001@gmail.com*

1. Introduction

The bulk of radioactive waste generated in Kenya is disused sealed and unsealed radioactive sources arising from their use in medicine, industry and research. Currently, the radioactive waste is conditioned and stored at a central location operated by the Materials Testing and Research Laboratory (MTRD) in the Ministry of Roads. The Government, through the Radiation Protection Board (the regulatory body) is constructing a modern facility for treatment, conditioning and interim storage of radioactive waste. Plans for constructing a disposal facility has also started but still at its formative stages. This paper traces the quantity of waste generated in Kenya since 1980's, its handling and future waste generation by proposed activities. This will give an insight on the need to find a reliable solution for responsible radioactive waste management requiring the implementation of measures that will afford protection of human health and the environment.

2. Inventory of radiation sources

Kenya's regulatory body, the Radiation Protection Board (RPB), is established under an Act of Parliament that came into force on 1st November 1984[1]. Its main function is to oversee matters of radiation safety, security of radioactive materials, control of contamination of food and environment with radioactivity. Since inception, the Board has managed to maintain a register of radiation facilities and workers, dealers in radiation devices and radioactive materials and other related nuclear materials. Table 1 is a summary of the total number of active radiation sources under regulatory control.

Table 1: Summary of radioactive sources [3].

Radioactive Source **(No.)**
Cs-137 (**56**); Mo-99 (**4**); Am-241(**82**); Co-60 (**33**); Kr-85 (**6**); Ir-192 (**31**); Sr-90 (**27**); Th-228 (**6**); Na-22 (**8**); Ra-226 (**120**); Ni-63 (**5**); Cf-252 (**3**); DU-238 (**5**); Cd-109 (**11**); Fe-55 (**11**); Th-232 (**4**); Ba-133 (**22**); Co-57 (**12**); Mn-54 (**2**); I-125 (**15**); Fe-59 (**1**); Cr-51 (**3**); H-3 (**3**); S-35 (**4**); C-14 (**114**); P-32 (**11**); I-131 (**11**); Tc-99 (**12**); Sr-89 (**2**); Y-90 (**17**). Uses: Medical, Teaching, Research and Industrial

2.1. Waste classification system

Categorization of radioactive waste in Kenya is similar to IAEA's waste classification standards. This is legally provided for in section 3(3) of the Act. Most of the sources listed in Table 1 are in sealed form while a few are unsealed. Exempt waste as well as very short-lived waste (VSLW) are usually in solid and liquid form and originate mostly from research and medical institutions. Table 2 gives an indication on existing disused sealed and open radioactive sources as classified. Some of them are spent sources awaiting disposal while others are sealed sources still with high activity and capable of being re-used

Table 2: Waste classification scheme for the disused radioactive sources and their total numbers/amounts.

Waste Category & examples	**Total number or amount of sources**
Exempt Waste (EW) { solids and liquids from medical or research, below clearance levels (CLs) e.g. I-131, Tc-99m, Iodine-125, F-18 }	Four major hospitals generate an average, between 2 and 10 kgs of waste per day – in form of syringes, needles, cotton swabs, vials and contaminated gloves
Very Short Lived Waste (VSLW){ Ir-192, Y-90}	Open - most are declared EW after short period Sealed - 73
Very Low Level Waste (VLLW){ from mining operations, slightly above CLs}	Mine tailings of NORMs (uranium & thorium) - accumulated as waste piles
Low Level Waste (LLW){ Co-60, H-3, Kr-85, Cs-137}	Open - Twelve 200-litre drums of liquid and close to 100 kgs of solid waste. Sealed -109 (7*)
Intermediate Level Waste (ILW){ Am-241, Ra-226}	Open - None Sealed -85(16*)
High Level Waste(HLW) { Mostly spent fuel from power reactors}	None
(7*) & (16*) represent sources that have high activity in that category and could be recycled for use.	

2.2. Treatment and Storage options

EW and VSLW are stored to decay until they reach clearance levels. Figure I is a representation of

the quantity of sealed sources that has been delivered, immobilized in 200 litre drums and being stored at MTRD.

Presently, a Central Radioactive Waste Processing Facility (CRWPF) is under construction and expected to be complete by the end of 2013. This facility will have the capacity to process and temporarily store radioactive waste being generated by all licensees throughout the country and will be operated by a committee drawn from several Government agencies. IAEA's technical cooperation projects has assisted in great deal by providing the necessary equipments used in radioactive waste management, identification and processing. There is a review of legislation to allow applicants or licensees to own a waste disposal facility.

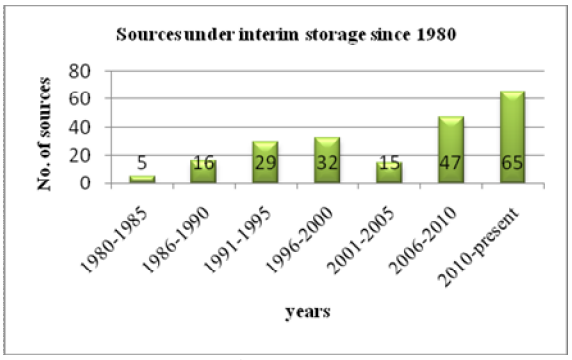

Figure I: Number of sealed sources delivered and immobilized at MTRD since 1980.

3. Foreseen waste generation activities

Kenya's decision to construct nuclear power reactors will definitely affect the radioactive waste management regime. The nature and amounts of waste produced depend on the type of reactor, its specific design features, operating conditions and fuel integrity. Several tonnes of waste will be generated and will require effective and reliable methods of treatment, conditioning, interim storage or disposal for safety and economy of the entire waste management system [2].

Since early 2005, a number of construction, exploration, drilling and mining firms have imported significant number of industrial nuclear gauges that are declared disused after a few years. The line chart in Figure II illustrates the trend of such sources imported for the period 2005 to 2012.

Kenya's vision 2030 blueprint is spearheading development programmes in the areas of science, technology, and innovation. Such an enhanced growth in infrastructural, medical and research sectors in the coming years will see a rise in the use of radioactive source-embedded devices. Both polynomial and linear trend reliability in Figure II indicate an increase in imported sources leading to extensive future generation of waste, supplemented by NORMs from planned mining and drilling activities.

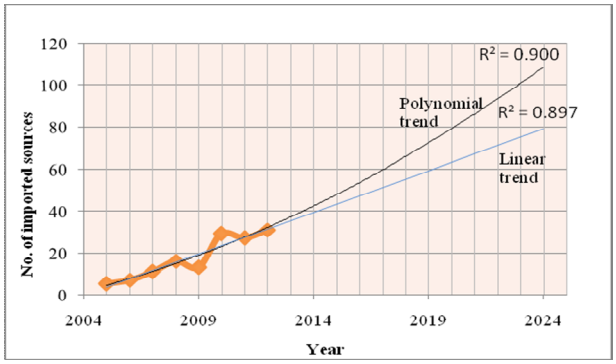

Figure II: An illustration of sources imported since 2005[3] with a 12-year prediction by linear and polynomial reliability

4. Conclusions

Indefinite storage of radioactive waste in small facilities is inconsistent with international best practice, which involves the provision of central storage or disposal facilities, with the imposition of regulatory requirements to ensure that risks are minimized [2].

The high activity sealed sources already declared disused by their owners could be recycled instead of segregating them for interim storage or disposal. RPB should consider involving interested stakeholders to acquire them for re-use. This could significantly reduce the volume of waste that would have required processing, storage and eventual disposal.

It is crucial for the Kenyan Government to put in place measures to manage the accumulated waste that is currently piling at MTRD. Completion of the CRWPF alone will provide a short relieve and hence there is need for fastracking the development of a repository. A viable option for Kenya will depend on the existing volume of waste and the amount to be generated from future activities. A near surface repository may suffice for the next several decades. A borehole disposal facility will also resolve waste management issues in future.

Meanwhile, waste management in Kenya will continue being managed in accordance with the policy principles enumerated in the Radioactive Waste Management Policy and Strategy.

REFERENCES

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[2] IAEA, The Principles of radioactive waste management, S. S. 111-F, IAEA, Vienna, 1995.

[3] Government of Kenya, Verified inventory of radiation sources in Kenya, RPB, Nairobi, 2013.