Introduction

Nuclear technology and application in Nigeria is fast developing; Nigeria and many other developing countries use nuclear application in everyday activities, in health sector, agricultural sector, oil and gas industries, Construction industries, Manufacturing industries, Education and training. Nigeria has a nuclear power program which has been going on for quite a long time. The country hopes to have its first nuclear power plant by 2025. The issue of nuclear waste management comes up whenever there are nuclear programs, the challenges of nuclear waste is enormous, due to safety and security concerns. A developing country using sealed radioactive sources may generate hundreds of dispersed sources with low levels of radioactivity over several years. The presence of thousands of radioactive sources used in the oil and gas sector also calls for concern. Low activity sources pose the larger challenge because they exist in large quantities around the world and in different forms and variations

Materials and Methods

The design of the near surface facility for radioactive waste, the facility consists of various facilities which would help in waste management operations before final disposal. It is subdivided into two major sections, Administrative and Operational

The Administrative section is meant for daily administrative activities, with provisions for reception, offices for records and other administrative duties, security office for monitoring access and physical protection of the facility

Zaria Site Characteristic

It was important to consider and know the sub soil formation of Zaria and Ahmadu Bello University, where the trench was designed for; the only research reactor in Nigeria is also located in Zaria, there are also possibilities they consider this design when they plan to build a new radioactive waste facility. The A.B.U Zaria in being part of the kubani, basin, is therefore underlain by Precambrian rock of the Nigerian baseman. The proposed site is situated within the southwestern part of the campus and underlain by muscovite biotite gneiss. The alluvial deposit in Zaria area consists of granite, sands, silts, and clay. Thickness ranges from 5 - 15m and the aquifer ranges from 28 – 34m

Trench Design Consideration

➢ The trench is designed for disposal of low and intermediate waste to take care of current and future radioactive waste to be generated.
➢ The trench is designed to be partitioned into four sections, each section is designed to accommodate 100 drums and more waste containers arranged in two columns or more depending on the numbers of waste containers ready for disposal, it is expected to accommodate around 500 waste containers

![Cross section of the waste container arrangement](image1)

Fig. 2: Cross section of the waste container arrangement.

➢ The trench depth 25 meters before the aquifer this is to provide reasonable distance to the aquifer to prevent ground water contamination.
➢ The depth of the containers to the top soil is 9 m
➢ Distance from the drums to the cap is estimated to be 5 m
➢ Drainage layer 200mm

![Plan](image2)

Fig. 1: Showing the Site Plan

Shielding Design Calculation

\[ n = \frac{x}{HVL} \]

were:
- \( x \) = Thickness of shield, HVL Thickness of concrete permit ½ of the incident radiation to pass
- \( n \) = \( \frac{\ln \left( \frac{1}{2} \right)}{\ln 2} \)
- \( \ln \frac{1}{2} \) = 0.693
- \( \ln 2 \) = 0.693

\[ x = HVL \times 2^{(\frac{\ln x}{\ln 2})} \]

No Note that HVL of Am 241 was considered because it has higher HVL for concrete at 0.5, Shielding factor from IAEA Safety Series No: 47, “In order to solve nuclear waste problem you have to solve the americium problem

HVL = 6.9 cm \times 10 = 4000 mSv/hr

\[ x \approx 0.693 \times 20.17 \approx 14.1 \text{ meters} \]

Therefore the shield concrete thickness \( x \) is determined to be Approximately 14 meters

Conclusion

A trench with a capacity of storing and receiving over 400 low and intermediate level radioactive waste was designed for disposing low and intermediate level waste in Zaria.

The design concept of capping the top of the trench was developed based on years of utilizing the trench and in expectation of waste readily available for disposal, so that after each section is fully utilized before the other section is used. Structural Analysis of the pillars & concrete was carried out.

1.4 meters thickness of concrete shield was arrived at for the cover of trench. The environment is expected to be safe.

The cost of constructing the Trench was estimated @ N24,103,900.00 about $70,000 USD

Fig 3 showing the underground sub soil depth and formation

References