Challenging Issues in Regulating Uranium Mining in Tanzania

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Abstract. Experiences have shown that unregulated uranium mining practices have led to significant radiological risk to workers, public and the environment. Tanzania is about to start uranium mining in different parts of the country. Although the legislation and regulations to control doses to workers, public and the environment are in place, there are challenges to adequately address best practice requirements during and after the mining operations. This paper provides an overview of the challenges in addressing the regulatory compliance.

Background

Experiences from historical uranium production sites all over the world have consistently shown that unregulated uranium mining practices have led to significant damage of water, soil, put persons at risk and resulted high cost of clean up the environment (IAEA 2004). In Tanzania the primary legislation, which control practices of ionizing radiation is the Atomic Energy Act 2003 (TAEC 2003) and associated regulations: Mining (Radioactive Minerals) Regulations of 2010 (TAEC 2010) and the Atomic Energy (Radiation Safety in the Mining and Processing of Radioactive Ores) Regulations of 2011 (TAEC 2011). According to the Act an ore is classed as radioactive mineral if its total activity concentration exceeds 74 Bq/g (TAEC 2003). In this context, the activity concentration of economical uranium ores which are likely to exceed this activity are classed as radioactive ores and thus subject to stringent regulatory control. The dose limits applicable in these regulations are those recommended by the ICRP (1977) for both occupational and public exposure to ionizing radiation. The dose limits are as follows: maximum occupational dose of 50 mSv in any year with a mean of 20 mSv over any five years, and a public dose limit of 1 mSv in any single year. In addition, the regulatory authority has a clear role to enforce regulatory compliance with the national and international standards. The doses apply to both internal and external

exposure exclude background radiation and medical exposures received during examination or treatment.

The background radiation referred herein composes of terrestrial radiation, cosmic radiation together with the contribution of fallout from man-made radiation sources. The terrestrial radiation is mainly a result of ^{40}K, ^{232}Th and ^{238}U and associated decay products. These radionuclides are commonly found on the earth's crust (soils, oceans, food, and drinking water) and they occur with various concentrations. Implicit that depending on the altitude above sea level and radionuclides content in the environment media, the background radiation would vary from one place to another. Literature report that high doses and dose rates of background radiation occurs in soils with rich concentrations of uranium and thorium (UNSCEAR 2000). Normally igneous rocks of granitic composition are rich in thorium and uranium compared to rocks of basaltic composition. Because of the thorium and uranium concentrations, higher background radiation levels are associated with igneous rocks and lower levels with sedimentary rocks, with exception of shales and phosphate rocks (UNSCEAR 2000). Hence, extractions of uranium ore from deposits have the potential to generate wastes with substantial amount of radionuclides and heavy metals in soils, groundwater and surface water. The heavy metals associated with uranium deposits which are threat to the living organisms i.e. plants, animals and humans are: Ag, As, Ba, Cd, Hg, Pb, Sb, and Th and trace elements which are toxic to living organism above certain tolerance level such as: Co, Cr, Cu, Mn, Mo, Ni, Se, and Zn.

Airborne geophysical surveys undertaken country wide in Tanzania by Geosurvey International in 1976-1980 and follow up detailed surveys by Uranerzbergbau in 1978-82 have delineated potential uranium occurrences viable for economical exploitation. Locations of uranium occurrences are shown on blocks A-G in Figure 1 and deposits name and area coverage are indicated in Table 1. The discovery of uranium deposits in Tanzania have attracted foreign company's interests to invest on large scale mining and milling projects in some parts of the country. According to the projections, for example production of uranium in Mkuju deposit is targeted to commence very soon.

Considering that uranium occurrences in many deposits of Tanzania are on shallow deposits, heap-leaching or open cast methodologies are foreseen as economically viable methodologies that would be used to extract the uranium ores. The productions of yellowcake using these methodologies involve removing of uranium ore from the ground and extraction of the yellowcake through crushing of the ore, grinding of the ore to produce fine particles for subsequent chemical leaching (IAEA 2009). It is worth noting that all these processes produce significant amount of waste rock, tailings, and contaminated water or soils containing radionuclides and non radionuclides which potential to environmental contamination. Typical examples of expected waste products from extraction of uranium ores are: barren rocks which are uneconomical to process in the mill and tailings which retain about 5-10% of uranium and 85% of long lived radioactive radium and thorium (IAEA 2009).

While it may seem that there are proven, best available, technologies for long term management of waste rock, tailings and waste water in developed countries,

in certain cases, challenging incidents were reported where large-scale discharge of wastes in the environment e.g. New Mexico, Navajo. Nabariek, Ranger, Olympic dam, Beveriey and Rum Jungle occurred (IAEA 2004). Quite often the perceived cost of managing a non-scheduled environmental release is usually very high financially, ecologically and socially. As a result, mining firms worldwide are focused on the early planning and implementation of wastes management.

It is likely that through wind and water pathways, the waste products containing radionuclides and non radionuclides from uranium mining can access the environment and become potential for radiological exposure to public. In order for the regulatory authority to be effective in assessing and mitigating the associated radiological and heavy metals risks, benchmark data of the natural distribution of these elements in the environment at the vicinity of the uranium mines are inevitably needed for managing safety and environment before the mining operations.

In recognition that the uranium mining is effectively controlled, the regulations in Tanzania require the regulatory authority and company to prepare an Environmental Impact Assessment (EIA). Knowledge of pre existing environment prior to the beginning of the mining activities is important in the uranium mining context to assess radiation doses to humans and the environment both during and after mining. This information is particularly useful in rehabilitation planning and developing closure criteria for uranium mines as only radiation doses above the natural background are usually considered 'controllable' for radiation protection purposes. The EIA also serve the regulatory authority to review the license conditions as well as indicators for monitoring and evaluation of changes on the environment as a point of comparison during and after the project operation.

Regulatory Challenges

Although a legal framework and relevant infrastructure for the management and control of occupational and public exposure, waste and the environment are in place, there are challenges for effective monitoring of the uranium mining industry in Tanzania. Finance and technical resources sounds as major limitations that may hinder the regulatory authorities to complete its primary responsibilities. Establishing baseline environmental data by the regulatory authority and the mining company prior to project development is of crucial importance and cannot be underestimated. Lack of comparable data could prevent the effective monitoring of changes in compliance with the environmental standards during and after the mining activities. Since data that established after the mining activities commences cannot be used to relate the impacts of uranium mining have on the environment and public exposure. Because the anticipated area in need of pre mining data is vast and time available to establish them before actual uranium mining commences is very short, the regulatory authority need substantial amount of resources. Big cost required establishing the baseline data and building technical capability wholly resting on the government funds are big challenges. Implicit, inadequate budget

and technical capability could lead to impairment on assessing and effective controlling the uranium mining.

Conclusion

For Tanzania to effectively implement best practice principles in the uranium industry, the competent regulatory authority must have adequate financial capabilities, equipment and competent staffs for verifications of compliances with standards. This is because stringent laws and regulations alone may not guarantee the full enforcement of compliances and preventing the hazard from actually occurring. The regulatory compliance will be verified only when resources and reference data made available prior to the mining operations.

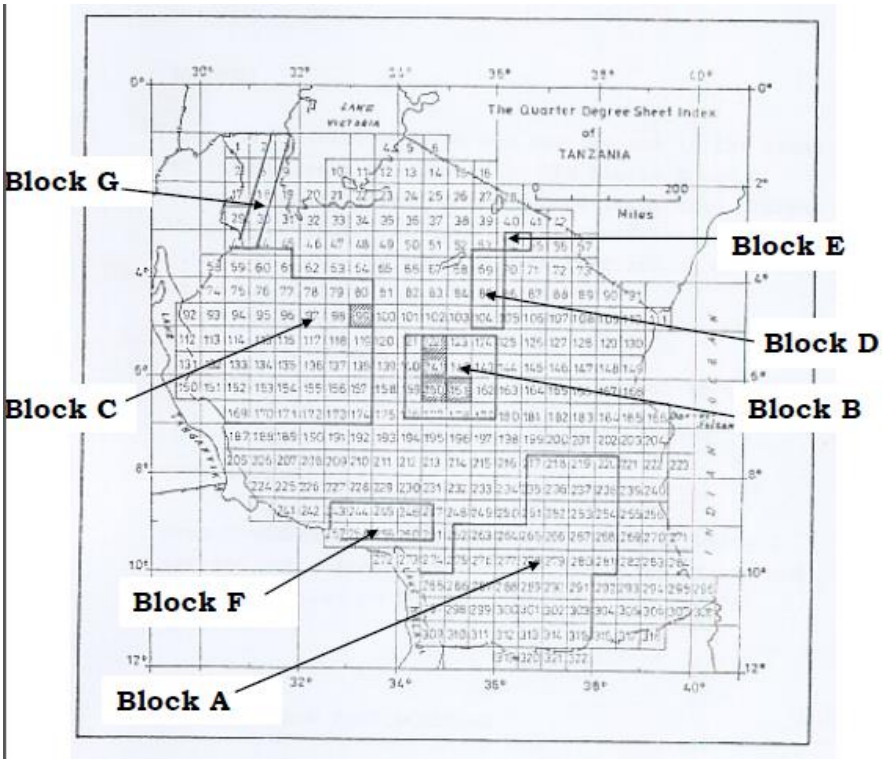


Fig.1. Blocks A – G for discovered Uranium occurrences in different geological environment in Tanzania.

Table 1. Shows block name, Locations and Area coverage of discovered Uranium occurrences in different geological environment in Tanzania.

Block Name	*Deposits Locations*	*Occurrences Area (Sq km)*
A	Mkuju, Madaba	135,000
B	Isuna, Bahi, Makutupora	37,000
C	Ndala, Igombe, Kigoma Ugalla River, Mpanda,	142,000
D	Minjingu, Gallapo	13,000
E	Monduli, Tarosero	2,000
F	Chimala, Panda, Njombe	19,000
G	Bukoba, Biharamulo	10,000

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