

OCCUPATIONAL RADIATION PROTECTION IN THE WORKPLACES INVOLVING EXPOSURE TO NATURALLY OCCURRING RADIOACTIVE MATERIAL, RADON AND COSMIC RAYS IN NIGERIA



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Abstract

Sustained exposures to natural sources of radiation (primordial radionuclides, radon, cosmic rays, etc.) in workplaces comes with attendant health risks. Optimization principle is central to instituting occupational protection below the relevant established reference levels.

Introduction

Exposures to natural sources of radiation (NORM, radon and cosmic rays) accounts for over 85% of the total annual world population dose of 2.8 mSv [3]. Of this, annual average effective dose from cosmic rays at ground level is 0.4 mSv, albeit there are variations in altitude and latitude, with general air travel giving rise a further annual dose of 0.01 mSv to aircrew [3].



Chart showing average radiation exposure from all sources

Exposures to existing sources of radiation in Nigeria comes from NORM from past mining activities and contamination from unmodified concentrations of ubiquitous primordial natural activity in earthen materials used in construction; concentration of radon in buildings; increased frequency of domestic flight operations which exposes aircrew to galactic cosmic rays.

The Nigerian Nuclear Regulatory Authority (NNRA) adopts the IAEA GSR Part 3 approach of protection in existing exposure situation for the control of occupational exposures in workplaces involving natural sources of radiation.

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References

- [1] International Atomic Energy Agency (IAEA), 2014, *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards. General Safety Requirements Part 3, Number GSR Part 3*, Venna Austria.
- [2] International Commission on Radiological Protection (ICRP) 2007, *The 2007 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 103.
- [3] United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) 2000, *Report on Sources and Effects of Ionizing Radiation to the General Assembly*, United Nations, Vienna

Legislative and Regulatory Framework for Protection from Natural Sources of radiation

The NNRA is the competent Authority established by the Nuclear Safety and Radiation Protection Act (the Act) with the responsibility for nuclear safety and radiological protection regulation in Nigeria, which amongst others, is mandated to protect the workers and the public from existing sources of ionizing radiation.

Nigeria Basic Ionizing Radiation Regulations (NiBIRR) 2003 and Nigerian Naturally Occurring Radioactive Materials (NORM) Regulations 2006 provides the regulatory framework for the regulation of exposures to existing sources of radiation.

NiBIRR 2003 was reviewed in line with IAEA GSR Part 3 to address specific aspect of protection in existing exposure situation (EES) for:

- ☐ radiation of natural origin (cosmic rays, radon gas, primordial radionuclides in - food, feed, construction materials, etc. and residual RM in which the activity concentration of no nuclide in either uranium or thorium decay series exceed 1 Bqg^{-1})
- ☐ Residual radioactive material from past unregulated activities e.g. mining, or after response to nuclear or radiological emergency.

Protective Measures

The reviewed NiBIRR provides for the application of optimization as the central consideration for occupational protection from radiation of natural origin. Specific protective measures to be considered are as follows:

- Radon indoors in buildings with occupancy of 7000h: priority is given to reducing activity concentration by all standard measures to keep it as low as reasonably achievable (ALARA) below reference level.
- Aircrew exposed to cosmic rays: dose assessment is required to ensure that doses is within the reference level of $5 - 10 \text{ mSvy}^{-1}$.
- For RAM from past unregulated activities: site characterization and remediation using graded approach, along with site specific reference level is required to control exposures, and
- A reference level of 1 mSvy^{-1} is considered for exposures to radionuclides in food, drinking water, feed, construction materials, etc. for all exposure pathways – external exposure, inhalation and ingestion.

Reference level is adapted from reference [2]. In the likely event where exposures persist in the workplace above reference level, requirements for exposures in planned exposure situations applies.

Conclusion

All protective measures or remedial actions to be applied in the management of EES in occupationally exposed workplaces are to be justified such that the benefits would outweigh the detriments associated with such measures or actions, including the detriments in the form of risks. Such measures are to be optimized from preventing doses from exceeding or remaining above any established reference levels.