

Monitoring and dose assessment of occupational radiation exposure for Zimbabwean workers: A decade of experience



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1. Background and Goal of the present work

In the past 10 years Zimbabwe has seen an increase in technology that uses radiation sources and related devices, and this has resulted in the need for a robust occupational radiation protection infrastructure. The Radiation Protection Authority of Zimbabwe (RPAZ) boasts of 2 state-of-the-art reader systems namely the Landauer Semi Manual InLight OSL (Optically Stimulated Luminescence) Reader and an automatic Harshaw 6600 Plus TLD (Thermoluminescent Dosimeter) reader. The TLD reader system uses the LiF (MgTi) crystal, TLD-100 and the OSL reader system uses Al₂O₃:C crystal, InLight OSL for external exposure monitoring of operational quantities Hp (10) and Hp (0.07). Both systems have an embedded algorithm for evaluation of doses. In the absence of a competent service provider, the technical services department of the regulatory body, independent of Regulatory functions has been responsible for the monitoring of all Radiation workers in the country. This paper gives an overview of activities that have been carried out in conducting dose assessments of occupationally exposed workers over the past 10 years.

2. Dose Assessments and Evaluation.

2.1. OSL System

The OSL reader system uses INLIGHT SYSTEMS software for dose evaluations coupled with other mathematical formulae to account for other influencing factors e.g., background radiation.



Fig 1: Landauer Semi-Manual InLight OSL Reader

2.2. TLD System

The TLD reader system uses WINREMS software for dose evaluations.



Fig 2: Harshaw 6600 Plus TLD Reader

3. Worker Information Management and the National Dose Registry

The regulator registered around 500 workers in the first year of individual monitoring work in 2011 and tremendously grew over the years with the current figure standing at 4000 plus workers enlisted in the National Dose Registry. The register includes information about workers from the industrial, medical applications and research applications as shown in the table below. Workers are classified into 2 categories for monitoring, which is monthly and quarterly as guided by national regulatory requirements. Worker dose information is missing as it would require more space for suitable presentation of the respective industries.

Table 1: Number of workers registered for individual monitoring since 2011

Year	Number of Registered Workers		
	Industrial	Medical	Research
2011	519	102	7
2013	1553	753	27
2015	1806	1207	39
2017	1986	1353	42
2019	2043	1506	44

2021	2585	1570	51
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No dose assessments were done for workers in the NORM industries since the gazetting of the NORM (Naturally Occurring Radioactive Material) regulations in 2011, however a plan is in place for dose assessment for NORM workers using information from the ongoing baseline studies and characterization of NORM Industries.

4. IAEA Regional Intercomparison Exercises

The IAEA (International Atomic Energy Agency) has been offering tremendous support to the regulatory body individual monitoring laboratory quality assurance programmes through Regional Intercomparison exercises in which Zimbabwe has participated since 2013 up to the year 2021. The results have been good yet highlighting the areas of improvement. The following trumpet curves for effective dose Hp (10) represent the dosimetry performance of the respective readers in selected years.

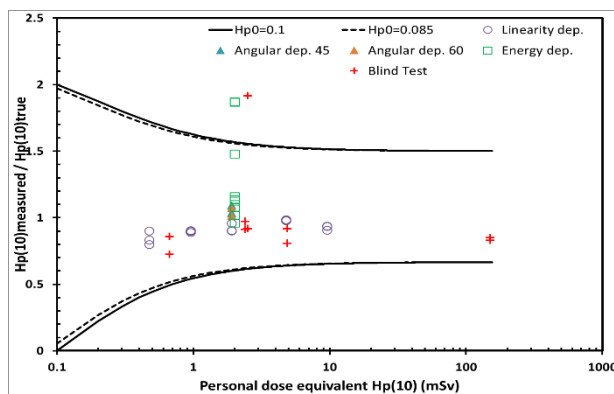


Fig 3: Trumpet Curve for TLD Reader in 2013 IAEA regional intercomparison exercise.

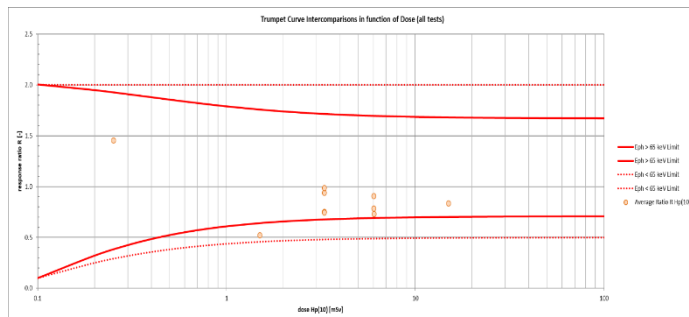


Fig 4: Trumpet Curve for OSL Reader in 2021 IAEA regional intercomparison exercise.

5. Conclusions and Acknowledgements

- In conclusion, because of the immense support from the government of Zimbabwe, the IAEA and other interested parties, the occupational radiation safety regime in Zimbabwe has improved in the past 10 years and is set on an upward trend.
- The regulatory body has since increased its efforts to ensure adequate occupational radiation protection requirements are in place for all users of radiation generating devices and equipment to provide assurance for health and safety for workers. This is attributed to continued strengthening of the overall regulatory framework, awareness programmes and trainings of licensees, interested parties as well as collaboration with other agencies.
- Since the gazetting of the NORM (Naturally Occurring Radioactive Material) regulations in 2011, the regulator has increased its efforts for occupational radiation protection for NORM (Naturally Occurring Radioactive Material) workers. In line with that, RPAZ (Radiation Protection Authority of Zimbabwe) team started participating in trainings offered by the IAEA to map a way forward as far as worker protection is concerned for NORM industries and Radon exposure measurements and assessments.