MONITORING AND DOSE ASSESSMENT OF OCCUPATIONAL

RADIATION PROTECTION EXPOSURES – THE NIGERIAN PERSPECTIVE [IAEA-CN-300-#13]

Idris YAU, Isa SAMBO & Godwin EKONG, Nigerian Nuclear Regulatory Authority (NNRA)

godwin.ekong@nnra.gov.ng

1. BACKGROUND OF OCCUPATIONAL DOSE

Planned, emergency, and existing exposure situations results in occupational exposure according to the IAEA safety standards, United Nations Scientific Committee on the Effects of Atomic Radiation. Radiation workers in both radiological and nuclear facilities are often exposed to sources of ionizing radiation resulting in some level of occupational dose, in which depending on amount of doses incurred has likelihood for radiological hazards, and this requires appropriate optimization of protection for doses reduction

The evaluation of annual average effective doses data reported in this paper relates to dose received by the occupationally exposed workers in various practices in Nigeria. In this regard, the Nigerian Nuclear Regulatory Authority (NNRA) established in 2001 by NSRP Act 19, 1995, is empowered to protect the health of all users, handlers and the public from the harmful effects of ionizing radiation and has in place strong regulatory framework to ensure occupational exposure for all practices involving the use of ionizing radiation is safe;

The external exposures assessment of workers through accredited Dosimetry Service Providers (DSPs) with deployment of dosimeters is reported from 2012 to 2020,

- 2. GENERAL PROCEDURES OF DOSE RECORDS IN NIGERIA
- NNRA has stipulated regulatory dose limits of 20 mSv/y for occupational exposures to radiation workers which must not be exceeded
 Radiation workers are involved in practices like Industrial Radiography, Diagnostic
- Radiography, Well Logging, Research Reactor, Gamma Irradiation Facility, Radiotherapy, Nuclear Medicine, Nuclear Gauge, Other Activities like Transport
- The DSPs carry out proficiency Test conducted by Secondary Standard Dosimetry Laboratory (SSDL) for traceability purpose as a precondition for accreditation
- The NNRA accredits DSPs for providing dosimetry services for radiation Employer in Nigeria

2.1 Methods of dose Collation in Nigeria

- Radiation Employers engages the DSPs for dose monitoring of their of radiation workers from various practices
- DSPs deploys dosimetry products like Thermos-Luminescent Dosimeters (TLDs), Optimally Stimulated Dosimeters (OSLs) for monitoring which are exchange quarterly for the radiation workers
- DSPs submits Quaterly / Annual doses as required by extant laws to the NNRA
- Annual Effective Dose of individual workers (AEDi) are collated, averagely and evaluated based on the regulatory limits of 20 mSv/yr
 The evaluated AEDi were collated into an Occupational Groups based on Practices
- (AEDp)
- Number of Workers (NW) monitored in each group were determined
- Collective Dose (manSv) were derived based on ratio of cumulative AEDp by NW

3. RESULT EVALUATIONS FOR NINE YEARS UNDER REVIEW

The AEDs of radiation workers from practices ranges between (0.28 to 1.24) mSv/yr from 2012 to 2020 with overall average of 0.81 mSv/yr for 9 years under review, which are all presented in Table 1.

Table 1: The AED records for radiation workers from 2012 to 2020

PRACTICES / YEAR (mSv)	AED 2012	AED 2013	AED 2014	AED 2015	AED 2016	AED 2017	EAD 2018	AED 2019	AED 2020
Industrial Radiography	0.57	0.54	0.5	1.1	0.78	1.14	1.61	1.28	0.34
Nuclear Guage	1.26	0.71	0.25	0.64	1.15	0.63	1.39	0.89	0.79
Well Logging	0.34	0.3	0.14	2.42	0.85	Nil	1.43	0.5	0.19
Gamma Irradiation Facility	0.95	0.86	Nil	1.45	2.07	1.64	1.9	0.38	Nil
Diagnostic Radiography	1.1	0.47	1.64	1.41	0.58	0.6	0.34	Nil	Nil
Radiotherapy	1.22	0.35	0.55	0.92	0.41	0.08	Nil	0.5	0.06
Nuclear Medicine	Nil	Nil	Nil	1.84	0.04	Nil	2.34	1.17	0.16
Research Reactor	2.48	1.44	2.34	1.11	1.86	1.33	1.18	1.27	0.79
Activities (Transport Etc)	0.31	0.4	0.36	0.23	0.15	0.42	0.05	0.47	0.21
Range	0.31-	0.3-	0.14-	0.23-	0.04-	0.08-	0.05-	0.38-	0.06-
	2.48	1.44	2.34	2.42	2.07	1.64	2.34	1.28	0.79
Average AED	1.03	0.63	0.64	1.24	0.88	0.65	1.14	0.72	0.28

4. DISCUSSIONS

Range and average effective dose for all the practices/occupational groups from 2012 to 2020 and as presented in Table 1 Figures 1 and 2 represent bar charts of average dose as a function of year within practices respectively. As culled from the graph, the highest dose received across all practices was in well logging practice 2015 with average dose of 2.24mSv translating to 1.24mSv in 2015 while the lowest dose received was in other Activities e.g. Transport in 2018 with average dose of 0.05mSv translating to lowest of 0.20mSv in 2020 which was probably due to the COVID pandemic which no much activities took place. The average doses for

2012 to 2020 across all practices were far below limit of **20mSv** per year averaged over 5 years or **50mSv** in a single year as stipulated by Recommendation 103 of the ICRP 2007 and NiBIRR 2003.



Figure 1: AED of practices for 2012 to 2020





4.1 Dose Distribution of average Nigerian Radiation Workers (NRW)

The Dose distribution of average NRW recorded for 2012 to 2020 is presented in Figure 3. The average number of radiation workers incurring a range of doses were recorded as 1475. The lowest dose of ≤ 0.5 was distributed to total number of 1093 out of average radiation workers of 1475 representing 74.1%, while the highest dose of >12 to ≤ 12.5 was recorded for only one radiation worker. The average dose for all practice for 2012 to 2020 were less than 2 mSv/yr which indicates a strong regulatory oversight as instituted by the NNRA,



Figure 3: Average dose distribution for all occupational groups of 1475 NRW

5. CONCLUSIONS AND ACKNOWLEDGEMENTS

Dose records of external exposures from radiation workers in Nigeria has been collated, evaluated and reported from 2012 to 2020, and found within regulatory limit due to effective regulatory framework as instituted by the NNRA these past 20 years. The Authors Appreciate the Nigerian Government, Management and the NNRA Dose Evaluating team.

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