

ESTIMATION OF BACKGROUND RADIATION AT RIVERS STATE UNIVERSITY OF SCIENCES AND TECHNOLOGY, PORT HARCOURT

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(Received 26, May 2009; Revision Accepted 21, January 2010)

ABSTRACT

Background radiation from the use of photocopies, computers and other electronic devices around River State University of Science and Technology was measured using a specialize digital, radiation meter type, radalert - 50, which is optimized to detect radiations like alpha, beta, gamma and x-rays.

Measurements were carried out within seven working hours of the day and for seven days of the week in each of the five locations selected evenly. Using a calibration factor linked to Cs-137, the values obtained in count per minute (CPM) were converted to dose equivalent rate in mSv/Week.

Results show that an average radiation level of 2.87×10^{-3} mSv/Week was prevalent. This is clearly below the recommended safety radiation limit of 2.0×10^{-2} mSv/Week as prescribed by ICRP, hence no cause for alarm.

KEYWORDS: Radiation, Radalert-50, electronic devices, radiation limit

1. INTRODUCTION

Radiation as one of the sources of environmental pollution is enhanced by the ever increasing demand and production of certain technological equipment like computers, photocopies, fax machines handsets, and other spectral emitting devices like clock and watches.

However, there has been a public concerned on whether, the level of radiation from the use of these devices has exceeded the recommended level by the International Corporation for radiological protection (ICRP). In the same vein, whether there are certain health hazards associated with the continuous use of these equipment (Attix, 2005). It is a common thing to note that, computers, photocopies, fax machines and handsets are found generally in companies, offices, house whole and institutions like River States University of Science and Technology where greater percentage of the school environment has them situated

Though studies by (Agba and Ayangeaka, 2005) shows that computer monitors emit certain level of radiation to the background, but it is inconclusive to note whether there is any health hazards associated with it. The outcome of this study will provide a baseline on the level of background radiation in the vicinity and also informed the producers of computers, photocopies, fax machine with their rating of low level radiation.

It is therefore necessary to understand the radiation propagation mechanisms and provide an adequate and reasonable limit for man exposure and procedures to ensure protection.

To achieve this, radiation emitted by computers and photocopies should be measured and analyzed correctly using the appropriate methods. Generally, computer comprises of a cathode ray tube (CRT) built into a monitor whose screen is coated with florescence radiative powder of phosphor which is bombarded at very high speed by electron particles fired from an electron gun and the back of CRT (Philip and pick, 1996). The electron beam is directed by a powerful magnet to the back of the screen which it scans in rapid continuous motion, visiting the spot several times a second to refresh the florescent powder, then making it to glow (Muellers, 2000). When such an electron been moving with energy and dependent on the accelerating potential in kilovolt (KV) strikes the phosphor coated screen, some of its energy is dissipated as heat and some is transferred to phosphor atoms raising them to higher quantum energy levels. When they lose this energy, the fall back to ground state and photons of different frequencies are emitted as predicted by quantum theory (Adam and Lowder, 1964).

Based on quantum theory, when a beam of sharply focused electron decelerates on impact with phosphor material (target) some of the energy is converted to electromagnetic energy

propagated as photon whose maximum frequency is
 $f = eV$ ----(1)

h
Where e = Electronic Charge
V = Accelerating Potential and
f = Maximum Frequency
h = Planck Constant (Attix, 1986)

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studies by Rieke, (1996) show that, photocopiers like every other electrical component (circuit) undertake minimal radiation emission. Thus during photocopying process, a low intensity light is illuminated on the toner powder which consists of silicon or germanium. This component allows the flow of current through electrostatic process and subsequent emission of different rays (Kimmelman, 2004). In another development, any circuit failure arising from excessive voltage greater than 15kv as normal operating voltage for photocopiers leads to dangerous emission of radiation, ranging from solve to hard X-rays. (Agba and Ayageakaa, 2005). This study is geared toward estimating the level of background radiation from computers and photocopiers at different locations in the surveyed areas and moreso, measuring the quantity of absorbed dose of possible ionizing radiation and ascertaining whether the level is within the international recommended dose 0.2mSv/week (ICRP, 2006). It is believed that this study will not only provide a base-line data for estimating background radiation in the vicinity of Rivers State University of Science Technology, but also create awareness in radiation measurement and control in the environment.

2.0 MATERIAL AND METHOD

Background radiation levels from 5 different areas on campus, with some of the areas densely populated with computers and photocopies was measured using a specialized geiger Muller counter Radalert – 50 (P. A. International Inc, Britain). The radiation meter displays it count in liquid crystal displace (LCD) in count per minute, (CPM); miliroentgens per hour (mR/hr) or total count based on the adjustment of the mode knob. This instrument which is optimized to detect low-levels radiation has a mica window of density 1.6-20mg/cm² and takes up to 50,000 Cpm or mR/hr reference to Cs-137 (Radalert-50 operating manual, 1997). It has an accuracy of 16% with easy conversion to mSv/week level. The on-botton can be turned to "audio" or just "on" and selection to

mR/hr or CPM; it does a three second system check, displaying all the indicators and numbers with the hour glass disappearing after one minute. This shows that, the equipment is ready for measurement.

The technique use for data acquisition was, direct measurement on the field with the radiation meter positioned at a distance of 0.6m and 1.0m from the centre of computer screen and photocopying machine respectively. For each daily measurements a ten-minutes average count was conducted which was followed by a standard deviation of count per minute score in each area. This was necessary to set the limit for normal mode and alert mode to regulate radiation in that vicinity, before proceeding with counting.

In each location, different positions were maintained in every one hour, this was to estimate a uniform background radiation and at the end obtain the actual background radiation in that location. Measurements of activity and exposure rate was in miliroentgen and total count per minute (CPM) while maintaining the same distance of 0.6m was 1.0 from the sources and ground. These counts were further converted to dose equivalent rate in millisievert/week by a conversion factor (55200 cpm = 100mSv/week) as specified by the manufacturer. To achieve this, working 7(seven) hours a day for seven days a week was used. The final conversion was compared with the dose equivalent rate of 0.02mSv/week reference to ICRP (ICRP, 2005)

3.0 RESULTS AND DISCUSSION

The results from the estimation of background radiation are summarized in Table1. This shows average background radiation levels in area 1 to 5. The results displayed are for the measured parameters of activities in CPM converted to dose equivalent rate in millisievert per week (mSv/week) and milliroetgen per hour (mR/hr) To ascertain the level of background radiation in the locations, a plot of exposure to dose rate in mSv/week against the different locations is shown in figure1.

Table 1: Summary of Result form the 5 monitored Locations in Rivers State University of Science and Technology, Port Harcourt

| Day | Location 1 X10 ⁻³ mSv/week | Location 2 X10 ⁻³ mSv/week | Location 3 X10 ⁻³ mSv/week | Location 4 X10 ⁻³ mSv/week | location5 x10 ⁻³ mSv/week |
|--------------|--|--|--|--|---|
| 1 | 2.35 | 2.36 | 2.78 | 2.99 | 2.04 |
| 2 | 2.93 | 2.27 | 2.86 | 2.86 | 2.35 |
| 3 | 3.35 | 2.38 | 3.19 | 3.13 | 2.07 |
| 4 | 2.77 | 2.77 | 3.65 | 3.19 | 2.20 |
| 5 | 2.71 | 2.85 | 3.89 | 3.34 | 2.27 |
| 6 | 2.72 | 2.70 | 3.77 | 3.26 | 2.38 |
| 7 | 3.32 | 2.23 | 3.20 | 3.14 | 2.45 |
| Total | 20.15 | 17.56 | 23.34 | 21.91 | 15.76 |
| Average | 2.87 | 2.50 | 3.53 | 3.13 | 2.25 |

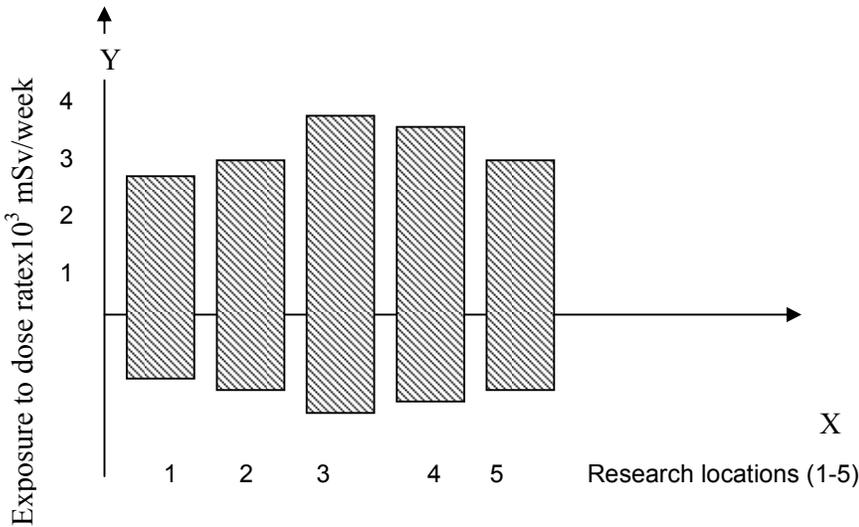


Figure 1: A bar chart showing Exposure to does rate in mSv against Research locations

The result obtained from table 1 shows that, the average dose equivalent radiation level emitted to the background ranges between 2.04×10^{-3} mSv/week to 3.53×10^{-3} mSv/week between research locations 1 to 5. The result depicts that, there is gradual rise and fall in trend of background radiation level between locations 1 to 5 with locations 3 and 4 (business centre and school library) recording the highest values respectively. Locations 1, 2 and 5 (main gate entrance, convocation Arena, and living quarters) having moderately low values. The hike in values of locations 3 and 4 indicates that the level of background radiation has been slightly increased and may be attributed to the presence of computers, photocopiers and other electronic devices.

The trend also shows that, within the seven days in each research location, there were observed variations in emitted radiation per minute change due to activities in those areas. Further statistical analysis was also carried out using one way analysis of variance (ANOVA) from the existing data of dose equivalent in mSv/week in all the monitored locations to know the variations of each score from the main score. The result computed at 0.05 significant level with a critical f-ratio of 2.69 and of 4.30, shows the calculated f-value of 14.75 being greater than 2.69, meaning that the study locations are significantly different in terms of background radiation as shown in table 2.

Table 2: Summary Of Data From One Way Analysis Of Variance (Anova) In Dose Equivalent Rates

| SOURCE | 53 | df | ms | Cal.f-ratio | Critical f-ratio |
|--------|-------|----|-------|-------------|------------------|
| Area | 5.841 | 4 | 1.460 | 14.75 | 12.421 |
| Error | 2.973 | 30 | 0.099 | | |
| Total | 8.814 | 34 | | df-4.30 | |

Where df = degree of freedom,

Ms = mean square

Source 53 = the average number of emitting sources.

Finally, despite the presence in the level of background radiation within the 5 monitored areas, those living or working in the business centres, operate within a safe recommended dose limit of 0.02mSv/week as prescribed by international corporaion for radiological protection as they have an average value of 3.92×10^{-3} mSv/week.

4.3 CONCLUSION

The result from the radiation monitored locations on campus of Rivers State University of Science and Technology shows some level of background radiation in the vicinity. This underscores the fact that, despite the moderately high values of 0.35×10^{-3} mSv/week and 0.32×10^{-3} mSv/week obtained in locations 3 and 4, those working within these locations are operating within a safe limit of 0.02msv/week as recommended by international Cooperation for Radiological Protection (ICRP, 2005).

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