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Assessment of Exposure Level to Background Radiationin South Valley University, Egypt

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Abstract:*Background terrestrial radiation survey of South Valley University was carried outusing a digital radiation meter (Thermo FH 40 G-L10 Survey Meter) which is optimizing to measure gamma background radiation.A total of 24 locations were surveyed across the campus for background environmental radiation. About twenty reading or more were taken in each location in survey and then an average computed. The indoor and outdoor mean ambientdoserate for all the location were the same (0.083±0.006)µSv/hr while the mean of indoor annual effective dose rate (IAEDR) andoutdoor annual effective dose rate (OAEDR) were found to be0.583±0.039and0.145±0.01mSv/yr, respectively. IAEDR varies from 0.516mSv/yr to 0.684mSv/yr. For the outdoor measurement, the minimum dose rate 0.123mSv/yrand the maximum dose rate 0.17mSv/yr. It was noticed that the outdoor dose level was lower than the indoor dose level. The obtained results do not indicate any immediate health side effects on the staff and students and the hostcommunitiesandoperating within the recommended safety limit of 1.0mSv/yr.*
Keywords*: Background Radiation, Equivalent Dose, Ambient dose rate and safety limit.*

I. Introduction

Human beings are constantly exposed to natural sources of ionizing radiations in nature. The natural background radiations have both terrestrial and extra-terrestrial origins. The extra-terrestrial radiation is largely due to cosmic rays (1). Cosmic radiations are highly energetic particles which come from extraterrestrial sources such as the sun and galactic radiation. Its examples are protons, electrons, alpha particles etc. These cosmic radiation travels through the atmosphere and on interaction, it produces secondary radiations such as neutrons and gamma rays which are highly penetrating (2).The investigation of gamma dose rate in surface air is veryimportant to assess the external radiation exposure and the risk tothe publicindividual for both natural and artificial radiation (3).

The ambient radiation encompasses both the natural and artificial radiation radioactivity in his environment (4). The ambient dose equivalent rate (ADER) depends on the intensity of ionizinggradation of radionuclides in the atmosphere and on the ground surface as well ason cosmic radiation (5).Terrestrial radiation varies from place to place depending upon the variation of radionuclide concentration in soil (6).Over the last three decades, there has been increasing global concern over the public health impacts attributed to radioactivity and environmental degradation. Increasing environmental regulation and more exact standards for the quality of water, air, soil, and food have led to a significant expansion of the environmental monitoring industry throughout the world.

Studies on environmental radiation levels and radionuclide distributions in the environment are important for satisfy basic scientific curiosity and gain knowledge and an improved understanding of the world and assess the impact of human activities involving radioactivity and radiation on the environment, a process which may require differentiation of natural and anthropogenic sources of radioactivity and lead to assessment of dose from environmental sources (7). Our knowledge of the natural radiation levels serves as a historical record of the environment's quality and provides a reference database for future use, e.g. for epidemiological studies (8).Various research works have been done regarding ambient dose rate and indoor and outdoor background gamma radiation measurements. This work is aimed at measuring ambient dose rate and indoor and outdoor background gamma radiation on various campuses in south valley university.

II. Sampling and measurements

1.1. Sampling of Area

South Valley University (SVU), covers a large area in Upper Egypt. SVU campus is located in Qena, a city which is 600 km south Cairo. The University includes a lot of Faculties which in Fig. 1

1.1. Materials And Method

Fig. 1 Map of Study Area

Fig. 2FH 40 G-L10 Multi-Purpose Digital Survey Meter (9)

Background Radiation Measurement of SVU campuses was adopted using direct dosimetry. The FH40G-L10alert Background radiation monitor was used.The digital alert Background radiation monitor adopted (FH40GL10) is a health and safety instrument that measures gamma and X-ray radiation.The Model FH40GL10 is a stand-alone unit with an internal proportional detector and can simultaneously function with an external detector.Its measuringof dose rate range goes from10 nSv/hr to100mSv/hr. The study area was subdivided into three locations. The academic block comprising of the College ofmedicine, science building 1 and 2, agriculture, art, educationbuilding 1 and 2, Archaeology, rights, Veterinary Medicine, Physical Education and quality education.The hostel block involving of A, B, C, D, E and L building, and some other public places inside the university like classes building hotel, theatre, bank and hospital.

FH40GL10 Dosimeter was set to Background radioactivity in nanoSievert per hour (nSv/hr) and held at a height of 0.1m above sea level. This height of 0.1m was suggested and represented by the international commission on radiological protection (10) and(3) , in order to accurately estimate radiation exposure to man. The radiation exposure level was measured and the readings were obtained. For each building, twenty counts per hour in different point were recorded and then an average was computed.For each point, three countswere recorded and then an average was computed.UNSCEAR, (11)recommended indoor and outdoor occupancy factor are 0.8 and 0.2 respectively. This occupancy factor (OF) is the proportion of the time during which an individual is exposed to a radiation field.

This work is based on indoor and outdoor exposure and outdoor occupancy factor of 0.8 and 0.2 was used to determine the indoor and outdoor annual effective dose rate. 8760 hours per year was used to calculate the IAEDR andOAEDR.

To convert the average dose rate per hour into an equivalent dose in milli-sievert per year (mSv/yr), the equation below was used:

IAEDR (mSv/yr) = (x) μSv/hr x 8760hr/yr x 0.8 x 0.001[1]

OAEDR (mSv/yr) = (y) μSv/hr x 8760hr/yr x 0.2x 0.001[2]

Where x is the indoor mean equivalent dose rate and y is the outdoor mean equivalent dose rate in micro Sievert per hour (μSv/hr) for each building.

III. Results and dissection

Table 1 below shows the result of the background gamma radiation measured from SVU campusesin Qena Government, Egypt. The results compared with the standard value of the background ionization radiation level are shown in Fig.3

The average dose obtained from the measurement showed that the background ionising radiation level within the campus is low. The maximum indoor dose and outdoor dosewas showed atthe College of education qualitywith an average of(0.098±0.015) and (0.096±0.012)μSv/hr,respectively.While theminimum indoor does was obtained from the bank which records an average of(0.074±0.005)μSv/hr and minimum outdoor dose was showed atthe College of Physical Education with an average of (0.07±0.006) μSv/hr.Maximumandminimum values obtained clearly show that background radiation was not regularly distributed in all buildingsthrough the campus. The scattered distribution in the plot clearly showed the variation in background radiation across these locations.

The analysis of the results revealed that the indoor and outdoor mean dose rate of the twenty-five locations in the three portioned major stations that could be given to an individual within these locations on the campus were the same (0.083±0.006)μSv/hr, and the mean of IAEDR and OAEDR for all the locations was (0.583±0.039) and (0.145±0.01)mSv/yr. These values fall within the safe radiation limit of 0.13μSv/hr and 1.0 mSv/yr recommended bythe international commission on radiological protection (10) andUnited Nations Scientific Committee on the Effects of Atomic Radiation(11)that could pose threat to health as a result of natural background terrestrial radiation.

Table 1: Indoor and Outdoor Mean Dose Rate (μSv/hr) and annual effective dose rate (AEDR) (mSv/yr) for the twenty-four locations inside SVU, Egypt.

Code	NAME OF LOCATION	Indoor Mean ambient dose rate (μSv/h)	Outdoor Mean ambient dose rate (μSv/h)	Indoor annual effective dose rate (mSv/yr)	Outdoor annual effective dose rate (mSv/yr)
L1	ICTC	0.081±0.004	0.081±0.007	0.568	0.141
L2	Classes Building	0.082±0.006	0.088±0.006	0.573	0.155
L3	Hotel	0.080±0.008	0.089±0.013	0.562	0.156
L4	Theatre	0.074±0.006	0.086±0.012	0.520	0.151
L5	Bank	0.074±0.005	0.084±0.011	0.516	0.146
L6	Hospital	0.093±0.019	0.090±0.002	0.650	0.157
L7	College of medicine	0.084±0.004	0.083±0.004	0.586	0.145
L8	College of Veterinary Medicine	0.086±0.014	0.095±0.013	0.600	0.166
L9	College of science 1	0.081±0.003	0.082±0.01	0.565	0.143
L10	College of science 2	0.084±0.009	0.078±0.003	0.588	0.136
L11	College of agriculture	0.082±0.005	0.081±0.004	0.572	0.142
L12	College of art	0.082±0.005	0.084±0.006	0.573	0.147
L13	College of education 1	0.079±0.003	0.080±0.003	0.556	0.139
L14	College of education 2	0.085±0.006	0.080±0.006	0.593	0.140
L15	College of Archaeology	0.080±0.005	0.082±0.009	0.561	0.144
L16	College of rights	0.083±0.006	0.080±0.002	0.580	0.140
L17	College of Physical Education	0.091±0.013	0.070±0.007	0.641	0.123

L18	College of education quality	0.098±0.015	0.097±0.012	0.684	0.170
L19	Hostel (A)	0.081±0.003	0.085±0.013	0.569	0.150
L20	Hostel (B)	0.081±0.006	0.079±0.003	0.568	0.139
L21	Hostel (C)	0.085±0.011	0.081±0.001	0.596	0.142
L22	Hostel (D)	0.081±0.004	0.079±0.005	0.569	0.138
L23	Hostel (E)	0.081±0.004	0.083±0.002	0.565	0.145
L24	Hostel (L)	0.093±0.022	0.077±0.006	0.650	0.134

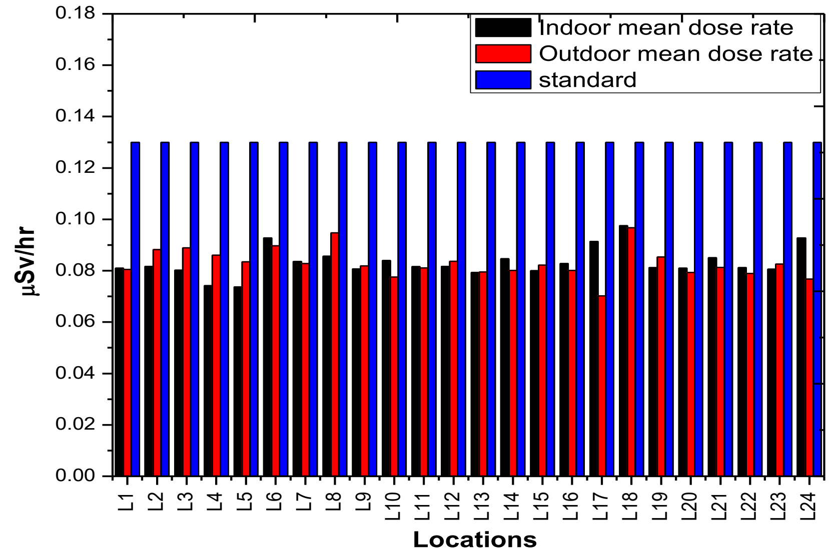

Fig. 3: Plot Mean Dose Rate (μSv/hr) and Standard Background Radiation with different locations

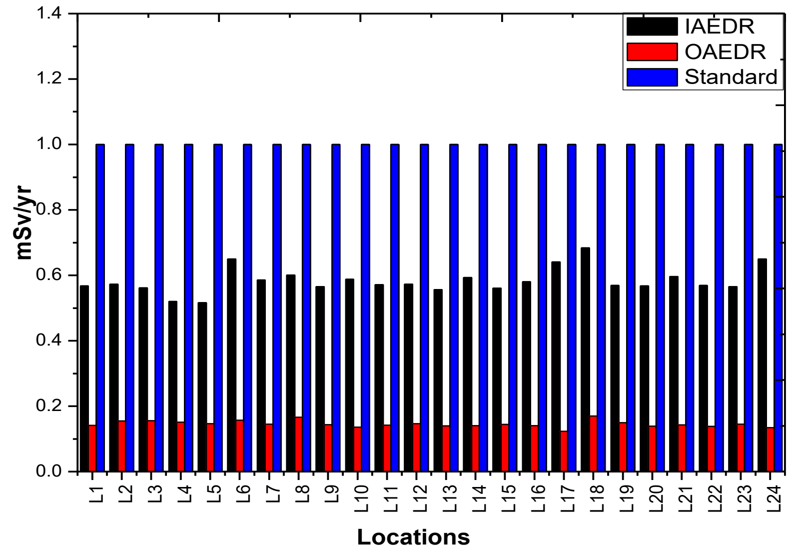

Fig. 4: Plot annual effective dose rate (AEDR) (mSv/yr) and Standard Background Radiation with different locations.

IV. Conclusion

Measurements of ambient dose rates for 24 building insouth valley university in Egypt were performed usingFH 40 G-L10dosimeters .The estimated indoor and outdoor annual effective dose rate has been obtained as 0.583±0.039and 0.145±0.01mSv/yr, respectively. This dose is assumed to correspond to worker, students and those residents in the study area. From this study, the annual effective dose rate of background gamma radiation is observed to be below the world average value and also indicates that there is no adverse health effect on the population under study.

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