

Exposure Rate Measurements of the Natural Background Radiation in Some Najaf Regions

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Abstract:

Exposure rate measurements of the natural background radiation have been done in some chosen regions of Najaf city by using G-M tube .The radiation survey was conducted for the following regions:

- Al-Ansar (12 locations)
- Al -Fateh at Al-Hurya (8 locations)
- Al -Rashadya at AL-Kufa (2 locations)

The total average exposure rate in this study was (9.22 μ R/h), this value is less than the permissible limits, as a comparison with the exposure rate limit for the whole body for the general public (22.61 μ R/h). Each count of measurements is repeated many times and the statistical fluctuation is less than $\pm 12\%$.

Thus, Najaf city could be classified as an area of normal background radiation.

1. Introduction:

Radiation is energy in the form of particles or waves that travels from one object to another .For example, sunlight is radiation that travels from the sun to the Earth.

Radiation that causes ionization is called ionizing radiation .Examples of types of ionizing radiation are:

- alpha particales
- beta particales,and
- gamma rays.

Radiation that does not cause ionization is called non-ionizing radiation. Examples of non-ionizing radiation are :

- radar
- radio waves,
- microwaves, and
- Visible light.

Note that non-ionizing radiation such as microwaves can cause harm. However, because it is not ionizing radiation, it causes harm in a different way from ionizing radiation.

The particles in ionizing radiation are like speeding bullets; neither the particle nor the bullet is in itself dangerous; however, the energy resulting from their speed is dangerous. After the particle stops, it becomes harmless.

Humans have always live in the presence of radiation from natural sources .The four major sources of natural radiation are discussed below; these are

- cosmic radiation (from outer space),
- terrestrial radiation (from the earth),
- internal sources(from food), and
- radon

Natural occurring radioactive material is called by the acronym NORM [1].

Cosmic radiation comes from the Sun and distance stars. High-speed particles are emitted from the Sun and stars and hit the Earth's atmosphere ,which acts as partial shield .At sea level ,the dose rate to each individual is about 3 $\mu\text{rem/hr}$.At higher altitudes ,the amount of atmospheric shielding is less so the dose is more United Nations Scientific Committee on the Effects of Atomic Radiation [2].At Los Alamos, the dose rate is 7 $\mu\text{rem/hr}$;on a 10,000-ft mountain it is 10 $\mu\text{rem/hr}$;and in airplane at an altitude of 12 km and a latitude of 50 degrees it is about 500 $\mu\text{rem/hr}$.The following equation was used to calculate the dose rate , H , in $\mu\text{rem/hr}$ as a function of the altitude, z ,in km [3]

$$H = 3.2[0.21\exp (-1.649z) + 0.79\exp (0.4528z)]$$

The dose rate from neutrons is not normally included in these estimates because it is small and has not been measured precisely. It is estimated to be 1 $\mu\text{rem/hr}$ at sea level and 2 $\mu\text{rem/hr}$ at an altitude of 2 km.

Most cosmic rays are high-energy muons, which can penetrate a meter of lead shielding. Even inside a lead storage vault, the dose rate from cosmic-ray muons is about 3 $\mu\text{rem/hr}$.

Terrestrial radioactivity refers to the activity of natural radioactive material in the soil, primarily uranium, thorium, and potassium. These have very long half-lives .They were formed when the Earth formed, and have not yet decayed [4].

All living thing contain natural potassium-40, which is radioactive.Food , which is derived from living thing, contains potassium-40 , and so our bodies contain potassium-40.Radioactivity inside the body is called internal radioactivity. All humans receive about 4 $\mu\text{rem/hr}$ from internal radioactivity ,most of which is from potassium-40 [5].

Radon comes from the radioactive decay of natural uranium and thorium ,which are present in all soil. Because radon is a gas, it diffuses from the soil and collects in buildings and homes from where it gets inside the body. The average dose rate to each person in the US from radon decay products is about 20 $\mu\text{rem/hr}$ [6].

2.Experimental procedure and experimental settings

Twenty two locations of 3 regions from Najaf city, Iraq have been radiation survey, as seen in the maps (fig.1,2), and these regions are :

- Al-Ansar (12 locations)
- Al -Fateh at Al-Hurya (8 locations)
- Al -Rashadya at AL-Kufa (2 locations)

The experimental results of this study were done using G-M tube with an exposure rate meter type [G-M survey meter (Riken Fine Model Sum-AD8,Riken Keiki Co.,Ltd,Tokyo Japan)] this meter measure with unit count per mint and mR per hour to gamma and beta rays, exposure rates were measured 1 m above the ground .Two radioactive sources (Cs-137 of 6.01 μCi activity) & (Co-60 of 0.23 μCi) were used to calibrate the G-M exposure rate meter . An exposure rate vs. source to detector distance calibration curves were done for calibration & plotted in figure (3) .Figure (3) shows that for same distance, the exposure rate by the Cs-137 source is higher than that by the Co-60 source of the higher energies, and this can be explain by the higher activity to Cs-137 source .

3.Results and discussion:

The results of this study are presented in table (1) , shows the exposure rate at each location. Each reading is repeated of several times and the statistical fluctuations is less than $\pm 12\%$.

Many results have obtained from this survey as the following:

- The average exposure rate of the natural background radiation is $(8.54,8.41)\mu\text{R/h}$ for up and down detector, respectively in Al-Ansar region, and $(10.25,8.5)\mu\text{R/h}$ for up and down detector, respectively in Rashadya region. This result is an indication that, the natural radiation of the cosmic origin is higher than the radiation of the earth origin.
- The average exposure rate of the natural background radiation is $(9.56, 10.06)\mu\text{R/h}$ for up and down detector, respectively in Hurya region. This result means that, the background due to the Earth is higher than the background from the air at the studied area .
- As a comparison with the exposure rate limit for the whole body for the general public (170mrem/year) [7], which is equal to $(22.61 \mu\text{R/h})$, we can show that the total average exposure rate in this study ($9.22\mu\text{R/h}$) is less than the permissible limits.
- The results have been compared with previous works, as seen in the table (2).

4. Conclusion

The results suggest that the total of exposure rate of the natural background radiation ($9.22\mu\text{R/h}$) is less than the permissible limits. While the total of exposure rate in previous works by (Al-Ahrajy and Al-Attiyah, 2001) (20.25) is within the permissible limits.

Thus, Najaf city could be classified as an area of normal background radiation.

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Figure (1) Iraq map

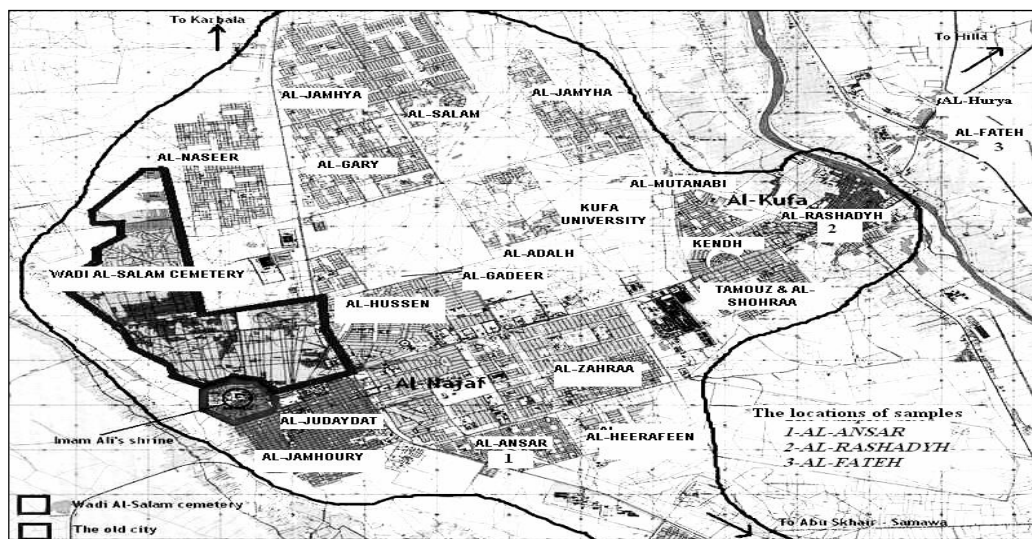


Figure (2) The administrative Najaf city map

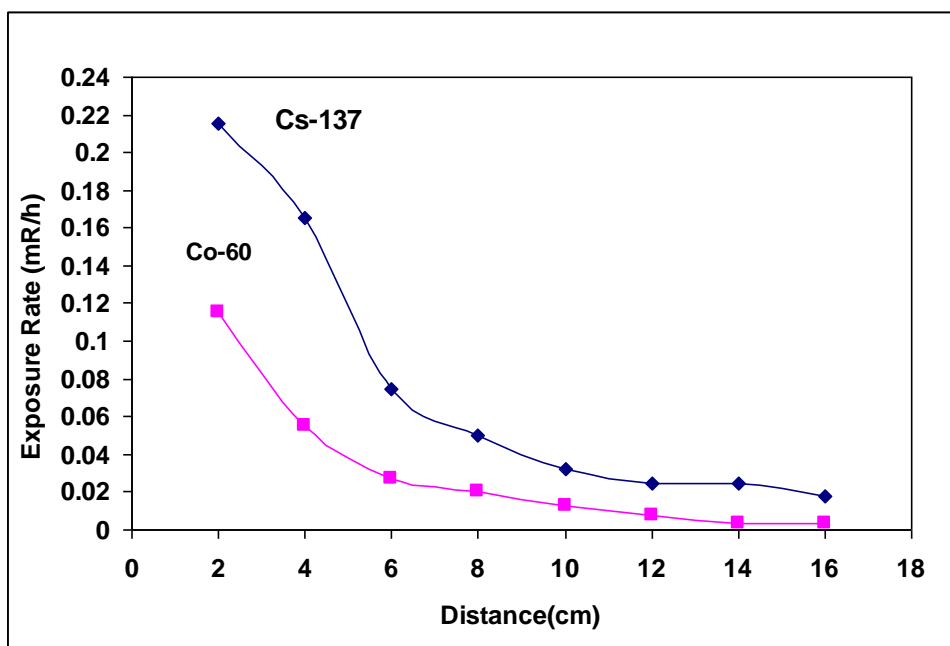


Figure (3) The calibration curves for the G-M exposure meter by Cs-137 & Co-60 sources.

Table(1) The exposure rates ($\mu\text{R/h}$) in each location

Location	Al-Ansar		Al-Hurya		Al-Rashadya	
	Up	Down	Up	Down	Up	Down
1	7.5	7.5	6.5	10	11	8
2	10	9.5	9	7.5	9.5	9
3	10	7.5	10	11.5		
4	10	11.5	10	10		
5	7.5	10	10	10		
6	7.5	7.5	10	10		
7	7.5	7.5	10	10.5		
8	10	7.5	11	11		
9	7.5	10				
10	7.5	6.5				
11	10	8.5				
12	7.5	7.5				
Average	8.54	8.41	9.56	10.06	10.25	8.5

Table (2) The Total of Exposure Rate ($\mu\text{R/h}$) for previous works in Iraq and different countries

Location	The Total of Exposure Rate	Reference
Germany	10.45	[8]
Italy	8.27	[8]
Switzerland	8.50	[8]
Ireland	9.42	[9]
College of Medicine-Kufa University	12.6	[10]
Babylon and Al-Najaf Cities	7.01,10.68	[11]
Babylon University	20.25	[12]
Babylon Government	6.37	[13]
Colleges of science and agriculture- Kufa University	7.68	[14]
Some Najaf regions (Ansar, Hurya, Rashadya)	9.22	Present study

ش" قياسات معدل التعرض للخلفية الطبيعية الإشعاعية في بعض مناطق النجف"

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الخلاصة:

جرى قياس معدل التعرض للخلفية الإشعاعية الطبيعية لمناطق منتخبة من مدينة النجف ، باستخدام جهاز محمول (عداد كايكر ميلر)، حيث تم إجراء مسح إشعاعي للمناطق التالية :

- حي الأنصار (12 موقع)
- الفتحة ناحية الحرية (8 مواقع)
- حي الرشادية (2 موقع)

حيث وجد إن معدل التعرض الكلي بمقدار (9.22 مايكرورونجن/ساعة) وهو اقل من الحد المسموح به لمعدل التعرض لكل الجسم ولعامّة الناس والذي هو بمقدار (22.61 ميكرورونجن/ساعة). أعيدت القراءات لكل حالة عدة مرات وكان التراوح الإحصائي اقل من $\pm 12\%$. وبهذا يمكن تصنيف مدينة النجف ضمن المناطق ذات الخلفية الإشعاعية الاعتيادية.