مبرهنات النقطة الصامدة للتطبيقات المتعددة الانكماش و التطبيقات المتمددة في الفضاءات G-المترية

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الكلمات المفتاحية :- نظرية النقطة الصامدة،الفضاءات G-المترية ،التطبيقات الانكماشية

الخلاصة:

الغرض من هذا البحث هو لتعريف نوعين من التطبيقات في فضاءات G-المترية ومن ثم إيجاد النقاط الصامدة لهذه التطبيقات. النوع الاول من هذه التطبيقات تسمى التطبيقات متعددة الانكماش، حيث قدمنا تعريف شرط الانكماش على إنغلاق المسار وحيث ان المسار يكون مقيدا وتام مسارياً. أيضاً، سوف نناقش وحدانية النقطة الصامدة فقط على هذه المسارات. كذلك، سنبرهن وجود النقاط الصامدة للتطبيقات المتمددة الشاملة.

Concentration of Radon, Thorn and their Progeny Levels in Different Location in Some Dwellings of Zubair City

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Abstract

Radon, thoron and their progenies are the most important contributions to human exposure from natural sources. Radon is a natural radioactivity gas without dour, color or taste, it comes from uranium decay. Uranium is a natural radioactivity material found in varying amounts in all rock, soil, concrete and bricks. This study assesses the indoor radon, thorn and their progeny in some dwelling in Zubair northwest of Basrah city by using Solid State Nuclear Track Detectors (SSNTD) type CN- 85. The value of concentration of radon ranges from 12.169 (Bq/m³) to 99.470 Bq/m³ and with an average 50.216 Bq/m³, where the value of thoron concentration ranges from 4.569 Bq/m³ to 35.729 Bq/m³ with an average 16.134 Bq / m³.The range of radon progeny and thorn progeny from 1.3 o 10.75 mWL and from 1.66 mWL to 12.99 mWL respectiv inhalation dose for radon

and thorn (Rn + Tn) varies from 0.255 mSv/y to 2.067 mSv/y .The annual exposure to radon and thorn (Rn + Tn) in terms of WLM ranges from 0.106 to 0.854. The annual effective dose for radon and thorn (Rn + Tn) was ranges from 0.411 mSv/y to 3.88 mSv/y with an average value of 1.597 mSv/y.

Introduction

Radon-222 as a natural gas , has three main natural isotopes ; namely , Radon-222 a decay product of uranium- 238 , radon -220 known as thorn product in the series of thorium-232 and radon-219 decay from the chain origination with uranium-235 [1] and also radium-226 the parent of radon-222 [2] , radon-222 has half- life of 3.82 day ; radon- 220 (thorn) has a half life of 55 second and radon-219 has a half- life of 3.96 seconds [3] . Radon, thorn and it's (α – emitting) decay product is naturally occurring in the environment in the form of ionizing radiation [4]. These isotopes became hazard if found in high concentration in covered areas like mines, caves and poorly ventilated houses [5]. Indoor radon, thoron and their decay products is assumed to be health hazard for human. About 90% of average radiation dose received by human for natural sours and 50% is due to inhalation of radon, thorn and their progeny are present in the dwellings [6].

Measurement of radon, thoron and their progeny is important because the radiation

dose to the human population due to inhalation of radon and it is progeny contribute more than 50 % of the dose from all sources of radiation. Risk projections imply that radon is the second leading cause of lung cancer after smoking [7]. It may cause about 15000 lung cancer deaths per year in the United State and the World Health Organization (WHO) says; radon cause up to 15 % of the lung cancer worldwide [8,9]. When inhaled radon and thorn gases flow quickly in and out of the lung, almost never lingering enough to cause damage .The radon progeny, Po–218 and Po–214 (Bi–214) which are solids tend to lodge in the bronchial tree where they emit " heavy " particles (alpha particle), alpha particles can cause more damage to tissues because of their greater electrical charged and relatively large mass [10]. The damage in DNA in cell nuclei or create a free radical lead to uncontrollable cells reproduction and growth of a cancer tumor [11, 12].

In this whole study, measurement of the radon and thoron in the some dwellings that selected in Zubair city, where Zubair city is about 10 Km from center of Basrah city.

Materials and Methods

For measuring indoor radon, thoron and their progenies have been carried out in some dwellings in Zubair city. The detectors used in this study were Solid **S**tate **N**uclear **T**rack **D**etector**s** (**SSNTDs**) Cellulose Nitrate ($C_6H_8O_8N_2$) known as CN-85. The area of detector was 1.5 cm x 1.5 cm, are fixed at the top inside of plastic cup 7 cm in diameter and 5.6 cm in depth a circular hole with a radius of 1.8 cm was made in the center, the hole was covered by a piece of sponge (2 cm x 2 cm) with a thickness 0.14 cm, shown in Fig. (1), this a plastic cups was hanging on the ceiling of

different locations in houses (living room, bed room, kitchen and bath room) in high as about 2.4 m. The detectors were left to 90 days, after the exposure time, the detectors were collected and brought back to the laboratory in the physics department for analyses. The etching process was a achieved by using a sodium hydroxide solution (NaoH) in 2.5 N at 60 C^o for 90 minutes . After the etching process, the detectors were washed by distil water and dried. The counting of alpha particles tracks was done using an optical microscope with a power of 400X.

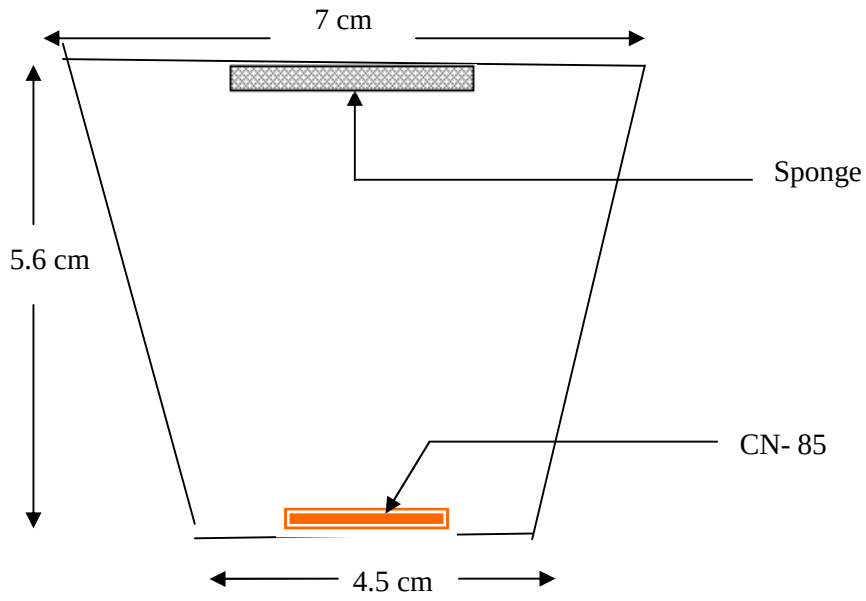

Fig. (1) Plastic cup using in the present work

To calculate the radon concentration ($\mathbf{C}_{Rn}$) and thoron concentration ($\mathbf{C}_{Tn}$) in terms of (Bq/m³) using the following relation [13, 14]:

$$\mathbf{C}_{Rn}\ (Bq/m^3) = t_{rm} / T\ K_{rm} \quad (1)$$

$$\mathbf{C}_{Tn}\ (Bq/m^3) = t_{total} - K_{rf}\ C_{Rn}\ T / TK_{tf} \quad (2)$$

Where t_{rm} is the track register on detector T/cm^2 , T is the exposure time in days.

t_{total} is the total tracks recorded in the **S**olid **S**tate **N**uclear **T**rack **D**etector**s** (**SSNTD$_s$**) films .

$K_{rm} = 0.021 \pm 0.003$ track. cm $^{-2}$.d / Bq.m^{-3}

$K_{rf} = 0.023 \mp 0.004$ track . cm $^{-2}$.d / Bq.m^{-3}

$K_{tf} = 0.019 \mp 0.002$ track . cm $^{-2}$.d / Bq.m^{-3}

The inhalation dose **D**in (mSv/y), was calculated by using the following relation [14]:

$$\mathbf{D}_{in}\ (mSv/y) = \mathbf{C}\ (0.11 + 40 \times 0.03) \times 24 \times 0.8 \times 365 \times 10^{-6} \quad (3)$$

Where **C** is radon or thoron concentration.

To calculate the radon and thoron progeny Working Level (WL), using the following relation [15]:

$$\mathbf{C}_{Rn}\ (Bq/m^3) = 3700 \times WL_{Rn} / F_{Rn} \quad (4)$$

$$\mathbf{C}_{Tn}\ (Bq/m^3) = 275 \times WL_{Tn} / F_{Tn} \quad (5)$$

Where F_{Rn} = 0.4 and F_{Tn} = 0.1 are the equilibrium factor of radon and thoron respectively [16]. The annul exposure have been calculated through radon progeny by Working Level Month (WLM) where 1 WLM equivalent to 36 x WL and annual effective dose received by the bronchial and pulmonary regions of human lungs have been calculated by using the conversion factor of 3.88 mSv . WLM^{-1} [17, 18].

Result and Discussion

The results of radon, thoron concentration and their progenies are shown in table (1). where , the radon concentration values vary from

12.169 Bq/m^3 to 99.47 Bq/m^3 with an average of 50.216 Bq/m^3, while the thoron concentration value varies from 4.569 Bq /m^3 to 35.729 Bq/m^3 with an average of 16.134 Bq/m^3 as shown Fig.(2). The radon progeny value varies from 1.31 mWL to 10.75 mWL with an average 5.423 mWL and the thoron progeny varies from 1.66 mWL to 12.99 mWL with an average 5.863 mWL. All values of radon and thoron concentration are found to be lower than the recommended active level (200–600 Bq/m^3) according to ICRP [18]. The Inhalation dose for radon and thoron (R_n + T_n) value varies from 0.255 mSv/y to 2.067 mSv/y with an average 1.014 mSv/y shown as in table (2), Fig. (3) Shown as the relationship between number of location and inhalation dose of different locations. The annual exposure of radon and thoron (R_n + T_n) in Working Level Month (WLM) unit was range from 0.106 to 0.854, while the range of the annual effective dose from 0.411 mSv/y to 3.88 mSv/y, these results shown in table (3) and Fig.(4). According to all the values of the results within the

limited permissible, where the inhalation dose and effective dose to radon and thoron (R_n + T_n) are below the action levels (3-10 mSv/y) which has been recommit dose by International Commission of Radiation protection ICRP.

Table (1) *concentration of radon* ***C****Rn(Bq/m^3) ,concentration of thoron* ***C****Tn(Bq/m^3) radon progeny(mWL) and thoron progeny(mWL)*

No.	Location	Radon Concentration C_{Rn} (Bq / m^3)	Thoron Concentration C_{Tn}(Bq/ m^3)	Radon progeny (mWL)	Thorn progeny (mWL)
1	Bedroom	59.259	18.323	6.40	6.66
2	Bedroom	50.793	15.121	5.49	5.49
3	Living room	43.386	14.146	4.69	5.14
4	Kitchen	75.661	22.445	8.17	8.16
5	Bedroom	57.671	16.737	6.23	6.08
6	Living room	38.624	13.478	4.17	4.90

7	Bedroom	21.693	5.319	2.34	1.93
8	Bathroom	65.079	20.050	7.03	7.29
9	Living room	27.513	9.384	2.97	3.41
10	Bedroom	33.333	10.526	3.60	3.82
11	Kitchen	70.370	21.247	7.60	7.72
12	Bathroom	95.767	34.363	10.35	12.49
13	bedroom	22.751	8.121	2.45	2.95
14	bedroom	37.566	11.835	4.06	4.30
15	Kitchen	60.845	19.327	6.57	7.02
16	Bathroom	80.423	26.549	8.69	9.65
17	Bathroom	34.920	11.529	3.77	4.19
18	Living room	38.095	12.949	4.11	4.70
19	Bedroom	57.142	15.623	6.17	5.68
20	Kitchen	22.222	7.602	2.40	2.76
21	Bathroom	99.470	35.729	10.75	12.99
22	Living room	12.169	4.569	1.31	1.66
Average		50.216	16.134	5.423	5.863

Table (2) *Inhalation dose of radon, inhalation dose of thoron and inhalation dose of radon and thoron (Rn + Tn) by (mSv/y)*

No.	Location	Inhalation Dose of Radon Din(Rn) (mSv /y)	Inhalation Dose of Thoron Din(Tn) (mSv/y)	Inhalation Dose of Radon and Thoron Din(Rn+Tn) (mSv/y)
1	Bedroom	0.906	0.280	1.186
2	Bedroom	0.777	0.231	1.008
3	Living room	0.663	0.216	0.879
4	Kitchen	0.157	0.343	1.5
5	Bedroom	0.882	0.256	1.138
6	Living room	0.590	0.206	0.796
7	Bedroom	0.331	0.081	0.412
8	Bathroom	0.995	0.306	1.301
9	Living room	0.420	0.143	0.563
10	Bedroom	0.510	0.161	0.671

11	**Kitchen**	**1.076**	**0.325**	**1.401**
12	**Bathroom**	**1.465**	**0.525**	**1.99**
13	**Bedroom**	**0.348**	**0.124**	**0.472**
14	**Bedroom**	**0.574**	**0.181**	**0.755**
15	**Kitchen**	**0.930**	**0.295**	**1.225**
16	**Bathroom**	**1.230**	**0.406**	**1.636**
17	**Bathroom**	**0.534**	**0.176**	**0.710**
18	**Living room**	**0.582**	**0.198**	**0.780**
19	**Bedroom**	**0.874**	**0.239**	**1.113**
20	**Kitchen**	**0.340**	**0.116**	**0.456**
21	**Bathroom**	**1.521**	**0.546**	**2.067**
22	**Living room**	**0.186**	**0.069**	**0.255**
Average		**0.767**	**0.246**	**1.014**

Table (3) *Annual exposure of radon(WLM), annual exposure of thoron (WLM), annual exposure of (Rn + Tn) (WLM) unit and annual effective dose of (Rn + Tn) by mSv/y.*

No.	Location	Annual Exposure of Radon WLM	Annual Exposure of Thoron WLM	Annual Exposure of (Rn+Tn) WLM	Annual Effective Dose (mSv/y) (Rn + Tn)
1	**Bedroom**	**0.230**	**0.239**	**0.469**	**1.819**
2	**Bedroom**	**0.197**	**0.197**	**0.394**	**1.528**
3	**Living room**	**0.168**	**0.185**	**0.353**	**1.369**
4	**Kitchen**	**0.294**	**0.293**	**0.587**	**2.277**
5	**Bedroom**	**0.224**	**0.218**	**0.442**	**1.714**
6	**Living room**	**0.150**	**0.176**	**0.326**	**1.264**
7	**Bedroom**	**0.084**	**0.069**	**0.153**	**0.593**
8	**Bathroom**	**0.253**	**0.262**	**0.515**	**1.998**

9	**Living room**	**0.106**	**0.122**	**0.228**	**0.884**
10	**Bedroom**	**0.129**	**0.137**	**0.266**	**1.032**
11	**Kitchen**	**0.273**	**0.277**	**0.550**	**2.134**
12	**Bathroom**	**0.372**	**0.449**	**0.821**	**3.185**
13	**bedroom**	**0.088**	**0.106**	**0.194**	**0.752**
14	**bedroom**	**0.146**	**0.154**	**0.3**	**1.164**
15	**Kitchen**	**0.236**	**0.252**	**0.488**	**1.893**
16	**Bathroom**	**0.312**	**0.347**	**0.629**	**2.556**
17	**Bathroom**	**0.135**	**0.150**	**0.285**	**1.105**
18	**Living room**	**0.147**	**0.169**	**0.316**	**1.226**
19	**Bedroom**	**0.222**	**0.204**	**0.426**	**1.652**
20	**Kitchen**	**0.086**	**0.099**	**0.185**	**0.717**
21	**Bathroom**	**0.387**	**0.467**	**0.854**	**3.88**
22	**Living room**	**0.047**	**0.059**	**0.106**	**0.411**
Average		**0.194**	**0.210**	**0.405**	**1.597**

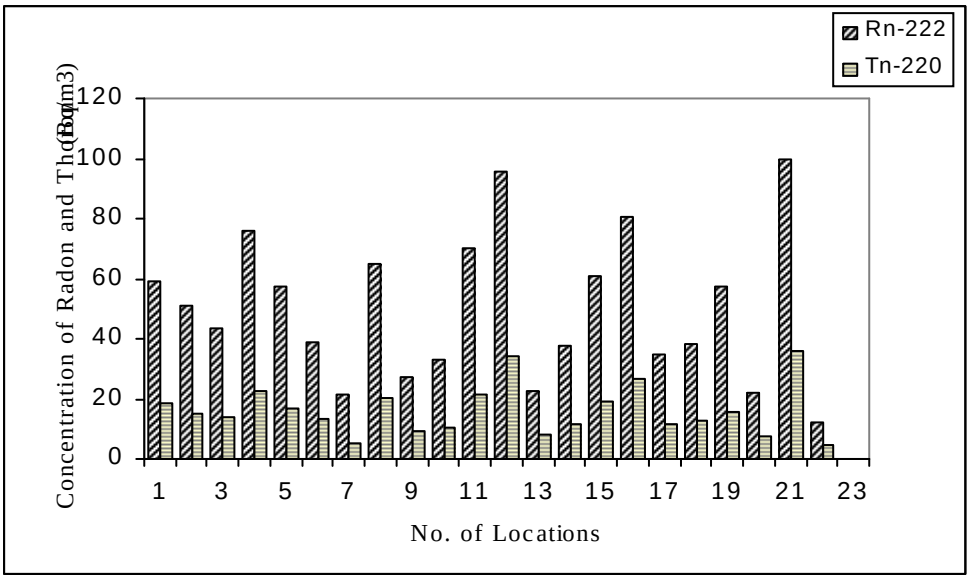

Fig.(2) Variations of radon and thoron concentration (Bq/m³) in different locations.

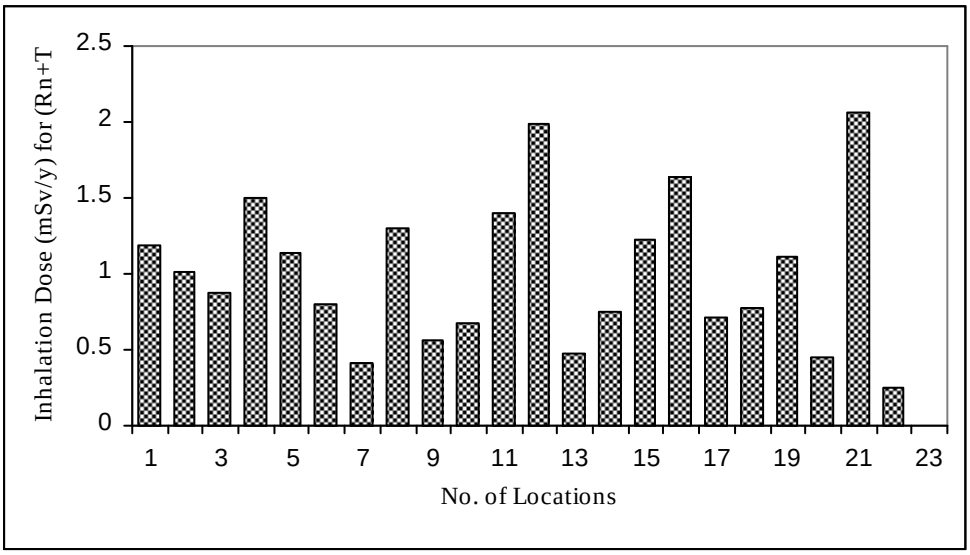

Fig.(3) Variation of inhalation dose (mSv/y) for radon and thoron (Rn + Tn) gas to different locations .

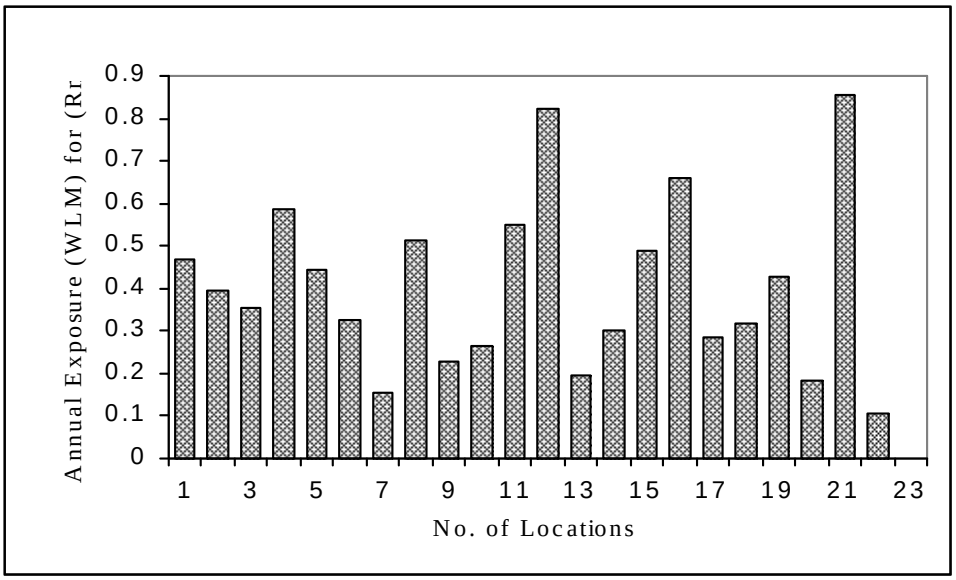

Fig.(4) Variation of annual exposure (WLM) for radon and thoron (Rn + Tn) gas to different location..

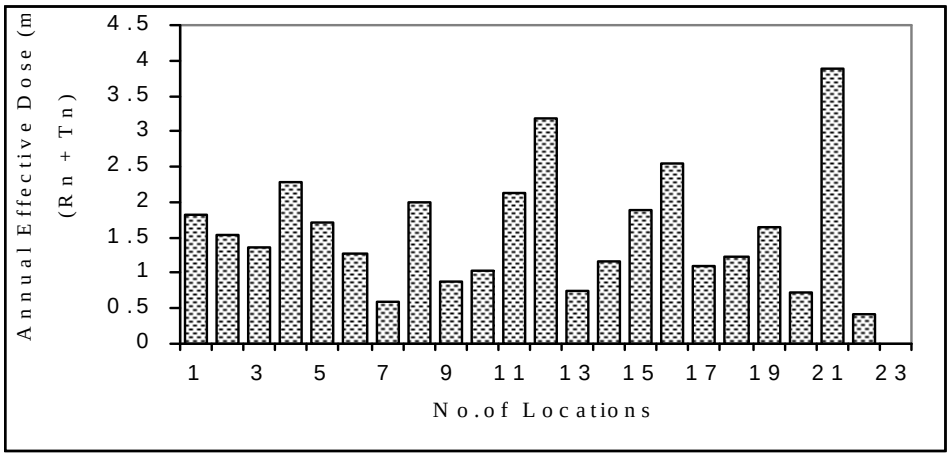

Fig.(5) Variation of annual effective dose (mSv /y) for radon and thoron (Rn + Tn) gas to different locations.

Conclusion

According to the results of the present work, the maximum of radon and thoron concentration, inhalation dose and the annual effective dose are below the active levels. The radon concentration and what to follow are depending on the type of houses construction, ventilation condition and location place (type of location) in the house and house place in the city.

الخلاصة

تهدف الدراسة الى قياس تركيز الرادون -222 وتركيز الرادون- 220 المعروف بغاز الثورون – 220 في بعض مساكن مدينة الزبير في محافظة البصرة ، بلستخدام كولثف الأثر النووي الصلبة SSNTDs نوع CN – 85. كان مدى تركيز الرادون - 222 من 12.169 الى Bq/m³ 99.470 Bq/m³ و بمعدل 50.261 Bq/m³ ومدى تركيز الثورون – 220 فكان من 4.569 Bq/m³ إلى 35.729 Bq/m³ وبمعدل 16.134 Bq/m³. مدى نواتج الرادون والثورون كان من 1.31 mWL إلى 10.75 mWL وبمعدل 5.423 mWL , ومن 1.66 mWL إلى 12.99 mWL وبمعدل 5.863 mWL على التوالي. جرعة الاستنشاق للراد ون والثورون (Rn+Tn) كانت من 0.255 mSv/y الى 1.014 mSv/y وبمعدل 2.067 mSv/. التعرض السنوي للراد ون والثورون (Rn+Tn) بوحدات WLM كان بمدى 0.106 الى 0.854 وبمعدل 0.405. الجرعة المؤثرة للرادون والثورون (Rn+Tn) فكانت بمدى من 0.411 mSv/y الى 3.88 mSv/y وبمعدل 1.597 mSv/y .

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