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# Natural Background Radiation Measurements of a Base Station in Yalvaç County

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**Abstract**

In this framework, measurements have been carried out with a Geiger-Mueller LND712 detector, Radiation Alert Monitor 4, calibrated by Cesium 137 ($^{137}$Cs) every month during one year in order to detect natural background radiation rate exposed by man around base station in Yalvaç. Measurements have been taken in every day on condition of three times (in the morning, at noon and in the evening) during a year. Annual arithmetic mean radiation dose changing from 1.92 to 2.27 mSv/year have been obtained and compared with radiation dose limits of a body.

**Keywords:** Natural background radiation, Geiger Mueller LND712, Base stations.

**Özet**

Bu çalışmada, Yalvaç'taki baz istasyonu civarında maruz kalınan doğal fon (background) radyasyon oranını tespit etmek için, bir yıl boyunca her ay, Sezyum–137 ($^{137}$Cs) ile kalibre edilmiş Radiation Alert Monitor 4 Geiger-Mueller LND712 detektörü ile ölçümler gerçekleştirilmiştir. Ölçümler, günde üç kez (sabah, öğle ve akşam) olmak koşuluyla her gün, bir yıl boyunca alınmıştır. Radyasyon dozunun yıllık aritmetik ortalaması değişimi 1.92 ile 2.27 mSv/yıl olarak elde edilmiş ve insan vücudunun radyasyon doz limitleri ile karşılaştırılmıştır.

**Anahtar Kelimeler:** Doğal fon (background) radyasyonu, Geiger Mueller LND712, Baz istasyonları.

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## 1. Introduction

Background radiation consists of cosmic radiation and radiation emitted from radioactive substances present in the ground or commercial sources. Thus, all living organisms have been exposed to background radiation since their appearance on Earth (Prasad et al 2004:77). Natural radioactivity is present in the environment right from the time of formation of the universe. Mankind has been compulsorily exposed to ionizing radiations of natural origin at every place. Ionizing radiation should have played a great role in the evolution of all the components, living and non-living of earth as we see it today. The effective dose due to this ionizing radiation for members of the public varies substantially depending on where they live, occupation, personal habits, diet, building type and house utilization pattern (Malathi et al 2005:1276).

Mobile phones, also called cellular phones or handies, are now an integral part of modern life. The widespread use of mobile phones has been accompanied by the installation of an increasing number of base station antennas on masts and buildings (Everaert and Bauwens 2007:26).

According to The National Radiological Protection Board, the fast-growing, second generation mobile phone system, global system for mobile communications (GSM), has become the world's largest mobile telecommunications system, with its one billion subscribers in over 200 countries (NRPB 2005:15). Thus, electromagnetic (EM) radiation produced by mobile phone and their base station antennas are in the 890–960 MHz frequency range for the GSM900 system (Yurekli et al 2006:25). The number of people who use mobile phones has dramatically increased in Europe and in the United States in recent years. This increased demand has led to the construction of more base stations. For the 3G/UMTS-Net that will be introduced in Europe soon, twice the number of base stations will be needed than for today's GSM-net (second generation). Therefore, even more base stations will be built in the near future. Concerned citizens in Germany (Asendorpf 2002, p.34) and in Switzerland, however, are fighting against the construction of base stations in their neighborhoods and in the vicinity of schools (Siegrist et al 2005:25). In Turkey, there has been a great increase in the number of base stations in recent years. There are several GSM companies and each of them is trying to widen its own containment area. Many base stations are being set onto the roofs of buildings. That makes people anxious about the health effects of base stations (Sahin 2003, p.18).

There have been reports in the media and claims in the courts that radiofrequency (RF) emissions from mobile phones are a cause of cancer, and there have been numerous public objections to the sitting of mobile phone base antennas because of a fear of cancer (Moulder et al 2005:81). Increased concern by the public about the safety and potential health effects at the appearance of a multitude of cellular transmitter antennas on the buildings and fear of unknown make it necessary to provide an answer to the question about safety of mobile phone base stations (Abdel-Rassoul et al 2007:28). Monitoring of any release of radioactivity to environment is also important for environmental protection. Furthermore natural radioactivity measurements are necessary not only due to its radiological impacts, but because it acts as excellent biochemical and geochemical tracers in the environment, as well. Therefore, the assessment of radiation doses from natural radioactive sources is of particular importance as it is the largest contributor to the external dose of the world population (El-Taher et al 2007, p.148). The radiation variations in natural environment are inevitable because of the use of nuclear technologies in several fields. The detection of these variations is made possible through the knowledge of previous radiation. As a consequence of these kinds of systematic researches it can be decided according to whether the natural radiation of any region is environmentally suitable for healthy life. In this framework, the present study reports the natural background radiation measurements around base station in Yalvaç County. Measurements have been verified every month during one year distance from 5 m, 10 m and 50 m from base station antennas. The results from this study are compared with national and world averages and the studies of this sort are expected to serve as baseline data of natural radioactivity level and will be useful in assessing public doses.

## 2. Materials and Method

Natural background radiation measurements have been materialized with a Geiger-Mueller LND712 detector (Radiation Alert, Operation Manual 1998), Radiation Alert Monitor4, calibrated by $^{137}Cs$ to research base station surrounding radiation rate in Yalvaç County. The measurements have been obtained from one meter above the ground in the morning, at noon and in the evening every day for a year.

### 2.1 Study Area

Yalvaç is bound to Isparta Province and in the 105 km northeast of Isparta in Turkey. Yalvaç is on an area of 1415 km$^2$ and a very old settlement area which has a lot of historical and cultural values. Base stations were located on Hıdırlık hill where there are some antennas belonging to GSM operators. It can be easily seen from the Figure 1.

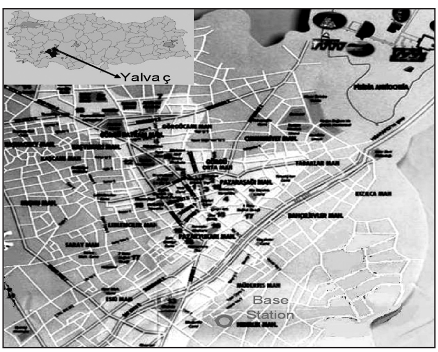


**Figure 1**. Map of the study region

## 3. Results

### 3.1 Base Station Measurements

In this work, change of radiation dose was detected for the different points around base station. Measurements were taken from 5 meter, 10 meter and 50 meter distances to the antennas. Base station radiation measurement results have been depicted in Figure 2 (for 5 meter), Figure 3 (for 10 meter) and Figure 4 (for 50 meter) in count per minute (cpm) unit. Base station annual arithmetic mean values can be also seen from Table 1 in cpm unit. Likewise, these measurement results have been given in Figure 5 (for 5 meter), Figure 6 (for 10 meter), and Figure 7 (for 50 meter) in micro Sievert per hour ($\mu$Sv/h) unit. Base station annual arithmetic mean values can be also seen from Table 2 in $\mu$Sv/h unit.

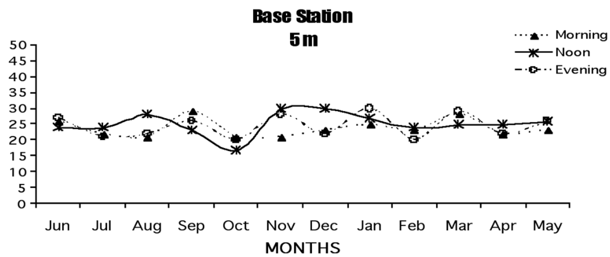


**Figure 2.** Base Station (5 m) Radiation Measurement (cpm)

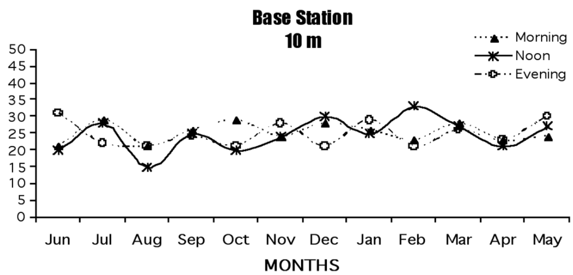


**Figure 3.** Base Station (10 m) Radiation Measurement (cpm)

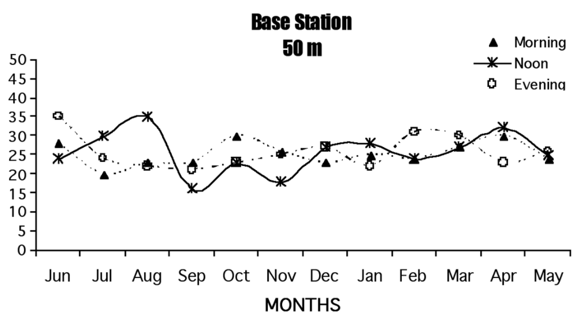


**Figure 4**. Base Station (50 m) Radiation Measurement (cpm)

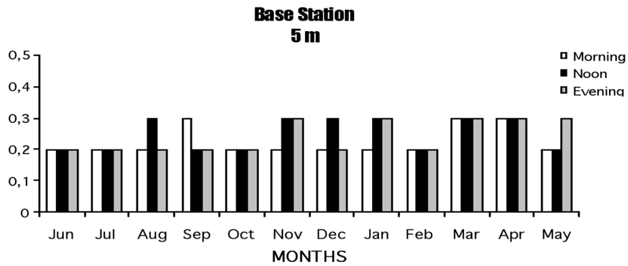


**Figure 5**. Base Station 5 m Radiation Measurement ($\mu$Sv/h)

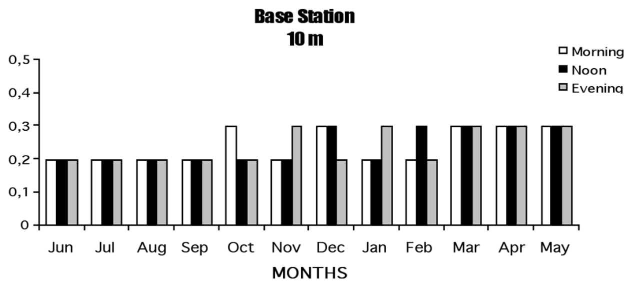


**Figure 6**. Base Station 10 m Radiation Measurement ($\mu$Sv/h)

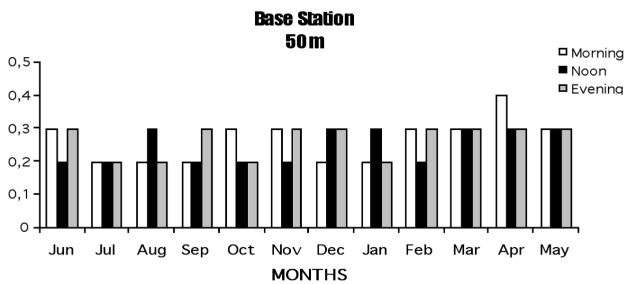


**Figure 7**. Base Station 50 m Radiation Measurement ($\mu$Sv/h)

## 4. Discussion

The measurements including have been taken from different seasons, hours of the days and also different measurement distances for a year. The taken measurements have been depicted in the Figure 2, Figure 3 and Figure 4. As can be seen from the Figure 2 showing the radiation dose levels in 5 meter distance, maximum radiation doses have been measured about 0.3$\mu$Sv/h during a day in March and April months. Similarly, measurements have been found to be about 0.3$\mu$Sv/h during noon and evening in January and November whereas they have been found to be the same level 0.3$\mu$Sv/h during noon in August and September, respectively. Further the radiation doses have been measured about 0.3$\mu$Sv/h during morning in September and evening in May month. Measurements for the other months have been also found to be about 0.2 $\mu$Sv/h level in 5 meter distance. In addition it can be said from the Figure 3 that, the measurement have been found to be about 0.3$\mu$Sv/h (maximum level in 10 meter distance) during a day in March, April and May months. Likely, the radiation doses have been measured about 0.3$\mu$Sv/h during morning and evening in December, morning in October, noon in February, evening in January and November months. Furthermore, the measurements for the other months have been found to be about 0.2 $\mu$Sv/h level in 10 meter distance. Moreover, the maximum radiation doses for 50 meter distance measurement have been found to be about 0.4$\mu$Sv/h during morning in April and 0.3$\mu$Sv/h during noon and evening. Likewise, the radiation doses have been measured about 0.3$\mu$Sv/h during a day in March and May, morning and evening in June, November and February, noon and evening in December, noon in August and January, evening in September, morning in October months, respectively. Measurements for the other months have been also found to be about 0.2 $\mu$Sv/h level in 50 meter distance. Therefore, the maximum radiation dose levels have been obtained to be about 0.4$\mu$Sv/h for April morning in 50 meter distance.

**Table 1.** Annual arithmetic mean values in cpm unit

| | Arithmetic mean (cpm) | | |
|---|---|---|---|
| Distance to antennas | Morning | Noon | Evening |
| 5 m | 23,66 | 25,25 | 24,41 |
| 10 m | 25,16 | 24,58 | 24,75 |
| 50 m | 25,25 | 25,75 | 25,75 |

**Table 2.** Annual arithmetic mean values in $\mu$Sv/h unit

| | Arithmetic mean ($\mu$Sv/h) | | |
|---|---|---|---|
| Distance to antennas | Morning | Noon | Evening |
| 5 m | 0,22 | 0,25 | 0,24 |
| 10 m | 0,24 | 0,24 | 0,24 |
| 50 m | 0,26 | 0,25 | 0,26 |

**Table 3.** Annual arithmetic mean values in mSv/year unit

| | Arithmetic mean (mSv/year) | | |
|---|---|---|---|
| Distance to antennas | Morning | Noon | Evening |
| 5 m | 1.92 | 2.19 | 2.10 |
| 10 m | 2.10 | 2.10 | 2.10 |
| 50 m | 2.27 | 2.19 | 2.27 |

In addition annual arithmetic mean values in different units have been depicted in the Table 1, Table 2 and Table 3. As can be seen from Table 2, all the measurements have been close to each other. The minimum measurement of annual arithmetic mean values have been obtained to be about 0.22 in $\mu$Sv/h level during morning measurements in 5 meter distance whereas the maximum measurement have been found to be about 0.26 $\mu$Sv/h level during morning and evening measurements in 50 meter distance. These measurements have been also shown in Table 3 in mSv/year unit. Namely; the maximum measurement of annual arithmetic mean values have been obtained to be about 2.27 in mSv/year level during morning measurements in 50 meter distance whereas the maximum measurement have been found to be about 1.92 mSv/year level during morning and evening measurements in 5 meter distance. These values are useful to get information about the radiation dose imposed on the body in Yalvaç. However, the measurements have also included natural background radiation changing any time in a year, since this radiation type depends on soils, rocks, climate conditions, altitude, geographical characteristics of living area, cosmic rays and etc. therefore, these type ingredients have contributed to the measurements. Nevertheless, the body does not distinguish between natural and man-made radiation. Neither natural nor man-made background radiation has been shown to be harmful. The body has developed repair mechanisms to deal with negative effects of background radiation. For people radiation dose limits that should be taken in any one year all the lifespan are illustrated in Table 4 from International Commission on Radiological Protection (Annals of the ICRP 1991:21).

**Table 4.** Dose limits

| Stochastic limits | Nuclear energy workers | Non-Nuclear energy workers |
|---|---|---|
| Averaged over a period of five years | 20 mSv/year | 1 mSv/year |
| In any one year | 50 mSv/year | 5 mSv/year |

In Yalvaç a body has been subjected to radiation dose measured by using Geiger-Mueller detector is about 1.92-2.27 mSv/year. As can be seen from the Table 4, radiation dose limits of a body is 5 mSv/year in any one year, therefore radiation dose measurements have claimed that no healthy risks have been around the base station (5 m, 10 m and 50 m distance) in Yalvaç. On the other hand, the same table observes that averaged over a period of five years is 1 mSv/year. Radiation dose level of Yalvaç is slighter higher than the averaged level due to the fact that the base station including antennas contributes to radiation dose level.

## 5. Conclusion

In this study, we have tried to investigate the natural background radiation rate by man around base station in Yalvaç during one year by using a Geiger-Mueller LND712 detector. All the taken data in the year have been compared with the obtained data from

International Commission on Radiological Protection determining the radiation dose limits in any one year all the lifespan. Thus, we have pointed out that no healthy risks have been around the base station in Yalvaç owing to the compared data. To sum up, it can be said that these kinds of studies are useful to serve as baseline data of natural background radiation levels and also show the way to the background radiation studies in the future.

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