IMPACT OF ELECTRICAL RADIATION ON HUMAN HEALTH

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INTRODUCTION

Electricity-caused radiation is a consequence of the activities of low-frequency electromagnetic fields (in further text EMF): from railroad (16,66 Hz and 50 Hz) to electric power generation and distribution systems (50 Hz).

The European Standard for railroad safety was adopted in 2001. This Standard specifies the maximum acceptable levels of EMF radiation in the vicinity of railroads and railroad facilities as well as the minimum distances of these facilities from areas where construction is allowed.

Unfortunately, in our country we now witness the poor level of control for appartment building construction that is allowed even close to powerfull transmission lines. It is also a frequent practice to incorporate transformers in the appartment buildings themselves, which has long ago been banned in the developed world.

Near the end of the 20th century, the Italian regions Emilia and Romagna and the towns Venice and Rimini started with the court processes and a strong public initiatives of the Environment Protection Society that pointed to the danger coming from transmission lines that are located near the residential houses. Namely, a direct connection of children leukemia and the vicinity of transmission lines have been observed. An initiative was made to dislocate the transformers and transmission lines, which is going to acrue a cost of 10 billion Euro.

Real impacts of EMF

Since both the construction materials and constructions themselves are mainly transparent to EMF, the elecromagnetic environment is formed by external and internal sources. The external ones can be natural and artificial. This paper is going to deal only with artifical sources, that is, those made by man.

Internal EMF sources in an appartment, for example, can occur as a consequence of the application of electrical and electronic devices. They are either in constant use (boiler, refrigerator, freezer) or in intermittent use (electric furnace, TV, PC monitor, kitchen blender, hair dryer, electric shaver etc.).

Whether the interaction between a man and a field will result in biologically negative output depends on the chatacteristics of the electromagnetic environment and on individual sensitivity to it.

When speaking of nonionizing radiation, globally known as ***electrosmog,*** there is the impression that the reasoning will be identical as that associated with the term radioactivity. Namely, during the 20th century, the acceptable radioactivity level was constantly reduced at twenty-year intervals (the accptable radiation dose in 1910 was 100 rem, while in year 1958 that dose was reduced to only 0.5 rem) [1].

Within this area of radioactivity, special place is taken by radiation coming from extremely low frequencies from 0.30 to 300 Hz, as well as the radiation of low field levels.

Based on my personal insight into the issue in numerous households, the conclusion is that the current nonionizing hazardous radiation norms exceed the really acceptable levels. Harmful effects are self-evident. The density of the magnetic flux coming from common household appliances, based on the WHO data [9], is shown in Table 1.

Table 1. Magnetic fluc density in the vicinity of household appliances

No.	Appliance	Density of magnetic flux μT		
		3 cm	30 cm	100 cm
1.	Electric furnace	6-200	0.35-4	0.01-0.1
2.	Refrigerator	0.5-1.7	0.01-0.25	<0.01
3.	Washing machine	0.8-50	0.15-3	0.01-0.015
4.	Iron	8-30	0.12-0.3	0.01-0.025
5.	Hair dryer	2-30	0.03-4	0.01-0.35
6.	Vacuum cleaner	200-800	2-20	0.13-2
7.	Portable heater	10-180	0.15-5	0.01-0.25
8.	TV set	25-50	0.04-2	<0.15
9.	Kitchen blender	60-700	0.6-10	0.02-0.25
10.	Electric shaver	15-1500	0.08-9	<0.03

According to CENELEC SC 111A (EU Standard), the maximum acceptable magnetic flux density for low frequencies from 0.30 to 300 Hz in an uncontrolled environment is 5000/f (μT) for a continually operated appliance or 50 000/f (μT) for an appliance operated for 3 hours during the day. For 50Hz frequencies and the continually-operated appliances it is 100 μT and 1000 μT for all other appliances. The comparison of these criteria and the data shown in Table 1 shows that the magnetic flux densities for all

mentioned appliances are below the limit value, excluding electic shavers because they are used for several minutes during the day.

However, the manufacturers of measuring instruments state tolerance data in their documentation that are much lower than those adopted by the international professional association.

The impression is that powerful electromagnetic fields acting for shorter periods of time are equally harmful for humans as are the far weaker EM fields acting for periods of time as long as several years.

Electromagnetic environment of a family house or an appartment is formed by external artificial sources such as transformers, transmission lines, electrified city transportation etc. as the active radiation sources and depend on the position of the facility in relation to those sources. Passive radiation sources include buildings with metal facades, reinforced concrete constructions, turrets for different purposes etc. These sources are also grouped in permanently and intermittently operated sources.

The literature data [4] show that humans should be located at the distance of not less than 50 m away from city transformers. The same literature data specify the distance of 15-30 m away from electrical city lines.

The distance from 35-kV transmission lines should be from 30-50 m and that from 120-kV to 400-kV transmission lines should be 70 to 100 m. We all know that these distances are mush smaller in Belgrade periphery as well as in the suburbs.

Some epidemiological studies pointed to the potential connection between the exposure to grid frequency EMFs and the occurrence of lymphoma, leukemia and brain tumor. [4]

There is probably no need for particular pointing to the ecological importance of EMF having in mind that, based on certain data, the intensity of artificial EMFs during the decade between 1975 and 1985 inceased by more than 40 times.

The electric transmission grid generates electrical and magnetic fields at grid frequencies (in our case it is 50 Hz) as well as at harmonics frequencies. If there is a corona, an additional electrical field will develop at frequencies between 0.4 to 5 MHz. In case of sparks, a field occurs at frequencies exceeding several handreds MHz. The field level depends on voltage and current, as well as on line number, line distances from earth and interphase distances, earth conductivity etc.

EMFs exert their activities at different human body levels: cell, neuro-vegetative and cardiovascular systems etc.

Based on extensive practical experience the measurements showed that radiation emitted from transmission lines or grid transformers built in appartment buildings was extremely harmful for human health. That is the reason the developed European countries banned the construction of energy-generating facilities within residential areas.

Higher levels of radiation, i.e. those exceeding 15 mG (1.5μT) are the major cuse of the drop of body immunity, headache, insomnia, stress as well as other severe problems such as leukemia in children and cancer in adults.[1]

At the end of 80s, North Italy witnessed massive protests against the passage of transmission lines through the Venice region. The potential hazard was obvios,

particularly for children leukemia, which was brought to public through several published scientific studies (Severna, Savitz).

This resulted in regulations that were **far too stringent** than those adopted by EU. The Ministry of Environmental Protection even suggested the maximum tolerance level of 0.2 μT for all Italian schools.[8]

Case studies

- The appartment occupied by the author of this paper is in a four-floor appartment building located in New Belgrade. A grid transformer is built in the building and supplies several other buildings of 85 appartments each. According to literature data the area to the south of the transformer is much more exposed that the others presumably because of the superposition between the earth magnetic field and the transformer field. During the last 30 years twenty deaths were observed among the the people who lived in the wing to the south of the transformer in comparison to 3-4 deaths in other parts of the building during the same period.

- A three-floor building at the suburban settlement Ledine near New Belgrade was built between two transmission lines, each of 110 kV. The third-floor appartment is 10-15 m away from the lines. The harmful radiation levels in that appartment vary from 12 to 30 mG (1.2 do 3μT). Therefore, the residents had, as soon as after 6 months of living in the attic, bad sleep and frequent headaches. After crystal neutralizers had been placed their sleep improved and headaches became less frequent.

- A family house in the Belgrade settlement Braća Jerković is located 20 m away from a 110 kV transmission line. The house was not a pleasant place to live regarding sleep.

- An appartment in Belgrade, Koče Kapetana street, is located in the vicinity of a large grid transformer. The living conditions are unfavourable, i.e. the residents have sleep problems

- A two-floor house in a Belgrade settlement Borča, located immediately under a 35 kV transmission line, has a magnetic field of 10 mG (1 μT) on the upper floor beds during the day when electricity is more expensive while that level is increased during the night when the tariff is cheaper.

Conclusion

In order to prevent the occurrence of the current situation this and similar meetings should place every effort to point to the hazards threatening from harmful radiation. Particularly in light of the fact that it took three years to place the draft Law on nonionizing radiation into the parliament procedure. (The Draft Law was written in November 2002).

Next, the establishment of relevant institutions is essential. They would monitor the electrosmog pollution status of the living and work environments.

The last but not the least, The Faculty of Electrical Engineering might consider the introduction in its curriculum of at least one semester dedicated to this topic and the procurement of adequate instruments manufactured in developed countries.

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