PUBLIC CONCERN OF ELECTROMAGNETIC EXPOSURE IN BULGARIA – A CASE STUDY

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INTRODUCTION

Risk management in the precautionary framework proposed by the World Health Organization (WHO) concerning public health is an interactive process and it encourages the development of new information and understanding, as well as a review of the measures in the context of existing uncertainty. By including a wide range of stakeholders in the process, the framework requires clarification of their interests, as well as transparency about the way of decisions made. The protective framework related to the protection of human beings against electromagnetic fields (EMF) exposures is an upgrading approach that encompasses procedures for managing human health risks that are either known or insecure. The framework assists:

- Development and evaluation of the opportunities to reduce the electromagnetic exposure;
- Choice of action/actions appropriate to the risk under consideration;
- Assessment and supervision of the chosen action/actions.

WHO proposes the "Precautionary Principle/Approach" to be applied for cases when uncertainty of research is high, and when there are serious problems with the implementation of new technologies for which there is insufficient information on their harmful effects.
At the same time, WHO suggests communication strategies to be applied after analyses and evaluation of the exposure to reduce the public concern[1,2,3].

AIM

The main purpose of this study is to present our model for effective solving a problem of public concern connected with EMF exposure from base stations of mobile communication.

SCOPE AND METHODOLOGY

We would like to present a case study of public concern in connection with EMFexposure from base station for mobile communication situated in urban area, and the way how the problem has been solved.
According to the national legislation4, exposure assessment of EMF from telecommunication sources in urban areas should be made in two steps: first, theoretical calculation of safety zone around the selected site performed on the basis of documentation presented by the owner of the source; second, real measurements of EMF around the source at places with people's access.

In every case of public concern connected with EMF exposure, we apply ***communication strategy*** developed by our team. This communication strategy has been tested in practice, it is specific and proven, effective for our country and it refers to all stakeholders, including administration, mobile operators, local authorities, regional control bodies of the Ministry of Health, and others. It follows the steps below:

1. Description of the case:
We present a case concerning a complain of citizens for evaluation the electromagnetic exposure from base stations of two mobile operators. The base stations are situated in residential area in Sofia, and both telecommunication constructions are on the roof of dwelling house. The objections are from several apartments in neighboring residential building which is situated 20 m away from the building with the antennas. Both buildings are with approximately the same height that does not match the submitted information from the owner given to the municipality and to the national cadaster.

2. Surveying the situation. Hazard identification:
The place was visited on site, and a meeting with the complaining citizens was organized. The preliminary study found that the building with the concerned citizens has been built after construction and commissioning of the two base stations. That was the reason that the operator didn't present it into the situation, and did not take it into account in the calculation of the safety zone. Also, the azimuths of the antennae were different than those given into the official documentation. It was determined that a risk for the citizens in the new built dwelling is possible to exist on the base of preliminary measurements and visual inspection of the site. They were informed for the steps that we will be undertaken to solve the problem. For information, brochures have been distributed amongst the population in the building. (Figure 1)

Figure 1. Brochure "New wireless technologies connect us everywhere", developed by the team of the Physical Factors Department, National Centre of Public Health and Analyses, Sofia

3. Exposure assessment:
Primary exposure assessment of EMF has been performed in the dwelling, in maisonettes and trizonette located on the top floor with direct antenna visibility. We found that special attention concerning any overexposure should be taken for the terrace of the trizonette situated at the top floor of the building. There, some significant values of EMF have been found in comparison with our national legislation.
An image with the affected apartment with the terrace (3) is presented below; also both base stations (1) and (2).

Especially for the places with maximal values of EMF, a method with spectral analyses was applied for detailed evaluation of the exposure, and for information about the EMF sources that give contribution to the common value measured at the place. At the same places, 24-hours monitoring was made for collecting data for the exposure in real time.

Figure 2. Visualization of the bearing building and the building under investigation
1. Base station - mobile operator A; 2. Base station - mobile operator B;
3. Researched area

4. Communication with the stakeholders (mobile operators, control bodies, citizens, and our team, NCPHA).

On the basis of the performed measurements, recommendations for constructive and technical corrections of the two base stations were prepared to guarantee reduction of the exposure in the houses of the population to the threshold values in accordance with the Bulgarian legislation.

In order to take actions and to solve the problem, we have made correspondence with all stakeholders. Our standpoint containing data of the preliminary study was sent, suggesting new common measurements. They have to be performed on date and time according to the network traffic.
At the time of these measurements, we tested different exposure situations corresponding to a different technical adjustments of the base stations- the two base stations were sequentially disconnected; the electric tilt of the antennae was changed; also the height of the mounting of the antennae. On the base of the results, constructive and technological changes to reduce the exposure were proposed.

Different approaches for exposure assessment were applied, as follows:

- measuring methods: point measurements; monitoring measurements over a long period of time monitoring for more than 24 hours; spectrum analyses;
- analytical methods: exposure assessment through processing data of measurements; and/or evaluation of the safety zones by numerical calculation and modeling.

For measuring and evaluation of EMF selective and non-selective methods were applied, also 24-hour monitoring for assessing the EMF changed in real time.

For integral exposure assessment the non-selective method was used in all of the points of interest. The measuring equipment for such non-selective measurements was Narda NBM-550 field strength meter, of NARDA Safety Test Solutions is used: with an EF1891 E field probe. Frequency range: from 3 MHz to 18 GHz.

Figure 3. Narda NBM-550, NARDA Safety Test Solutions

For detecting, analyzing and localizing radio frequency (RF) signals, Interference and direction analyzer IDA-3106/102, NARDA Safety Test Solutions, has been used, with a 3100/13 active directional antenna set, operating frequency range 9 kHz to 6 GHz.

Figure 4. Interference and direction analyzer IDA-3106/102, NARDA Safety Test Solutions

For continuous 24-hour measurement of EMF values, NARDA Safety Test Solutions, NARDA AMB 8059, with a 100 kHz to 7 GHz operating frequency band, were used.

Figure 5. NARDA AMB 8059, NARDA Safety Test Solutions

EMF field modeling and calculation software of NARDA Safety Test Solutions „EFC-400 – Magnetic and Electric Field Calculation Transmitter and Telecommunication" was used to predict the field values. The software calculates electric and magnetic field of telecommunication plants and transmitting installations up to 300 GHz. It calculates the power flux density of emitters on an arbitrary ground profile; synthetic modeling of near field via segmentation method is used. Ground reflection is realized by applying a reflection coefficient to the ground level.

RESULTS AND DISCUSSION

The analyses of the situation determined that 2nd sector (operator A) and 2nd sector (operator B) were directed to the examined building, approximately with the same azimuths that gave overlaying radiation of the antennae patterns. The next figure gives a model of EMF calculated for the two base stations.

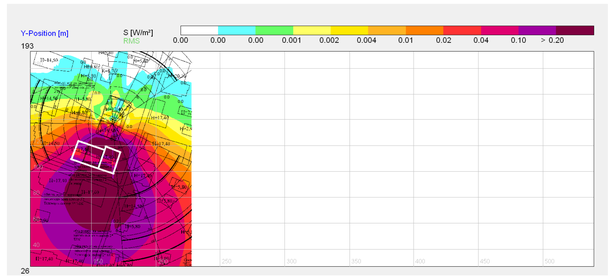

Figure 6. Calculation of EMF emitted by base stations of mobile operators A and B, using NARDA Safety Test Solutions software „EFC-400 – Magnetic and Electric Field Calculation Transmitter and Telecommunication"

We have investigated 7 apartments located at the last 3 floors of the building, the EMF values were below the threshold values in every one of the apartments (0.1 ÷ 2.8 μW/cm^2).
On 2 of the terraces, the EMF values were significant, but only at one of them above the limits (10.2 ÷ 16.9 μW/cm^2). On the other terrace, the EMF values were significant (7.6 μW/cm^2), but below the limits, and protective measures were not proposed.
The monitoring station placed at the point with maximal values of EMF confirmed the result of the non-selective measurement. The dynamics of the EMF values for a prolonged period of time is shown on Figure 7.

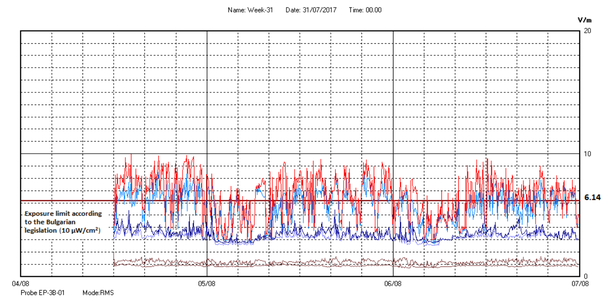

Figure 7. Data from the monitoring station

On the basis of analyses of the received data, subsequent measurements were performed on the same terrace with the participation of all stakeholders – operators, citizens, control bodies, our team.
There is a probability the EMF values to be higher when base stations are at maximum load. That's why we asked the operators to set the transmitters to maximum power.
We found out on site that the stations were working on the following technological standards: GSM/UMTS 900; LTE 1800; UMTS 2100.
We made tests and exposure evaluation applying the calculated exposure scenarios with the aim to identify the reason for finding the higher EMF values (above the limits). Results are presented on the following figure.

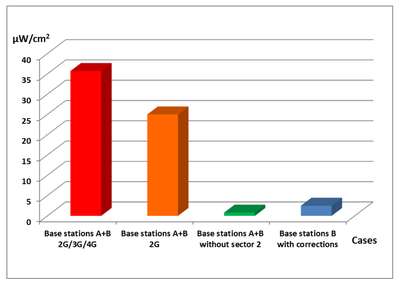

Figure 8. EMF exposure scenarios

The final analyses and evaluation of the exposure were used for the following adjustments of the transmitters:
Operator A – the height of mounting of the sector antenna 2, should be increased by 3 m; the azimuth should be changed from 190^0 to 145^0; correction of the electrical tilt with 2^0 up;
Operator B – because of constructive impossibility to increase the installation height of the base station sector 2 should be isolated (excluded).
A model how the adjustments would be reflected at the given situation was made, as it could be seen on Figure 9.

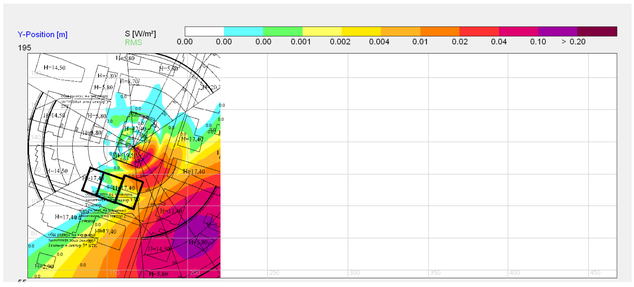

Figure 9. Calculation of EMF exposure after the changes have been made, using NARDA Safety Test Solutions software „EFC-400 – Magnetic and Electric Field Calculation Transmitter and Telecommunication"

Final measurements at the same places after finalizing all corrections in the configuration and technical characteristics of the two base stations were performed. Measured values were below the threshold values – under 10 μW/cm^2.
The same measurements were made without the knowledge and presence of representative of the mobile operators, and again the monitoring station was used for 24 hours measurement in real time. The results are shown on Figure 10.

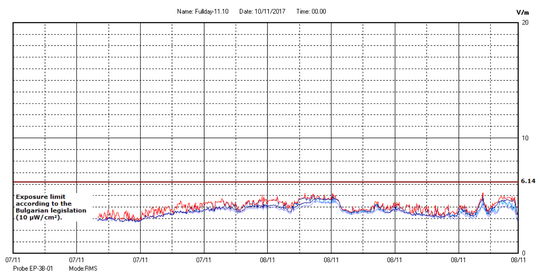

Figure 10. Data from monitoring station after completion of technical and constructive changes (sample)

CONCLUSION

The problem presented here connected with public concern about possible overexposure regarding installation of base stations in urban areas in Sofia is frequent. In most of the cases, the fears of the population have been proven to be groundless after checking the case and after exposure assessment are made.
However, in this concrete case the operator followed all requirements of the health regulations in our country, but subsequently (probably illegally) a building was built into the antenna pattern within the calculated safety zone. In this situation, the fears of the population are justified, moreover that we found EMF values above the limits in a part of the new building.
This case was solved successfully based on our effectively implemented communication strategy which follows the relevant rules and regulations in the country. As a result we can conclude that the fears of the population are reduced and the EMF exposure was decreased to levels corresponding to the national legislation, as well.

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