

Radio base stations placed on agricultural land. Evaluation of the workers' exposure.

Pascuzzi S.¹, Santoro F.¹, Pantaleo A.¹

¹ Department of Agricultural and Environmental Science (DiSAAT) - University of Bari Aldo Moro, Via Amendola 165/A – 70126 Bari – Italy

E-mail of corresponding author: francesco.santoro@uniba.it

Summary

The electromagnetic field generated by radio base stations (RBS) located on rural-agricultural lands was evaluated both using an ad hoc numerical forecast model and measuring the effective electric fields around some RBS located on Italian agricultural lands. The viability of this study was tested according to the Italian Regulations concerning general and occupational public exposure to time-varying EMFs. The actual power emitted by RBS antennas was much lower than the calculated values.

Key words: *cellular network, electromagnetic field, workers' exposure, EC Directive 2013/35*

Introduction

The number of the radio base stations (RBS) has greatly increased in recent years in Italy, due to the rapid spread of mobile telephone technology. The analysis of the electromagnetic field levels generated by radio base stations (RBS) situated on rural-agricultural lands allows to evaluate the farm workers exposure in the surrounding area. These workers are generally unaware of their exposure and the potential risks, and are not trained to take appropriate precautions. The recent European Standard (EU Directive, 2013) assesses "Exposure Limit Values" (ELV) and "Action Levels" (AL) also in the frequency range used by the RBS. This standard has not yet been incorporated into the Italian legislation regarding workplace health and safety (Law Decree, 2008) and the compulsory minimum health and safety requirements concerning the exposure of workers to EMF, that is Limit and Action Values, are not yet in force in Italy. However the Italian law obliges employers to analyse the EMF risks as part of their evaluation of the risks to which their workers may be exposed. Furthermore in Italy is still in force a Regulation and all evaluations of EMF exposure for both the general and occupational public are carried out in order to check on compliance with these restrictions (Prime Minister decree, 2003).

Materials and Methods

The electromagnetic field produced by a mobile phone RBS situated on a rural area was evaluated using an electromagnetic field forecasting software, which meets the requirements of the Italian Technical Standard (CEI, 2004). The simulated RBS suitable for 2G and 3G mobile communication networks allowed a spatial uniform signal distribution via a three-sector aerial system with a 120° layout. The aerial radio electric centre height above ground (RECh [m]) and the aerial downtilt angle (DownTilt [°]) were considered. The E-fields generated by some mobile telephone RBS operating in the GSM and UMTS bands and situated on agricultural land in the rural areas of Apulia (Italy) was measured according to the Italian technical standard. All instrumentation was set for continuous 6 min E-field values data acquisition, and the quadratic mean value of the acquired data was considered to be the E-field value (ECES, 2008). Taking into account that the traffic in rural areas is lighter than in the urban areas (Ardoino et al., 2004) and that the transmitted power

is generally lower at weekends (Colombi et al., 2013), the in situ measurements were carried out and recorded on day-time of working days, when it is reasonable to assume that most mobile telephone use takes place (Joseph et al., 2013).

Results and discussion

The simulations show that some combinations of RECh and DownTilt produce E-field values over 6.0 V m⁻¹ at heights more than 1.70 m above ground level, while other combinations of RECh and DownTilt generate E-field values equal to the “Attention Value” (E= 6.0 V m⁻¹) at 1.70 m above ground level, that is at the mean human head. Furthermore the “shortest distances” from the aerial beyond which the E-field is lower in all areas than the “Attention Value” are found. On the other hand, the E-field values are equal to or greater than 6.0 V.m⁻¹ under the “shortest distances” in the areas in the direction of RBS aerial sectors.

In the few circumstances in which the E-field values are higher than the “Attention Value” (E= 6.0 V m⁻¹) it could be useful to build a fence around the base of the RBS in order to avoid workers to be exposed to potentially dangerous values of electro-magnetic field.

The results of the in situ measurements show that the actual E-field values in the direction of each aerial sector are significantly lower than the “Attention Value” in the current Italian Regulations even at a short distance from the antennas. The significant differences between the calculated and measured E-fields may be explained considering that the calculated E-field values were obtained with the RBS working constantly at full power allow assessment. This hypothetical situation may occur only during specific circumstances in order to manage traffic peaks, while in reality the average output is lower than the maximum most of the time.

References

- Ardoino, L., Barbieri, E., Vecchia, P., 2004. Determinants of exposure to electromagnetic fields from mobile phones. *Radiation Protection Dosimetry*, 11(4), 403-406.
- CEI 211-10 V1, 2004. "Guide for the realization of a Radio Base Station observing the exposure limits to the high frequency EMF".
- Colombi, D., Thors, B., Persson, T., Wirén, N., Larsson, L., Jonsson, M., Törnevik C., 2013. Downlink power distributions for 2G and 3G mobile communication networks. *Radiation Protection Dosimetry*, 1-11.
- Directive 2013/35/EC, 2013. On the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (EMF).
- ECES (European Committee for Electrotechnical Standardization), 2008. Basic standard for the in-situ measurement of electromagnetic field strength related to human exposure in the vicinity of base stations. CENELEC EN 50492 (2008).
- Joseph, W., Verloock, L., Tanghe, E. and Martens, L., 2013. In-situ measurement procedures for temporal RF electromagnetic field exposure of the general public. *Health Phys.*, 96, 529–542.
- Italian Law Decree n.81, 2008. Protection of the health and the safety on workplaces.
- Italian Prime Minister decree, 2003. “Setting of the exposure limits, of the attention values and of the quality goals for the safety of the general public from exposure to produced electric, magnetic and EMF in the frequency range 100 kHz-300 GHz”. Italian Official Gazette n.199 of August 28, 2003.