Good measurement practice (GMP) in the exposure assessment of occupational ELF electromagnetic fields

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Good practice for measuring the electromagnetic field (EMF) in occupational and other situations is a multi-step concept. It starts by mastering the basic physics for field characterisation [1 2, 3, 4, 5]. In this respect it is important to mention the fact that, because of the ELF near-field exposure, the electric and magnetic field have to be measured and evaluated separately. GMP should be based on a balanced experimental design [6,7] related to the CENELEC standards [8, 9, 10, 11, 12] and will have to take into account variability and uncertainty [13, 14] caused by a panoply of factors.

An obvious and important aspect in GMP is the consult with the safety staff about the exposure problem, the measurement objectives and the job content of the workers in terms of exposure position and duration. In order to define the complexity of the measurement situation, GMP requires a careful inspection of the working environment. A list of the relevant sources, their EMF characteristics and their orientation with respect to the workers or adjacent offices is indispensable. If the waveform and the harmonic content are unknown they have to be defined by oscilloscopic and spectrum analyses respectively. Compliance of unperturbated single frequency fields without substantial harmonics can be measured by broadband equipment and be tested regarding to the ICNIRP (1998) formulas for single frequencies [5]. However, if one is faced to several sources emitting different frequency fields or to a single source emitting a substantial amount of harmonics selective measurements have to be performed and by consequence compliance testing is based on multi-frequency exposure approach [5]. GMP becomes still more complex if complex pulsed non-sinusoidal waveforms are part of the exposure game. In such cases advanced oscilloscopic techniques and spectrum analyses have to be combined. A crucial point of such a combination is that the oscilloscopic harmonic content doesn't always fit with the one observed by spectrometry. Anyway, reasons have to be found, repeated measurements have to be performed for exposure reality and compliance testing with standards or guidelines for complex exposure situation [3]. By performing GMP one always has to keep in mind that variability and uncertainty are a part of each measurement scenario. Though variability is a property of nature related to value heterogeneity over time, space and subjects and uncertainty is a lack of knowledge about the true value of exposure due to measurement errors or other factors, repeated measurement for defining the degree of reproducibility can bring some insight in both variables.
What about the relation between stationary and personal exposimetry? Is personal exposimetry a more realistic measurement approach than the stationary one?
Would personal exposimetry be efficient enough to result in the long run in a ELF EMF job exposure classification instead of a working place or source exposure classification? Which is the part of the total exposure variation that can be explained by the mobility of the worker moving from high to low occupational exposure areas? The introduction of a relative exposure index [15] for estimating the relation between the stationary and personal exposimetry could lead to some better insight in these issues.
Summarizing it may be stated that GMP is a complex process from which the methodology depends on the needs and the objectives of the exposure assessment. My talk will deal with the application of the GMP on high exposure sources like arc [16] and induction [17] ovens used in the metal industry, electrical welding equipment and handheld activators for magnetization of the antitheft safety strips in libraries. Since it was recently suggested that ESD could trigger Lipoatrophia Semicircularis [18, 19] a

brief touch upon the waveform, the generated electric and magnetic field and the GMP for ESD will be given too.

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