The Role Of Uncertainty In Measurements And Calculations In The View Of Risk Assessment Required From Directive 2004/40/Ce Or Other Regulation

Rosaria Falsaperla, Paolo Rossi

National Institute for Occupational Safety and Prevention (ISPESL), Rome, Italy

paolo.rossi@ispesl.it

The European Directive 2004/40/EC on the protection of workers from exposure to EMF claims the employer to specific risk assessment, but the problem of uncertainty in the compliance judgment is not discussed, and how to deal with uncertainties in exposure assessment is still an open question. The need of a clear indication from Authorities is manifest in the recent draft standard prEN 50499 “Determination of workers exposure to electromagnetic fields” (developed under mandate M/351 for application of Directive 2004/40/EC) in which, beside the indication of the necessity of uncertainty analysis, it is reported that the question of how to take measurement uncertainty into account is awaiting guidance from the EU Commission. Similarly, the draft standard prEN 50413 -Basic standard on measurement and calculation procedures for human exposure to electric, magnetic and electromagnetic fields- doesn't provide practical advice on how to deal with uncertainty in the compliance judgement with exposure limits.

At the moment only standards applicable to emission of specific products give practical advice on how to treat uncertainty. Recommendations are mostly based on the *shared uncertainty budget* (or *shared risk*) approach, but the criteria outlined are not always uniform. Few standards require the uncertainty to be included in the comparison with the limit of exposure. The *shared uncertainty budget* approach implies that the actual measured or calculated values must be used for comparison with exposure guidelines, provided that the total assessed uncertainty is less than or equal to permissible or reasonable pre-defined uncertainties, or if the assessment is proven to always overestimate the exposure. Uncertainty values shall be recorded but shall not be included in the comparison. Typical permissible uncertainties defined in relevant standards range from ±2 dB up to ±6 dB for field measurements, and are of the order of ±50 % for calculation. If the expanded uncertainty is higher than permissible values, the applicable limit for verification of compliance must be reduced by a specific factor. From the point of view of practice, the minimum permissible uncertainties for field measurements are of the same order of magnitude of typical performance of instrumentation. On the other side, computational permissible uncertainties seem to be optimistic if compared with realistic evaluations. Comparisons of numerical results with analytical solutions for simple-shaped models found a value of ±12.2 dB (+307%, -75%) for a worst-case expanded uncertainties in the determination of in situ electric field and current density

In order to support this approach, some standards invoke the presence of safety factors in the setting of basic restrictions and reference levels in the protection guidelines, but from the philosophical point of view, the *shared risk* approach is applicable when the end user, or the Authority responsible for control, makes a judgement of compliance and takes some of the risk that the product may not meet the specification. Generally it is acceptable in non-safety critical performance.

Some conclusions can be drawn in the perspective of policy indications for managing uncertainty in workers' exposure assessment and compliance verification with regulation. As far as concerns field measurements, the *shared uncertainty budget* approach could be practicable if explicitly recommended by Authorities, and provided that maximum permissible uncertainty doesn’t exceed more severe values (Italian regulation for the protection of population, for instance, accepts a value of ±3 dB). Concerning numerical dosimetry, both in low and high frequency range the basic knowledge for assessment of uncertainty is not completely achieved yet, especially for complex exposure conditions where the accuracy of results can be very poor. In order to produce valuable results, numerical dosimetry should be used to give information referred to standard and traceable worst-case condition. In this case, provided a strong conservative nature of calculation, realistic high values for permissible uncertainties could be accepted, in a *shared risk* approach.

ABSTRACT