Assessment of the electromagnetic field around electrical installations

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In response to Ricky's Afterthought in the latest issue of the AMPERE Newsletter [1], I am happy to confirm that Laborelec has over 25 years of experience in the assessment of the electromagnetic field (at all non-ionizing frequencies) around electrical installations.

The assessment with a view of the safety of persons or from the perspective of interaction with telecommunication is made by measuring or calculating the electromagnetic field (EMF) and comparing the results with the relevant limits as specified in the prevailing legislation.

Measurements and numerical studies with recommendations are carried out in a broad frequency domain ranging from static fields (0 Hz) to several tens of GHz.

The first thing to do on the site under investigation is identifying all possible sources of an EMF. This will include obvious sources such as high-voltage stations (50 Hz) and dielectric heating installations (MHz range), but also sources of a static magnetic field such as excitation of alternators, electrolysis installations or permanent magnets on conveyer belts.

Care must be taken to measure the EMF in all relevant operating conditions. In particular for dielectric heating installations, the leakage field is not only dependent on the applied power, but also on the dielectric characteristics and geometry of the charge.

Different legislation for workers and general public

In all countries to my knowledge, the legislation is different for workers and the general public. In particular the legislation for the general public stipulates in several countries more strict limits than those proposed by the ICNIRP (International Commission for Non-Ionizing Radiation Protection).

Therefore, in industrial practice, reference should be made to the legislation rather than to the ICNIRP limits. The latter are interesting to get some understanding of the underlying reasoning that constitutes the basis for the legislation. The assessment of EMF in locations accessible to the general public is triggered by a-posteriori complaints or by the a-priori procedure to get an installation permit for electrical equipment.

By now, all EU member states have transposed the European Directive on "*the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (EMFs)*" [2] into national legislation. This creates a legal obligation for employers to assess the possible risk of exposure of employees to EMFs. The level of exposure found in all relevant areas of the site must be properly documented and filed.

Measurement equipment

The measuring equipment to be used is dependent on the frequency spectrum in which the EMF is measured. **Figure 1** gives the equipment used for measurement of the electric and magnetic field at power frequency (50 Hz). For dielectric heating installations, the leakage field is measured by equipment that allows a measurement of the fundamental frequency as well as of some neighboring harmonic frequencies (**Figure 2**).

Fig. 1: Measurement equipment at power frequency (50 Hz).

Fig. 2: Measurement of EMF at dielectric heating frequencies.

Numerical modelling for assessment in design stage

In addition to the measurement service, Laborelec offers EMF related assistance in the design stage of new equipment and installations.

Using state-of-the-art numerical software, a model of the equipment is built and the EMF in every point of the three-dimensional surrounding area is calculated (**Figure 3**).

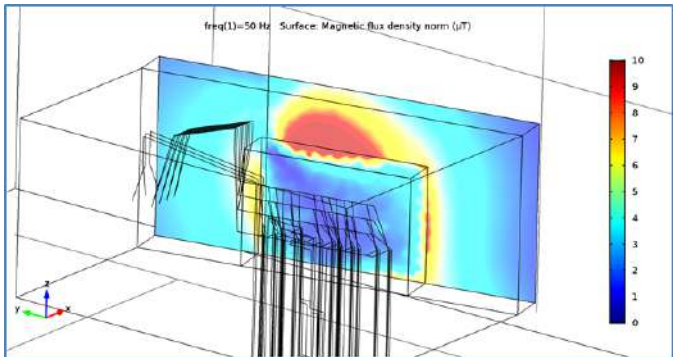

Fig. 3: Numerical model of the magnetic field around an electrical installation.

Based on this, recommendations to optimize the design can be formulated. A sensitivity analysis on the input parameters of the numerical model gives indications for material, geometrical dimensions, and position of the shielding to put in place.

Compliance with telecommunication limits

Industry needs also to check the compliance with the limits established by telecommunication authorities.

These limits are much more strict, and appropriate measurements antennas are needed. **Figure 4** and **Figure 5** give an example for the measurement at the outside of a factory where a dielectric dryer is used.

Fig. 4: Loop-antenna for the measurement at 27.12 MHz.

Fig. 5: Biconic antenna for measurement of harmonics between 50 MHz and 300 MHz.

Conclusion and outlook

An assessment of the EMF around electrical installations from the perspective of the safety of workers and the general public is in most countries a legal obligation.

Because the limits vary according to the frequency of the EMF, a broad range of measurement equipment is needed. In particular the assessment of possible interaction with telecommunication necessitates appropriate measurement antennas.

If the AMPERE Scientific Committee deems it useful, at the next AMPERE conference more ample information can be given concerning the underlying scientific reasoning used by ICNIRP that explains the difference in limits for workers and the general public. At the same occasion the variety in scientific models that are at the base of the huge spread in limits, as applied by different countries, can be discussed.

For further reading

1. AMPERE Newsletter, Issue 119, 8 July 2024, pp.7-8.
2. Directive 2013/35/EU of the European Parliament and of the Council of 26 June 2013 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (20th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC) and repealing Directive 2004/40/EC.

About the author

Koen Van Reusel received the degree of Master of Electrical Engineering from the KU Leuven (Belgium) in 1985, and the degree of Doctor of Engineering from the KU Leuven in 2010. Since 1992 he is at LABORELEC (Belgium), a technical competence center in energy processes and energy use. As senior expert he is member of the Power Networks Department. His current focus is on electrification of industrial thermal processes, lightning protection in wind turbines, and measuring the effects of electromagnetic fields from a human health perspective. He is visiting professor at the KU Leuven, where he teaches "Electromagnetic Processing of Materials" and "Power Quality". Koen Van Reusel is Member of the Management Committee of AMPERE; General Secretary to UIE, the International Union for Electricity applications; Member of the Board of Directors of FISUEL, the International Federation for the Safety of the Electricity Users; and Member of the International Electrotechnical Committee n° 27 "Industrial Electroheating and Electromagnetic Processing of Materials".

Next generation of Püschner industrial microwave applications

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At the beginning of 2023 the Püschner Microwave business has been transferred to the 3rd generation.

Founded in 1970 by former Phillipps microwave engineer Herbert-Alexander Püschner, the business was handed over to his son Peter-Alexander in 1996 and has constantly developed into various fields of industrial microwave applications ever since. With installations around the world Püschner has innovated multiple industrial heating and drying processes for its customers. Its engineering DNA has led Püschner to multiple application product lines with the latest development being microwave assisted vacuum freeze dryers in an industrial scale specifically for biotec and active pharmaceutical ingredients.

Peter´s oldest daughter Pia and her husband Jörn (**Figure 1**), the new owners of Püschner, are deeply thankful for this opportunity to benefit from