A European Initiative to Develop Procedures and Instrumentation for Worker's Electromagnetic Safety (WEMS)

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Abstract

A project is described that is developing procedures and instrumentation to demonstrate compliance with EU Directive 2004/40/EC. In 2012, the directive will pose new requirements on employers in the European Union to evaluate the exposure of workers to electromagnetic fields (EMF). Implementation of these requirements is a significant challenge to employers, many of whom lack the resources and expertise required to demonstrate compliance with EMF limits. Some industries that use high-current or high-voltage equipment in the workplace are particularly affected, such as the automotive, railway and metal fabrication industries. Simple and reliable tools are necessary for employers in these industries.

1. Introduction

The implementation of EU Directive 2004/40/EC is expected to significantly affect a minority but still a large number of workplaces at industries utilizing high-voltages and/or high currents, such as in the automotive, railway and metal fabrication industries. In the UK alone, it has been estimated that the directive will affect "at least 55,000 businesses / organizations, 260,000 sites, 277,000 pieces of equipment, [and] 447,000 to 713,000 workers" [1]. The same report estimates the annualized costs will range between £4.2 and £15.7 million, with a large majority of the costs directed to the determination and assessment of risks.

Existing measurement equipment used for electromagnetic field evaluation is insufficient to fully demonstrate compliance with exposure limits. The incident fields are measured rather than the induced fields in the body, leading to an over estimation of the exposure [2, 3]. For example, the current supplied to a modern train accelerating out of a station may lead to magnetic field levels for substation and trackside workers above the reference levels. A recent study [2] found that the incident electric fields at close distances to energy-saving light bulbs can exceed the ICNIRP reference levels [4], but they overestimate the actual exposure by more than an order of magnitude. If the reference levels are exceeded, modifications to the work environment are needed unless it can be proven that the basic restrictions are satisfied. The first is very costly and the second can be demanding.

Measurement equipment commonly used today is inaccurate when measuring fields that are highly non-uniform in space and time, and current analytical and numerical analysis tools are unable to model the complex sources adequately. In a recent report by the European Commission [5], several concerns were reported including high measurement uncertainty of existing equipment and complex implementation of the directive due to the fact that the basic restrictions are not directly measurable. Therefore it is imperative to provide reliable tools to allow employers to fulfill their responsibilities with respect to the directive. A strong scientific basis for the procedures and instrumentation is needed in order to avoid costly legal issues.

2. Objectives of the WEMS Initiative

The scientific objectives of the WEMS Initiative are to:

- Build novel instrumentation that enables the demonstration of compliance of high-field workplaces with the basic restrictions [4, 6], overcoming the short-comings of current measurement equipment;
- Develop validated numerical models and software analysis tools to obtain sound transformation from measured values to induced fields. High resolution anatomical models are used in typical exposure situations. The models are from the Virtual Population, developed by the IT'IS Foundation [7-9];

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- Create sound but simple-to-apply procedures to demonstrate compliance with the EU directive with known uncertainty;
- Develop specific validated procedures for the in situ assessment of relevant exposure scenarios in the automotive, railway and metal fabrication industries;
- Perform experimental evaluation of the exposure scenarios for the three industries, including environments with high temporal transients;
- Provide simple, user-friendly software tools allowing evaluation of exposure based on exposure assessment according to standardized procedures with harmonized quality criteria;
- Disseminate developed tools and procedures to relevant standard organizations.

The results of the project will be ready at the time of the EU directive implementation and will significantly contribute to the legal certainty of the required workplace evaluations of which the industry and agency will benefit alike.

A similar project to develop instrumentation and methods of the assessment of electromagnetic exposure of people to compact fluorescent light bulbs was recently completed. This project provides an initial basis for the work of this project. A linear induced field sensor was developed to measure the fields induced from the bulbs (at frequencies from 20 - 70 kHz), and simulations of anatomical models were performed in order to develop an appropriate transfer coefficient for human exposure (Figure 1). The expanded measurement uncertainty of the field sensor was estimated to be 16% at a distance of 20 mm from the source, which is significantly lower than the measurement uncertainty of a commercial incident field probe (40% at 300 mm and much larger at closer distances).

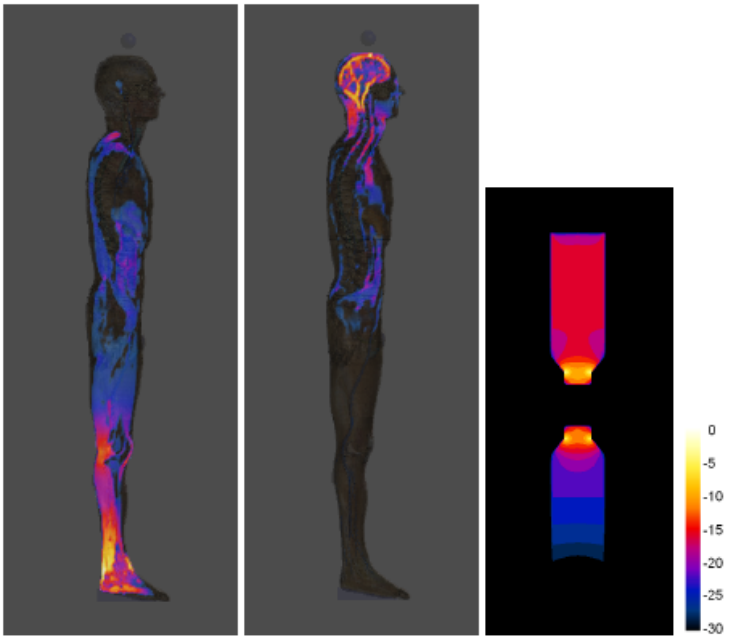

Figure 1: Current density distributions in vertical slices of Duke anatomical model (ankle and head) and a linear induced-field sensor exposed to a charged sphere.

The requirements for the sensors for the WEMS project are much more stringent than for the previous project. The induced fields from both electric and magnetic fields must be assessed, accuracy is required across a much broader frequency range, and very different environments with different spatial distributions of the fields must be assessed. The challenges of developing this instrumentation will be discussed.

3. Conclusion

New procedures and tools are needed to accurately assess workplace exposure to electromagnetic fields, as recent discussions about the impending EU Directive 2004/40/EC have revealed. The WEMS project is currently addressing the challenges faced by the implementation of the directive, using a robust scientific approach to provide simple and reliable tools to employers.

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