

Wireless Safety for Employees (WISE) Software Tool for the Evaluation of Electromagnetic Field Exposure in Industrial Environments

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Summary (min 150 characters) An easy usable web-based software tool for prevention advisors to assess the risk of occupational electromagnetic exposure the company with respect to the European directive is proposed. This “WISE tool” (<http://www.wica.intec.ugent.be/exposure-tool/prevention>) is based on a large database of electromagnetic field exposure values, enabling companies to assess the electromagnetic field exposure of their machines and compliance with EU directive 2013/35/EU without detailed knowledge of fields.

INTRODUCTION

Employers in the European Union will face new requirements concerning the exposure of their employees to electromagnetic fields when the EU Directive 2013/35/EU (European Parliament 2013) will be implemented in 2016. This directive is largely based on the ICNIRP 1998 and 2010 guidelines (ICNIRP 1998, 2010). Prevention advisors of companies in Europe will have to perform a safety assessment of the machines present in the company. The prevention advisors have often no knowledge about electromagnetic fields, the assessment of the fields, and measures that perhaps have to be taken.

The INTERREG IV WISE project (Wireless Safety for Employees, <http://www.wica.intec.ugent.be/wise>) addresses this problem by developing a software package for prevention advisors to assess exposure and possible risks in an easy way. The package is based on a large database of exposure data. This “WISE tool” (<http://www.wica.intec.ugent.be/exposure-tool/prevention>) is unique that no installation is needed (implemented as a web application) and it is easy usable, enabling companies to obtain an estimate of the electromagnetic (EM) field exposure of their machines without detailed knowledge of EM fields.

The goal of tool is to provide (i) a guide for prevention advisers, (ii) electric and magnetic field values as a function of the distance to the equipment, (iii) a comparison with exposure limits of the EU directive and to which category the equipment belongs, and (iv) specific actions that must be taken. This tool has no intention to replace measurements but will be used to enable prevention advisors to identify possible problems and measures that have to be

taken in the considered company. The WISE tool will reduce time consumption for the prevention advisors and provide a usable compliance report. The tool is usable on laptops, tablets, and mobile devices. This will thus be cost-effective for the advisors and the companies.

MATERIALS AND METHODS

The WISE tool consists of the following parts: (i) an inventory and categorization of all radiating equipment in the frequency range 1 Hz to 300 GHz, (ii) exposure assessment around each source, (iii) risk analysis for each source, (iv) a database and interface to assess the exposure around each kind of source, (v) the EU directive limits.

The machines are categorized and required measures to satisfy the directive are provided by means of compliance distances and a clear compliance report. The database is based upon a large measurement campaign as part of the WISE project, literature (peer-reviewed journal and conference papers), and available databases and information such as NBN EN 50499 (NBN50499).

The presentation layer of the tool is implemented as a web application using standard web technologies: HTML, JavaScript and CSS. It is a Single-page Application (SPA) that offers a user experience similar to that of a typical desktop or tablet application, but the user does not have to install any software or browser plugins. The measurement and simulation data is stored in a SQL database on a remote server, which also provides a web service (or API) that encapsulates all domain logic. The presentation layer retrieves exposure information by querying this web service. The tool is thus fully platform independent, requiring only a HTML5-capable browser and an internet connection. The output of the tool is a compliance report for the equipment and machinery present in the company. Fig. 1 summarizes the structure of the WISE tool.

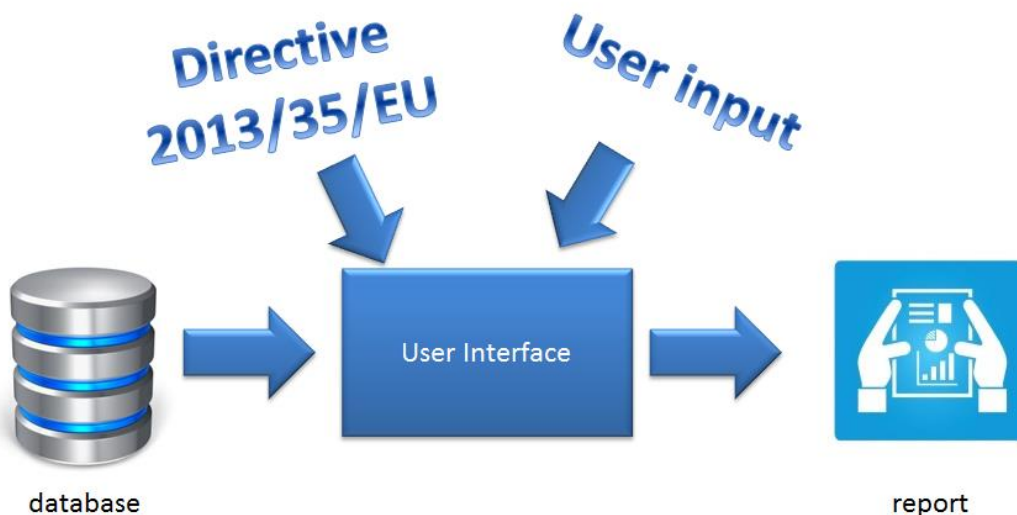


Figure 1: Structure of the WISE tool with database, user interface, user input and compliance report.

Some other initiatives are the following. EMES (Electromagnetic Fields Evaluation System, <http://www.eval.at/EMES>) aims to support employers to evaluate their workplaces (Molla-Djafari1 et al. 2014). EMES does not make use of a web interface and needs to be installed on the users' computer. EMES is more oriented towards experts, available in German, and

contains 2,450 sources (and also a lot of smaller non-industrial sources are present). The INTERROC study collects detailed lifetime job histories from study subjects in seven countries (van Tongeren et al. 2013). Amongst other things, INTERROC evaluates the possible association between occupational exposure to EM fields and tumors of the brain and central nervous system. They perform confidence evaluations for papers, reports, etc. and enter the data into an Occupational Exposure Measurement Database (OEMD). EMFWELD (Electromagnetic Fields in Welding, <http://www.emfweld.com/>) wants to increase knowledge and understanding of EM Fields in welding and magnetic particle inspection (MT) processes. One of the objectives is to produce a software toolkit for assessing exposure of an operator using a set of welding parameters. Hamnerius et al. (2013) focus on the assessment of welding in the context of the EU directive. Finally, the EU will provide a manual for the directive beginning 2016.

RESULTS AND DISCUSSION

For the inventory of all radiating equipment, a classification based on the industrial sector, followed by the category, and the various EM sources is proposed. The electromagnetic sources can be divided in different sectors dependent on their application. The following sectors are defined: industrial sector, electricity sector, broadcasting sector, telecommunications sector, radar, medical sector, trade and services, public transportation, offices, and miscellaneous. For each sector, different categories or types of equipment are defined. For each category, the available sources are determined along with the corresponding frequency and other specifications (maximum current, voltage, power, etc.). Figure 2 (a) shows a screenshot of the selection of an EM source within a category and sector.

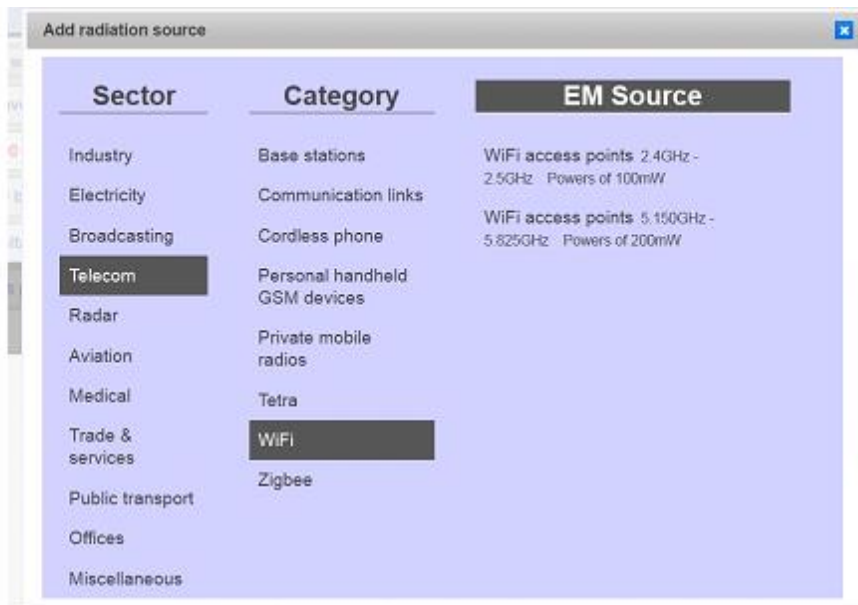
Exposure assessment around various equipment is performed to populate the database with EM fields around machinery and is based on the following data sources: measurements, simulations, literature (international papers and studies), and existing databases of field values. Measurements are the most interesting data source as these fields were acquired in real circumstances. However, measurements are performed with different measurement protocols and equipment, depending on the technology, frequency, etc. and these are time consuming. We performed broadband and narrowband measurements (contribution of individual sources can be identified) and selected measurement data from literature. Remark that there are often a limited number of measurements and field values and that the exact specifications of sources are not always available. All sources of information are cited in the tool.

The risk analysis consists of two parts. First, the analysis of the fields as a function of distance and at typical working places (see Fig. 2 (c)) and second, a comparison with limits of the EU directive for the low and high sensory effects (1 Hz – 10 MHz), and the thermal effects (100 kHz – 300 GHz) (Directive 2013). An example is shown in Fig. 2 (b). For the risk analysis, the tool makes use of the exposure categorization of Bolte and Pruppers (2006). They divided working environments and equipment into 3 categories, namely, category 1 (under normal conditions the action values will not be exceeded), category 2 (action values can be exceeded but the exposure limit values will not be exceeded under normal conditions; where 2a represents only brief instructions needed and for 2b technical measures are needed e.g., shielding or fences), and category 3 (exposure limit values can be exceeded).

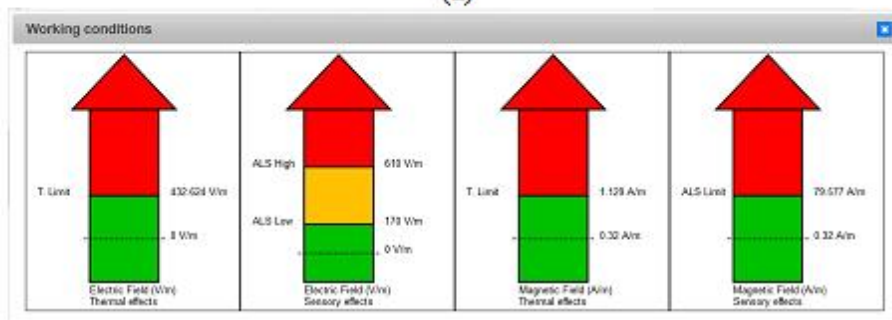
In total 117 sources are implemented in the database that contains 16,805 records (7,811 measurements and 8,994 simulations) as a function of distance. In the software tool, one can adjust the power of the machine or antenna. In summary, the following features are available:

- Web-based interface with general information and evaluation report generation
- Expanding source list divided by sector and categories
- Typical information displayed for each source
- Listing of minimum compliance distance with corresponding maximum exposure at typical operating frequencies (Fig. 2 (c))
- Dynamic safety measures information in case of exceeding action or limit values
- Scalable data where possible (power)
- Working condition analysis based on working distance, including clear visual representation (Fig. 2 (b))
- Specifications of the equipment are evaluated through manuals and datasheets and saved in the database

Finally, the prevention advisor adds all the machines present in the company in the tool, using the web-based interface, and a compliance report is generated with respect to the EU directive. The WISE tool indicates which measures are needed. The WISE tool can be tested at <http://www.wica.intec.ugent.be/exposure-tool/prevention>.



(a)



(b)



(c)

Figure 2: Screenshots of WISE tool (a) selection of machine (EM source) in a category and sector, (b) working conditions, (c) compliance distances around an EM source.

CONCLUSIONS

In this paper, an easy usable web-based software tool for prevention advisors to assess the risk of occupational electromagnetic exposure the company with respect to the European directive is proposed. This “WISE tool” is based on a large database of electromagnetic field exposure data (>16,800 records of electromagnetic fields), enabling companies to assess the electromagnetic field exposure of their machines and compliance with EU directive 2013/35/EU without detailed knowledge of EM fields.

This tool has no intention to replace measurements but can be used to enable prevention advisors to identify possible problems and measures that have to be taken in the considered company. The tool is available at <http://www.wica.intec.ugent.be/exposure-tool/prevention>.

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