Session 2: Dosimetry I

* 2-1 ASSESSMENT OF ELF ELECTROMAGNETIC EXPOSURE OF THE GENERAL PUBLIC DUE TO DISTRIBUTION SUBSTATIONS

Wout Joseph, Leen Verloock, Luc Martens
Ghent University / IBBT, Ghent, Belgium

Objectives. Distribution substations that transform typically voltages of 11,000 V to voltages of 220/230 and 400 V, are often located close to places where people are present e.g., in buildings, between houses,.... The objective of this paper is to determine the exposure of the general public due to extremely low frequency (ELF) electromagnetic fields of distribution substations and to compare the fields with the ICNIRP guidelines [1] (100 μT and 5 kV/m at 50 Hz) and the 0.4 μT value mentioned in epidemiological studies [2].

Methods. In order to check the compliance of the electromagnetic fields, distribution substations (with power of 160 kVA to 630 kVA) have been categorized. Four categories have been distinguished depending on their location: substations in buildings (mostly in basement), detached substations, substations between two houses (above ground level), and underground substations in the pavement. For each category two substations are selected (based upon power and possible exposure of general public) for the measurements. Thus in total eight substations have been investigated.
The fields are measured using an electric- and magnetic-field probe of type PMM EHP-50C. The magnetic fields depend upon the current load of the cables. Therefore, the course of the currents through the different cables of the substations is measured each 15 minutes during 24 hours at the day the field measurements are performed. The average, maximum, and nominal exposure due to the magnetic fields can then be calculated using the momentary measurement values and the course of the current, assuming that the course of the magnetic fields during 24 hours is similar to the course of the current.
The measurement procedure can be described as follows. First, the frequency spectrum of the magnetic and electric fields in the neighborhood of the substation is determined from 5 Hz to 100 kHz. Next, the location of the maximum value at each side of the substation is determined at 1.5 m above ground level. Fig. 1 shows an example of the normalized magnetic field B [μT] around a detached substation with indication of the location of the maximal value. Then, the magnetic and electric fields at the location of the maximal values of each side are measured as a function of the distance to the substation. Finally, the safety distances are determined by comparing the fields with the ICNIRP [1] guidelines and the average fields with the 0.4 μT value [2].

Results. Fig. 2 shows the average magnetic field (24 hours) as a function of the distance for different sides of a distribution substation. These values are then used to determine the safety distances. The electric fields measured around the substations never exceeded 5 kV/m: the maximal measured value was 536.0 V/m. The value of 100 μT is never exceeded

for maximal exposure during a day. For exposure due to the nominal currents (no normal operational conditions) safety distances of maximally 0.90 m are obtained. The maximal safety distance (for the investigated substations) for the 0.4 μT value for average exposure is 5.4 m.

Conclusions. Distribution substations have been distinguished in four categories and for each category the fields of two substations have been measured. The safety distances for these substations have been determined. The magnetic and electric fields of the investigated substations satisfy the ICNIRP guidelines. When comparing the average exposure with the value of 0.4 μT, safety distances of maximally 5.4 m are obtained.

REFERENCES

1. International Commission on Non-ionizing Radiation Protection, "Guidelines for limiting exposure to time-varying electric,magnetic, and electromagnetic fields (up 300 GHz)," Health Physics, Vol. 74, No. 4, pp. 494-522, 1998.

2. IARC Monographs on Static and Extremely Low-Frequency Electric and Magnetic Fields, Vol. 80, pp. 429. ISBN 92 832 1280 0.

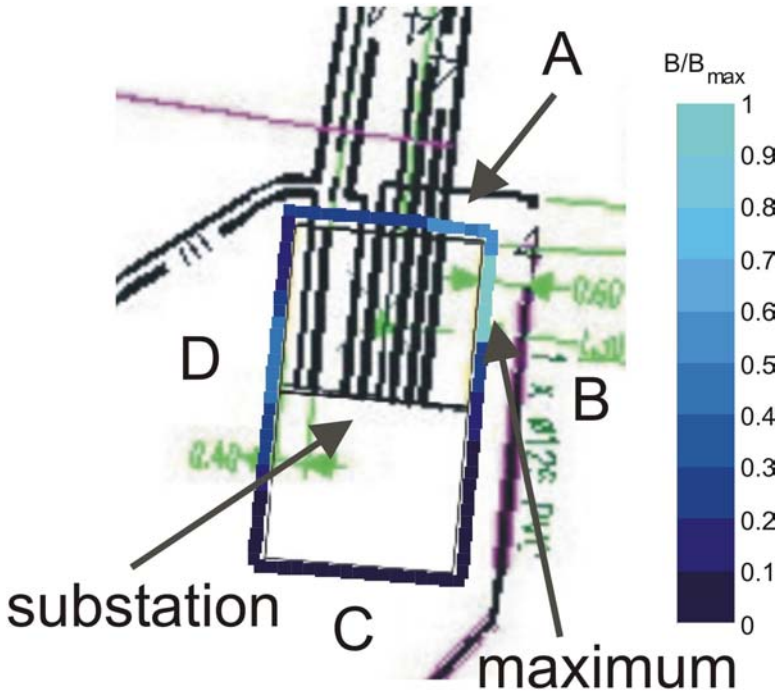

FIGURE 1. : Example of normalized magnetic field around detached distribution substation (A, B, C, and D indicate the different sides of the substation).

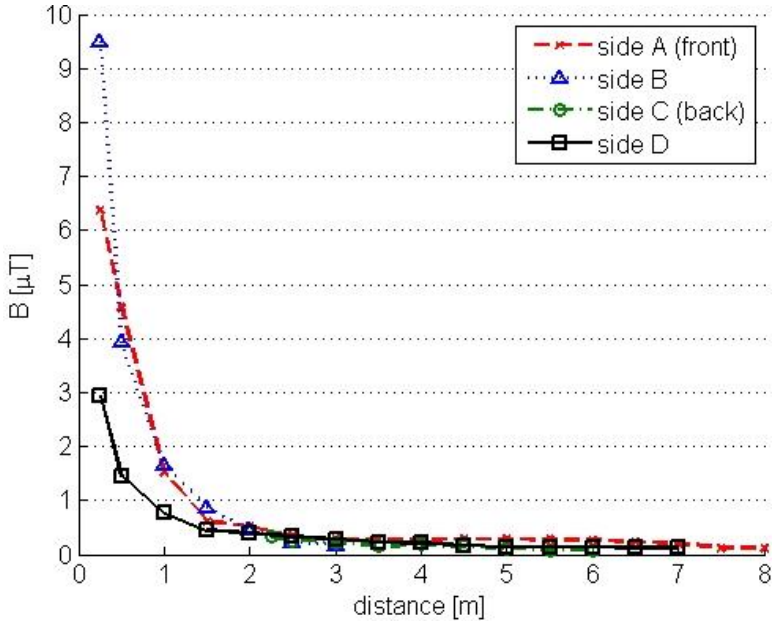

FIGURE 2. : Averaged (day) magnetic field B as a function of the distance to a detached substation (A, B, C, and D indicate the different sides of the substation).

2-2 THE "VIRTUAL FAMILY" – NOVEL CAD BASED ANATOMICAL MODELS OF TWO ADULTS AND TWO CHILDREN FOR DOSIMETRY AND IMPLANT EVALUATIONS

Wolfgang Kainz[1], Andreas Christ[2], Katharina Honegger[2], Eckhart Hahn[3], Jianxiang Shen[4], Wolfgang Rascher[3], Rolf Janka[3], Werner Bautz[3], Berthold Kiefer[5], Peter Schmitt[5], Hans-Peter Hollenbach[5], Ji Chen[4], Anthony Kam[6], Esra Z. Neufeld[2], Michael Oberle[2], Niels Kuster[2]

[1]U.S. Food and Drug Administration (FDA), Rockville, MD, USA [2]Foundation for Research on Information Technologies in Society, Zurich, Switzerland [3]Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany [4]University of Houston, Houston, TX, USA [5]Siemens Medical Solutions, Erlangen, Germany [6]National Institutes of Health (NIH), Bethesda, MD, USA

Objectives. Our goal is the development of four high-resolution anatomical models of an adult female, an adult male and two children (3-6 and 7-14
years of age). The models consist of CAD (Computer Aided Design) objects with smooth surfaces. Every organ, bone or muscle will be represented by a separate CAD object. This approach allows the generation of voxel models with the required grid step sizes without

The Bioelectromagnetics Society
29th Annual Meeting
Abstract Collection

Kanazawa-shi Bunka Hall
Kanazawa, Japan
June 10 - 15, 2007