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RESULTS OF OCCUPATIONAL-HYGIENIC MEASUREMENT AND EVALUATION OF ELECTROMAGNETIC FIELDS IN THE GERMAN DEMOCRATIC REPUBLIC

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ABSTRACT

During the last ten years the occupational-hygienic evaluation of electromagnetic fields with a frequency range between 60 kHz and 300 MHz has been gaining in importance. The authors report on the development and practical application of a near-field strength measuring device which is used to determine the electric component of the electromagnetic high-frequency field (frequency range from 60 kHz up to 1 GHz) and describe the operating gauging procedure. They present the results of practical measurements at high frequency and microwave workplaces in the German Democratic Republic and give a list of electromagnetic field sources.

It is pointed out that at workplaces exposed to high frequency electromagnetic fields and microwaves, injuries due to termic effects need not be expected except if safety regulations are seriously violated.

During the last few years the hygienic evaluation of electromagnetic fields and waves of high frequency (60 kHz – 300 MHz) and microwave range (300 MHz – 300 GHz) in industry has been gaining in importance. The thermic effect of these fields is relatively well known. However, within the range of exposures which do not lead to a measurable temperature rise in the organism, the experts' opinions on their relevance to health widely differ. The reported findings correspond to the clinical picture of vegetative disorders. The interpretation of the causal importance of exposure is rendered difficult by the multifactorial etiology of such disturbances. Moreover, the quantitative classification of the conditions of exposure involves problems of measuring techniques and methods.

The development of a corresponding measuring technique and the elaboration of measuring instructions meeting the practical conditions have become priority tasks.

In the German Democratic Republic a reliable, battery-fed near-field strength meter designated as type NFM 1 is available for measuring the electric components of the electromagnetic high frequency field. The instrument consists of an indicator and two probes permitting direct reading of the field strength in

V/m within the frequency ranges from 60 kHz to 30 MHz and from 20 MHz to 300 MHz.

Its weight is 860 g. At a minimum operating duration of 10 hours (chargeable battery) NFM 1 operates with stability within the temperature range from $-10\,^{\circ}C$ to $40\,^{\circ}C$. Presently, the meter is completed with a probe for measuring the magnetic field component (100 kHz–10 MHz), as well as with a probe for measuring electric 50-Hz-fields under high-voltage transmission lines and constructions.

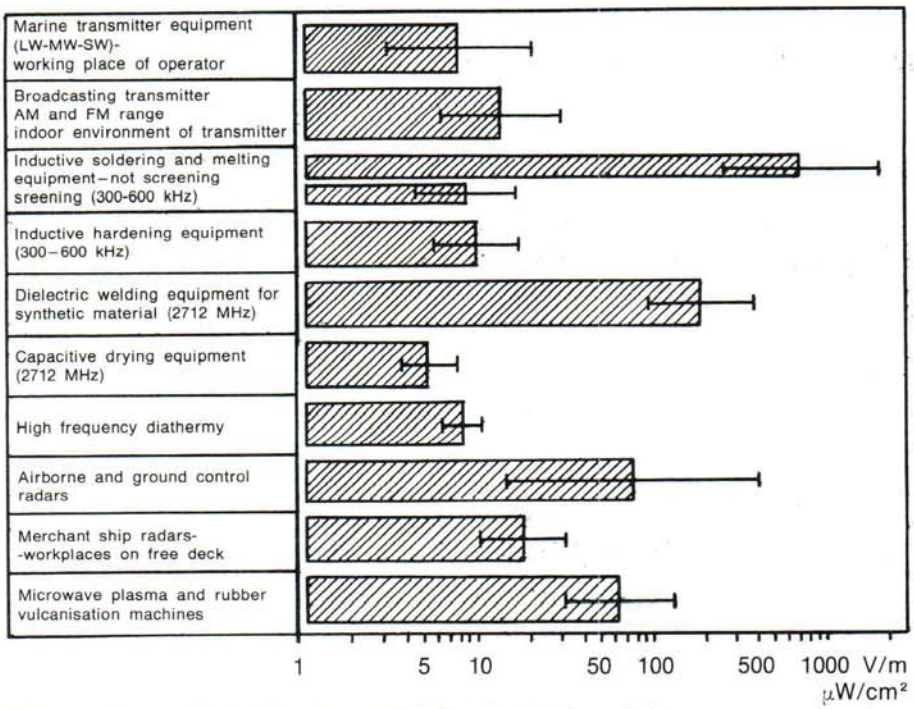

FIG. 1 – The extent of exposure at typical high-frequency workplaces.

Over a period of three years laboratory tests, and practical measurements were performed by applying NFM 1 in about 500 high-frequency workplaces. The measurements took place in industrial high-frequency plants with frequencies within the range from about 500 kHz to 1.6 MHz for inductive heating, in industrial high-frequency equipments for capacitive heating at the frequency of 27.12 MHz, and in telecommunication stations with workplaces located both inside the buildings and in the open air at antenna installations.

Figure 1 gives a survey of the exposure at typical high-frequency workplaces. While the field strength measured at radio operator's place on ships

is below 20 V/m, field strengths up to 200 V/m should be expected near transmitters and antennas at broadcasting transmitter stations.

Judging from own experience, the field strength at inductive and capacitive high-frequency industrial plants varies widely. At almost all plants a reduction to values between 5 and 50 V/m can be reached by aimed screening and earthing measures without a restriction of productivity. This is obvious from the example of the inductive solder and braze equipments and smelting plant. The mean power densities measured at the microwave workplaces were also recorded for typical plants (see the last three columns in Fig. 1). Obviously, the exposures are far below the value of 10 mW/cm² which is recognized as the thermic threshold.

On the basis of these measurements, a uniform measuring regulation has been elaborated, covering both the handling of the measuring device and the documentation of the results obtained. With regard to the envisaged epidemiological studies uniform measuring heights corresponding to the position of the following parts of the body: head, breast, pelvis have been stipulated as important parameters. They are for standing workplaces 155, 125 and 90 cm, for sitting workplaces 120, 90 and 45 cm (measured from the floor).

The above results have been duly considered in the Occupational Hygienic Measuring and Evaluation Standard TGL 32602, Sheet 1, in which the values for limited exposure to electromagnetic fields at workplaces valid in the Soviet Union and the People's Republic of Bulgaria have also been included. There exists a scaling measure for the exceeding of the normal values, depending on the intensity of exposure. If these maximum permitted levels are exceeded, the workers concerned are covered by an industrial hygienic and occupational-medical check-up programme.

This programme provides a complex occupational-hygienic analysis of all detrimental and burdening factors connected with the workplace, a medical check-up, the evaluation of a psychological-neurological questionnaire, as well as an additional ophthalmological examination when microwaves are concerned. We hope that by means of this long-term programme we will be able to create a basis for aimed epidemiological studies in the German Democratic Republic.

At workplaces exposed to high-frequency electromagnetic fields and microwaves injuries due to thermic effects need not be expected. Exceptions may occur in practice only if gross violations of safety regulations, especially at microwave equipments are committed. Special caution is also required at plants which are still in the designing and experimental stages.

Along with the studies in the field of measuring techniques, preliminary experimental studies in animals have been carried out. From animal experiments and *in vitro* studies we may expect in the first place possible explanations of the specific mode of action. For assessment of the health relevance of occupational exposures epidemiological studies are of special importance, as the analogy between animal experiments and observations on humans implies greater uncertainties with electromagnetic fields than with any other detrimental and

burdening factor. Such investigations require a reliable definition of all conditions of exposure, including other factors of the working environment, such as noise, climate and stress factors. In our opinion, a uniform regulation of the measurement, documentation and evaluation appears to be an essential step towards the realization of this aim.