A Method To Assess the Safety of Complex Electromagnetic Fields

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The International EMF Project of the World Health Organization (WHO) is presently assessing health and environmental effects of exposure to static and time varying electric and magnetic fields (EMFs) in the frequency range 0 - 300 GHz. The project's main task is to collate scientific knowledge regarding possible health risks, and support national and regional authorities in their development of any needed mitigation measures. The project is being pursued in collaboration with the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and other international organizations, with a view to implementing any required internationally recognized countermeasures. The circumstances leading up to the launch of this major project deserves treatment in monographs of environmental health criteria for extremely low frequency and radiofrequency field at a later date.

When equipment and devices transmit or use electricity, they leak an electromagnetic field of a certain intensity into the environment. Electric railways are no exception. The leaked EMFs may at times interfere with the proper operation of electronic devices. Because EMFs are invisible to the human eye, and because there is little information regarding safety levels at different intensities of exposure in the actual environment, there is a tendency to regard the issue with some concern.

In the actual environment in which electric trains operate, EMFs exhibiting a range of spectra are generated with complex spatiotemporal characteristics. Most research into the biological effect of EMFs has examined exposure to single frequency components, but a suitable method to adequately assess risk in an actual environment has not been developed. Therefore, during our research, we made on-site measurements of environmental EMFs, evaluated induced currents as indices for exposure intensity, and assessed biological effects under actual complex EMF exposure conditions. After collating scientific knowledge made available to date, and considering typical exposure situations in actual environments, we developed an appropriate method to assess the effect of EMFs (see Fig. 1), basing our research on specific scientific data.

Our studies use the numerical calculation model for Japanese people exposed to EMFs, which was developed by the National Institute of Information and Communications Technology (an independent administrative agency under the Japanese government). We apply this model to estimate induced current in a human body during exposure inside a passenger vehicle of an electric train. Sample calculations are shown in Figure 2. We made a device that induces exposure to complex magnetic fields (see Figure 3) and replicates exposure conditions close to those in an actual environment. We are presently acquiring a wide range of biological data by using the device to expose a variety of life forms, from bacteria and cultured cells to mice. And, to obtain our own background data, we have conducted exposure experiments for single frequencies using static , extremely low-frequency , and intermediate frequencies magnetic fields. We believe these efforts will make it possible to determine the electromagnetic environment of locations where a risk assessment is required, and to assess that risk from the point of view of frequency and spatial distribution, following procedures that are grounded on a scientific basis.

The European Parliament's directive 2004/40/EC obliges EU Member States to introduce measures, no later than April 2008, that provide for the risk analysis of EMF exposure in the workplace. This, too, indicates that concern over EMF health risks may rise once more.

There is therefore a need to be able to explain, in easy-to-understand terms, the safety of electromagnetic environments, in order to reassure passengers, trackside residents and workers that EMFs generated by electric trains are safe. We intend to promote this aim by presenting a scientific method to assess the safety of EMFs, and to provide the required scientific data and information on the methodology to support the method.

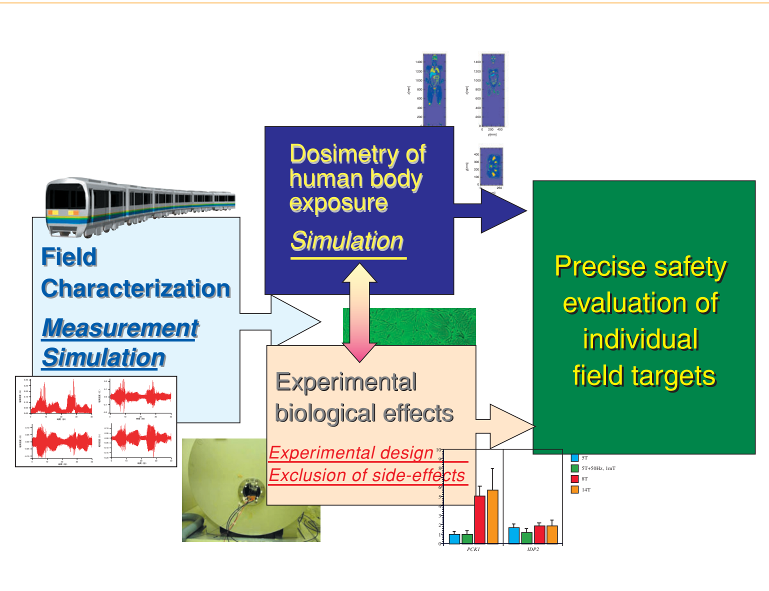


Fig. 1 Strategies promoting awareness of safety

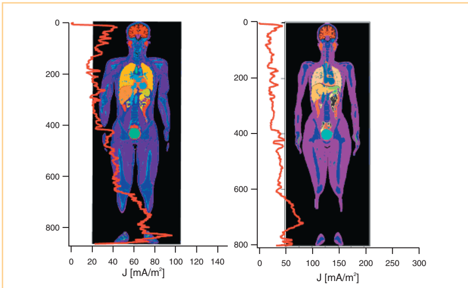
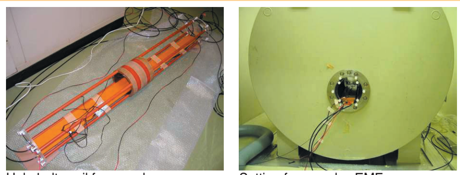


Fig. 2 Maximum induced current in standing heterogeneous voxel models exposed to magnetic field generated by line current under the floor



Helmholtz coil for complex exposure in DC and ELF magnetic fields

Setting for complex EMF exposure experiments

Fig. 3 Complex EMF exposure device