

Evaluating the Health Effects of Magnetic Fields

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1. Introduction

In the electric railway environment, it is known that magnetic fields (MF) in the range between zero Hz and several kHz is generated due to equipments such as overhead contact lines and on-board electrical units. And, socially there are voices of concern over the MF's adverse health effects such as carcinogenesis. The World Health Organization (WHO) started the International EMF Project in 1996 to scientifically evaluate the health risks of electromagnetic fields (EMF). The WHO indicated lack of scientific knowledge regarding the intermediate frequency (IF) EMF in the Environmental Health Criteria No. 238 in 2007. Accordingly, RTRI has conducted research to evaluate the health effects of the IF-MF.

We have used mammalian cells, microorganisms and other biological specimens to assess the static MF (0 Hz), power frequency MF (50 Hz), IF-MF (2, 10 and 21 kHz) and their concurrent exposures, and evaluated their effects such as those on genes in relation to carcinogenicity, on cell differentiation at an early stage of development, etc. This article provides an example of the research we have conducted in recent years to evaluate the effects of the IF-MF exposure.

2. Evaluation procedure

The figure below shows an example of the experimental procedure for evaluating the safety of MF. RTRI is using

strong MF as possible for the evaluations because the energy of a MF is usually extremely weak to detect its effect. The IF-MF exposure apparatus that we have developed lately is achieved suitable culturing conditions

for mammalian cells under uniform and strong MF conditions more than 100 times higher than the reference value defined for the general public by the International Commission on Non-Ionizing Radiation Protection.

A uniform and strong MF can be generated only in a limited space. Therefore we are using mainly the mammalian cells and microorganisms to which a MF can be exposed in a tight space. Moreover, we sometimes use such specimens as susceptible organisms which lack essential ability to maintain normality to evaluate the mode of action of a MF precisely.



3. Evaluation on effects of IF-MF

As the results of exposing the 21 kHz IF-MF of magnetic flux density of up to 3.9 mT (=mWb/m²) to mammalian cells, no effect was observed on mutagenicity (potential carcinogenicity) or cell differentiation at an

early stage of development (potential teratogenicity).

Considering these results and the experimental results obtained so far for other frequency MF, we conclude that the possibility that the MF generated in the railway environment will cause adverse effects against organisms is extremely low or hardly recognizable in general consensus of safety assessment.

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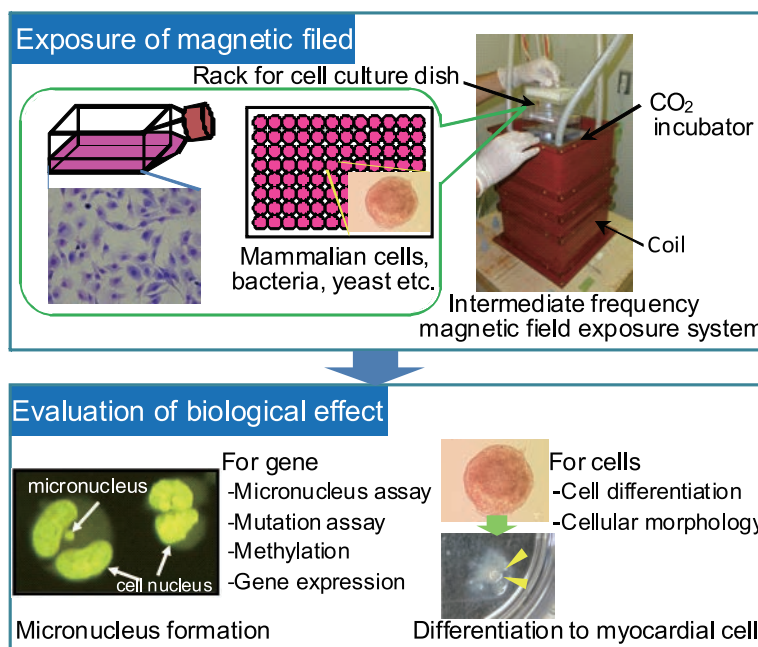


Fig. Example of Experimental Procedure for Safety Evaluation of Magnetic Field