§12. Visualization and Spectrum Analysis of Leakage EM Field in Magnetic Confinement Fusion Test Facilities

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## i) Introduction

The purpose of this study is to investigate the time varying (random and intermittent) properties of the leakage electromagnetic field that has specific broadband characteristics in the magnetic confinement fusion test facilities, and to establish worker's safety management method for particular leakage electromagnetic field (EMF) exposure. This study paid attention to the power supply room of coils and the surround of power amplifiers for ion cyclotron range of frequencies (ICRF) for plasma heating where workers may approach comparatively easily and the leakage EMF are generated. The visualization of the leakage EMF (i.e. EMF distribution measurement) has been performed using a position tracking device with IR camera of Wii-remote.

## ii) Methods

In the surrounding of the power amplifier for ICRF plasma heating, the visualization system for time varying leakage EMF distribution that had been developed recently is used.<sup>1)</sup> In this system, two electric field meters (EMR-20 and EMR-300, Narda S.T.S.) are used. One field meter that adhered an IR marker has measured the E-field strength distribution. Another is fixed to a comparatively strong position of E-field for obtaining the time variance. The E-field strength distribution corresponding to the peak of the time-variance is obtained based on the measurement results of both meters.

In the experiment in the coil power supply room, the compliance of the protection guidelines in the passage between power supply units was visualized and evaluated by the visualization system for low frequency leakage magnetic field distribution with magnetic field meter (ELT-400, Narda S.T.S.).<sup>2)</sup>

## iii) Results

The leakage E-field around the power amplifiers for ICRF heating that we measured was, however, very weak, and we can say that it hardly has potential hazard (Fig. 1).

Although the results of the instrument in accordance with the ICNIRP guidelines 1998 exceeded the reference level at the passage entrance between power supply units, the results by the instrument in accordance with the ICNIRP guidelines 2010 did not exceed it except the interior of the passage (Fig. 2).

## iv) Conclusion

At present, the leakage EMF that exceeded the protection guideline has not been observed around the devices of ICRF plasma heating. It is confirmed that the visualization system for the low frequency magnetic field

distribution can easily distinguish the compliance of protection guidelines of the leakage magnetic field in the power supply room of coils.

On the other hand, we have developed the system which analyzes the spectrum by using fast Fourier transform after it acquires the magnetic flux density waveforms for three axes with the oscilloscope, and which compares the results with the ICNIRP guideline. Although we could not perform the experiment by this new system in facilities, we have obtained an appropriate result for the IH cooker.<sup>3)</sup>



Fig. 1. E-field distribution around the power amplifiers for ICRF heating.



Fig. 2. Compliance distribution of protection guideline in the vicinity of interior of the passage (ICNIRP 2010).

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