

§14. Field Measurement in Hi-Level Multiple Source EM Environment

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In the nuclear fusion experiment facilities, there are the strong static magnetic fields, the ELF magnetic fields generated from the power supply equipments, and the leakage electromagnetic radiation such as various plasma heating devices of 10 MHz - 168 GHz. The electromagnetic radiations for the plasma heating are generated attended with the burst, and they show the spectra with wide frequency-range. These peculiar electromagnetic environment cause a potential error in the measurement result of the electromagnetic field measuring instrument. The purpose of this study is to establish the measurement technique whose reliability is higher than the employee's safety evaluations under such a special, high-level, electromagnetic environment. Moreover, the problem of an electromagnetic, environmental measurement is dug up, arranged, and the countermeasure method is examined.

Method

Magnetic field strength is measured with two or more measuring instruments such as ELF-LF magnetic field meter (ELT-400), ELF-VLF electromagnetic field meter (EFA-3) and portable accumulative magnetic field meter (EMDEX-II). These results are compared mutually, and analyzed. For comparing ICNIRP guideline¹⁾ with the magnetic field environment of multifrequency or complex waveform direct, we have used the STD mode of ELT-400. To obtain the frequency spectrum of the observed magnetic field, the output of ELT-400 has been sent to a digital oscilloscope, and analyzed by its fast Fourier transform function.

Result

As a result of the investigation, the maximum of the magnetic flux densities in the power supply room for the coils is 86.7 μT in the vicinity of power-supply unit. It exceeds the occupational exposure restriction (about three times) considering the harmonic though it is a level that slightly exceeds public exposure restriction (83.3 μT) of the ICNIRP guideline if the waveform of the magnetic field is only fundamental harmonic. However, the magnetic flux density in the area that a general person enters does not exceed the public exposure restriction even if the harmonic is considered.

In the ELF magnetic field measurement in the motor-generator room for NBI, the magnetic flux densities during the acceleration are higher than that during the power generation. The magnetic flux density doesn't exceed the public exposure restriction even if approaching

motor-generator up to 120 cm. The harmonic of 60 Hz or more has not been generated.

The IC card reader of the entrance management system generates the magnetic field of 16.6 Hz for the power supply and of 125 kHz for the data communication. When we have probe approach the card reader most, the magnetic flux density exceeds the occupational exposure restriction. The electromagnetic interference to EMDEX-II that we worried before has no problem.

The effect on measured value of EMDEX-II with an electric carpet is examined, it is found as follows: [1] when laying it down on an electric carpet, the highest value is shown, [2] the maximum value on an electric carpet becomes about 80 μT , [3] in the check experiment using ELT-400, the measured value decrease about 1/5 of EMDEX-II because the probe size is larger.

Discussion

It is necessary to refer to the statement of ICNIRP in 2003 to evaluate the magnetic field exposure of a multifrequency in the frequency band up to 100 kHz.²⁾ It is possible to execute it easily using the STD mode of ELT-400.

In the power supply room for the coils, though there is no problem in the general visitor route, the employees should carry the measuring instrument that has the STD mode when they enter the room for the check.

When the magnetic field is measured in the motor-generator room for NBI (5 Hz - 60 Hz), it is necessary to pay attention so as not to cut the frequency of 30Hz or less. An exact measurement cannot be expected with EMDEX-II.

EFA-3 and EMDEX-II are unsuitable to measuring the magnetic fields of the card reader of the entrance management system because the frequency range does not match. It is necessary to measure it paying attention to not cutting the frequency component of 30 Hz or less using ELT-400.

Note that the measured value can reach the public exposure restriction on an electric carpet when the employee carries about EMDEX-II and is monitoring the exposure to the magnetic field.

Reference

- 1) ICNIRP: "Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)," *Health Physics*, **41**, 4 (1998) 449-522
- 2) ICNIRP Statement: "Guidance on determining compliance of exposure to pulsed and complex non-sinusoidal waveforms below 100 kHz with ICNIRP guidelines," *Health Physics* **84**, 3 (2003) 383-387