

§8. 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 irregular electromagnetic fields 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 employed 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

Electromagnetic field strength is measured with two or more measuring instruments such as wideband electromagnetic field probe (HI-3604), portable electromagnetic field dosimeter (ESM-20), ELF electromagnetic field meter (EFA-3) and portable accumulative magnetic field meter (EMDEX-II), and it makes comparative study. The environment where two or more high-level electromagnetic fields exist is confirmed, and the evaluation method is examined according to the frequency.

Result

As a result of the investigation, it is found that the static magnetic field in the room that the employee entered is 0.12 mT or less when plasma magnetic field strength is 3 T. The static magnetic field at this level doesn't provide the disturbance to the electromagnetic field measuring instruments used.

The ELF magnetic field in the neighborhood of the electric motor-generator for NBI changes widely between 5 Hz and 60 Hz. By comparing with ELF electromagnetic field meter (EFA-3) that can be measured in frequency 5 Hz-30 kHz, it is found that the error is caused in magnetic field meter (EMDEX-II) of the portable accumulation type because the frequency 40 Hz or less is cut. Moreover, the exposure evaluation method for a multi frequency is needed because there is a possibility of existing together to the magnetic field of power frequency (60 Hz). Therefore, it is necessary to measure the shape of waves.

The leakage electromagnetic radiations of the plasma heating devices are evaluated by converting it into the power density. However, a remarkable error can be likely to lead by depending on the characteristic of the measurement meter when they have wide spectra.

Moreover, though it differs from the purpose for which it was originally intended, it is found that the IC card reader of the entrance management system is generated of an unexpectedly strong electromagnetic field. For example, the magnetic field of about 1 A/m has been generated in the distance 35 cm. There is a possibility of the mis-measurement by the use of the cellular phone, too. When an individual exposure is evaluated with the magnetic field measurement meter of the portable accumulation type, it is necessary to note it especially.

Discussion

Though a stationary magnetic field is no problem, it is necessary to estimate the influence by the rapid change magnetic field with quenching of the superconducting coil.

It is necessary to refer to the statement of ICNIRP in 2003 to evaluate the magnetic field exposure of a multiple frequency in the frequency band up to 100 kHz [1]. Electromagnetic environment of the neighborhood of the electric motor-generator for NBI (5 Hz-60 Hz) corresponds to that case. It is necessary to evaluate it by the peak value of the differentiation of the magnetic field, and the analog output of the magnetic field measuring instrument is passed through the differentiation filter, or the shape of waves of it is taken into the computer and calculates. If it is a pickup coil output, it is possible to evaluate as it is.

The measuring instrument used to measure the electromagnetic high frequency field with a wide spectrum that leaks from the plasma heating device should evaluate and check the response characteristic to the amplitude change.

It is necessary to investigate the electromagnetic interference generated by the card reader of the entrance management system and by the cellular phone.

Reference

- 1) 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