§11. Monitoring of Static and Varying Electromagnetic Fields for Safety Management in a Large Plasma Experimental Facility

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Environmental electric and magnetic field strength around a large magnetic plasma experimental facility like LHD and the relating devices had been measured. The international guidelines for various electromagnetic fields namely non-ionizing radiation has been proposed by the World Health Organization (WHO) and the International Commission on Non-ionizing Radiation Protection (ICNIRP). Also the Association of Radio Industries and Business proposed guidelines for radiofrequency-exposure protection named RCR STD-38 2.0 in Japan. Although chronic health effect exposure to the low level radiofrequency has not been found it would be required to obey the safety guidelines. The property of environmental electromagnetic fields around the LHD is to be occurred statistically, namely unstable. Safety issues are not only uniform electromagnetic field but also complex of static magnetic field and variable frequencies of magnetic fields, which are from extremely low frequency (ELF) to extremely high frequency (EHF). The LHD is using the largest super conductive plasma confinement device with strong static magnetic field and not less magnetic field is leak out. Except the static magnetic field, there are many sources of varying electromagnetic fields. The representative ones are plasma heating devices like ICRF (25-100 MHz), and ECH (84-168 GHz). Another is a resonance frequency (2.45 GHz) discharge cleaning device. Since the first plasma experiment of the LHD in 1998, leakage of static magnetic field strength has been measured with Gauss Meter 9900 (F.W. Bell Co) and three axial probe ZOA99-3208, at the fixed monitoring point where is 23 m far from the center of the LHD in south direction. On the LHD plasma experiment, it increased to 0.1 -0.2 mT. Since the LHD operation, the background in not-operation period is about 0.06 mT that is a double of terrestrial magnetic field.

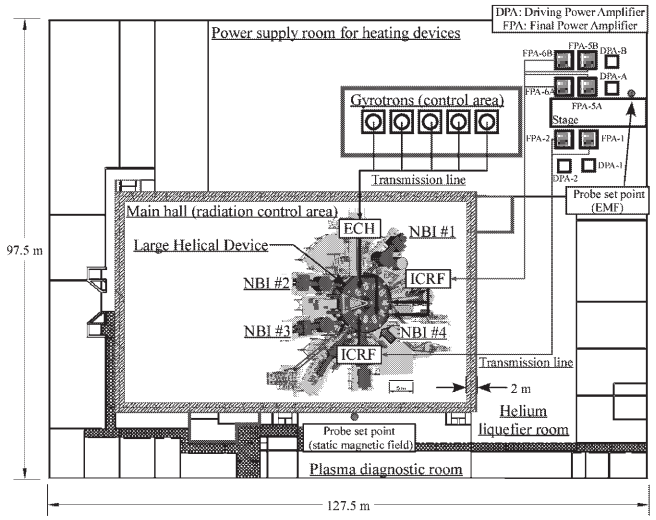

Fig. 1 Layout of LHD and ICRF RF power source

Except the magnetic coil systems of LHD, there are microwave generators for plasma heating device of the ICRF. We developed a data logging system to continuously measure around the ICRF wave generator. The measurement instrument is EMC-300 and three axes electric field probe Type 18 and magnetic field probe Type 10 (Narda S.T.S.). The devices arrangement and the probes setting point are shown in Fig.1. The data logging time is 5 Hz, 0.2 sec, and mean values of optionally selected time can be calculated.

A measurement result is shown in Fig. 2. The electric fields observed were less than 10 V/m and average in 6 minute was extremely small. All data were less than the occupational regulation level proposed guide line by the ICNIRP. However considering the long pulse experiment, the average can not be said so small. The present monitoring shows that the developed monitoring system is sufficiently available for safety management for electromagnetic environment monitoring. Except the ICRF, there are strong environmental electromagnetic fields such as electric power source room for super conducting coils. Also various time varying electromagnetic fields and complex fields of some radiofrequencies in the large plasma facility. They should be precisely concerned as the future environmental electromagnetic fields problems.

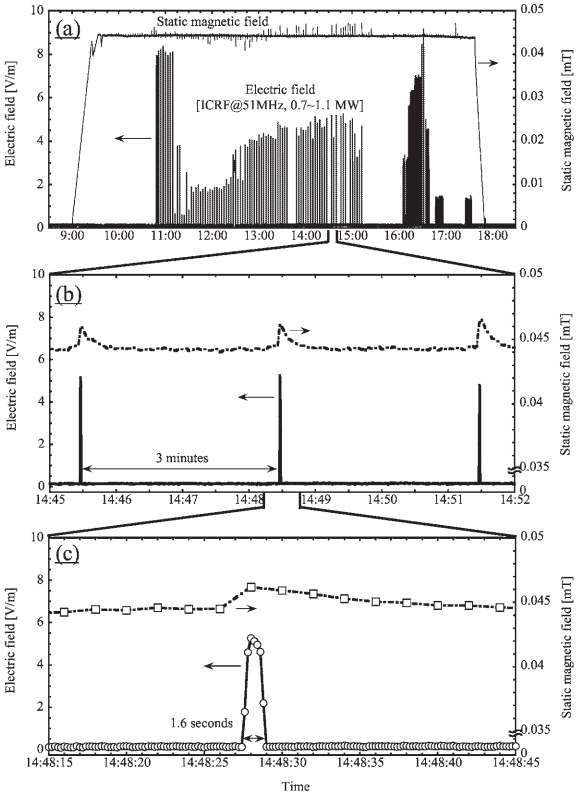

Figure 2 Static magnetic field lekage from the LHD and electric field strength around the ICRF power source devices.