§9. Occupational Protection against Electromagnetic Fields Emitted from X-ray Producing System

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Introduction

A high voltage producing system emitting X-ray is installed in fusion experimental facilities. The leakage of electromagnetic (EM) fields is considered near the high voltage system. This study aims to secure the safety protection for workers against the leaked EM field environment by measuring field strength around the X-ray producing system which is used in a medicine. The purposes in the present study are to measure the leaked EM field strength emitted from a X-ray computed tomography (CT) system, and to compare with the reference levels proposed in the guideline of the international commission on non-ionizing radiation protection (ICNIRP)¹⁾ and the Japanese guideline for EM field protection²⁾.

Materials and Methods

EM fields were measured at 5 points, center, top, bottom, left, and right, in the gantry of medical X-ray CT system by using a EM radiation meter (EMR-300, Wandel & Goltermann) and probes with tri-axial antennas (E-field Type 8.3 and H-field Type 12.1, Wandel & Goltermann). The sensitivity frequency bands of E-field and H-field probes are from 100 kHz to 3 GHz and from 300 kHz to 30 MHz. Electric and magnetic fields were measured for 1 min under exposure, and subtracted a back ground level in the environment of turning on only room light and air conditioner.

Results and Discussion

Mean electric fields were between 0.1 and 0.5 V/m, and the maximum field was 0.5 ± 0.2 V/m at the point of bottom, as shown in Fig. 1. Mean magnetic fields were between 0.002 and 0.006 A/m, and maximum field was 0.006±0.001 A/m at the point of bottom.

Fig. 2 shows a comparison of electric and magnetic field with the reference level of ICNIRP guideline. The reference levels of ICNIRP guideline are the minimum in the frequency bands from 10 to 400 MHz. The reference levels for occupational and general public exposure to time-varying electric fields in the frequency bands from 10 to 400 MHz are 61 and 27.5 V/m. The reference levels for occupational and general public exposure to time-varying magnetic fields are 0.16 and 0.073 A/m respectively. The reference levels of Japanese guideline are the minimum in the frequency bands from 30 to 300 MHz, the reference levels to electric and magnetic fields are 27.5 V/m and 0.0728 A/m. Since the actual frequency of EM fields were

not measured, electric and magnetic field values were compared with the reference levels for 30 MHz that the sensitivity bands of probes overlapped with frequency bands corresponding to minimum levels of guidelines. The electric fields were equivalent to 1/120 for occupational and 1/60 for general public exposure of ICNIRP guideline, respectively. The magnetic fields were equivalent to almost 1/20 for occupational and 1/10 for general public exposure, respectively. For the Japanese guideline, the electric and magnetic fields were equivalent to the ratio of general public exposure. Therefore, it would be concluded that a human body is not affected by a short time exposure for EM fields emitted from X-ray CT system.

Conclusion

Maximum electric and magnetic field emitted from the gantry of medical X-ray CT system were considerably lower than the reference levels of ICNIRP and Japanese guidelines. A short time exposure for EM fields emitted from X-ray CT system would not affect a human body.



Fig. 1. Electric and magnetic fields at 5 measurement points



Fig. 2. Comparison of electric and magnetic field with

1) International Commission on Non-ionizing Radiation Protection: Health Physics **74** (4) (1998) 494-522.

2) Ministry of Internal Affairs and Communications: Consultation **38** (1990) 1-79 (in Japanese).