§18. Effect of Electromagnetic Field in Fusion Facility on Electronic Personal Dosimeter

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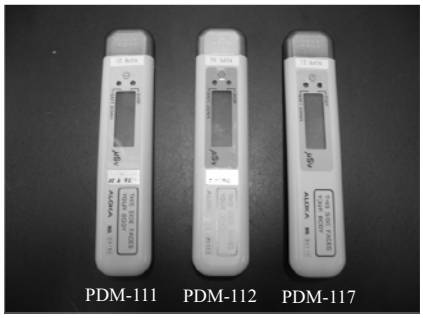
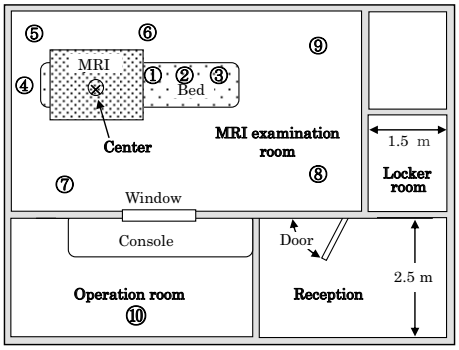
Work environment in a nuclear fusion facility is surrounded by, along with radiation field, electromagnetic field generated by many devices like a superconductive coils system (around 0.4～3T), a motor generator (60Hz), and heating systems, which include a neutral beam injection (NBI), an ion cyclotron range of frequency (ICRF, 25-100 MHz) and an electron cyclotron resonance heating (ECH, 77-168GHz). So, personal dosimeters used to evaluate exposed radiation dose is possibly also exposed to such electromagnetic field.

The effect of electromagnetic field on electronic personal dosimeters in a nuclear fusion facility was examined in a magnetic resonance imaging （MRI; 64MHz, 0.5～3T） examination room instead of a nuclear fusion facility, assuming an electromagnetic environment in a nuclear fusion facility is similar to that in a MRI examination room[1)].



Type	Radiation	Energy	Detection limit
PDM111	γ-ray	60 keV or higher	0.01μSv
PDM112	γ-ray	40 keV or higher	1μSv
PDM117	X-ray	20 keV or higher	1μSv

Fig.1 Electronic personnel dosimeters and performance.



Position No.	Static magnetic field (mT)
①	730
②	244
③	103
④	40
⑤	6.3
⑥	4.5
⑦	1.9
⑧	0.4
⑨	0.2
⑩	0.1

Fig.2 Magnetic field dispersion in the MRI examination room. (①～⑩ : Measurement positions).

Three types of electronic personal dosimeters (PDM-111, 112 and 117), were used as typical ones (Fig.1).

The electromagnetic field distribution was surveyed and dosimeters were placed at locations with various strengths of magnetic field (①～⑩ in Fig.2). The natural radiation dose was measured for about one week.

It was found that while dosimeters were not affected by the electric field[1)], they were affected by the magnetic one as shown in Fig.3. Figure 3 shows that the dosimeters detected radiation levels less sensitively as the magnetic field strength was increased up to 150 mT. The dosimeters underestimated the environmental radiation dose rates by about 10 – 30 % when the magnetic field strength was larger than 150 mT. It is concluded that the strength of the magnetic field needs to be carefully considered when an electronic personal dosimeter is used for monitoring both personal and area dose in a nuclear fusion facility.

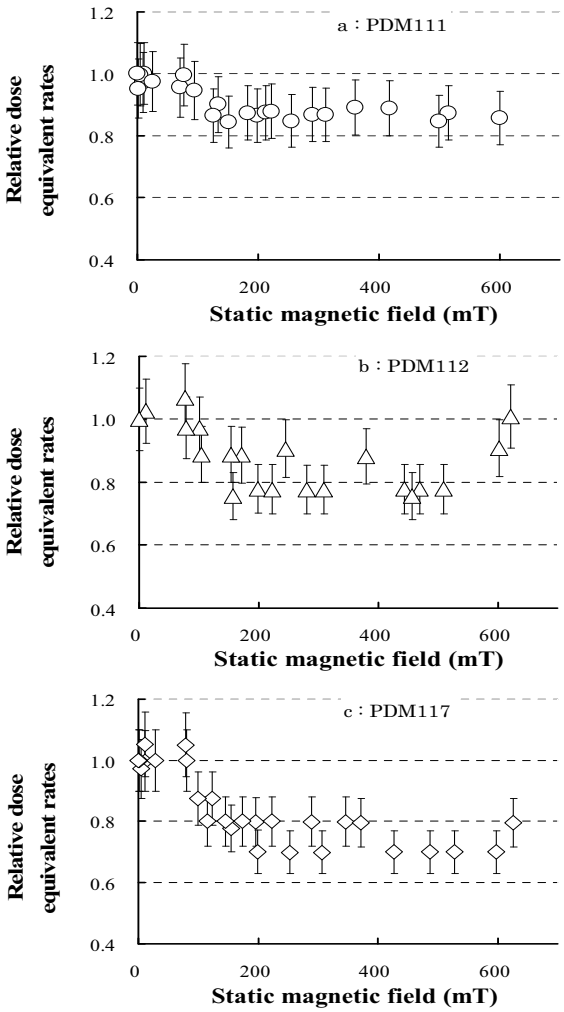


Fig.3 Effect of magnetic field strength on environmental radiation dose measured with electronic personal dosimeters. Relative dose equivalent rates were normalized to the dose rates at 0.08mT.

1)Yamada, J. et al.: Jpn. J. Health Phys., 45(2010)56.