

§8. Study of Biological Effects of Non-ionizing Radiation

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Non-ionizing radiation (NIR) is a general term for both radiations and fields that form part of the electromagnetic spectrum having insufficient radiated energy to produce ionizing in the medium through which it passes. In fusion devices there are many types of NIR generator. The representative devices are super conductive magnets, plasma heaters of high frequency wave generator like an electron cyclotron resonance heater (ECH) and an ion cyclotron resonance frequency (ICRF). The other is extremely low frequency electro-magnetic field that is produced by operating usual electric devices. Nowadays it is not clear whether the long term occupational exposure to electro-magnetic field is harmful to human or not. But we must pay deep attention to the strong electro-magnetic field. Although it is difficult to decide the regulate level for the occupational exposure by NIR and to measure, provisional level should be determined with reference to the international guide line. The regulated level should be conservatory or reasonably low level.

Report that is warning to worker's health effect is found in Russian where workers in plasma physics experimental researchers in "Kharkov Physical Technical Institute", tend to changing abnormal health status mainly heart vascular system, comparing to workers of the other departments. But as already mentioned it is not easy to detect the health effect of the electro-magnetic field on occupational. So study of the biological effect by electro-magnetic field on workers was started in collaboration with Japan Atomic Energy Research Institute and many researchers of universities. Major topics discussed were as follows.

- (1) The object of this study, and magnetic field problem around the LHD. (T.Uda, NIFS)
- (2) Magnetic field strength estimated at the international thermonuclear fusion experimental reactor ITER in the engineering design activity. (M. Taneda, JAERI)

- (3) Measurement cardiac magnetic field. (N. Nakaya, Tokushima U.)
- (4) Biological effect of magnetic field. (S. Ueno, Tokyo U.)
- (5) Measurements and instruments of electro-magnetic field. (Y.Kamimura, Utsunomiya U.)
- (6) Introduction to epidemiology. (T. Yamada, Aichi Med. U.)
- (7) Protection and guide line for electro-magnetic field. (K. Kato, Ibaraki Prefectural U. of Health Sciences)

Now we are going to study about monitoring of the environmental electromagnetic field concerned around the LHD, and plasma heating devices. Major magnetic and/or electric fields predicted at NIFS are shown in Table 1. The major issue is that there is various kinds of frequency electro-magnetic field and it is difficult to measure with a single monitoring detector. Our objection is to establish a conventional monitoring system for fusion experimental plasma devices. The ongoing studies are selection of suitable detectors for electro-magnetic field measurements, and comparing the characteristics of them. Then the direction of study will be decided.

Table 1 Specification of electric and magnetic fields EMF concerned at LHD

Frequency range	General purpose
Static magnetic field	Plasma confinement
Low frequency EMF 60Hz	Usual electric devices
High frequency EMF 50 MHz	Plasma ion heating
2.45GHz	Baking for first wall
84-168 GHz	Plasma electron heating