(2) Safety Management Research

The Radiation safety management of experimental devices, such as LHD, plasma heating devices like NBI and ECH, and a Tandem type accelerator for the Heavy Ion Beam Probe, is the major issue in the LHD research. For safety operation of LHD and related devices, radiation management system and access-control system were well integrated. Radiation monitoring by the Radiation Monitoring System Applicable to Fusion Experiments (RMSAFE) has been working successfully. The other radiation safety issues are a plan of the safety management system and development of precise radiation monitors considering the deuterium (D) plasma experiments in LHD, especially neutron protection and tritium treatment. Topics of these activities on the safety management research during FY 2010 are summarized as follows:

(i) Radiation management and monitoring

For the occupational workers in radiation control area, educational training and registration system have been established. The radiation management had been performed by radiation safety management office in the health and safety promoting division in NIFS. It is required that the annual exposure dose caused by operation of some radiation emission devices should not exceed 50 μSv in a year on the site boundary. To ensure this limit, a monitoring system RMSAFE works to detect burst X-ray and to discriminate the radiation caused by plasma experiment from the natural radiation and to accumulate the exposure dose. Also the environmental radiation has been measured every three months using a thermo-luminescence dosimeter (TLD), a radiophoto-luminescence dosimeter (RPLD) and an electrical personal dosimeter (EPD). Since an EPD has several advantages to monitor environmental radiation compare with the RPLD, we have a plan to prepare the EPD for all monitoring posts.

(ii) Studies of tritium treatment system and safety

Tritium and neutron are key issues from view point of radiation safety for the D experiment in LHD and for a future nuclear fusion facility. The specific technologies are extremely low level tritium monitoring and removing or recovering of tritium from the vacuum pumping gas or exhausting air from the large plasma vacuum vessel. It is also important to grasp tendency of the environmental tritium concentration level in water and atmosphere before Deuterium experiments in LHD. The topics of research and developments are an application of membrane dehumidifier for gaseous tritium recovery, developments in a high-sensitivity tritium gas monitoring system and in a tritium water monitoring system, research in an environmental tritiated hydrogen and methane concentration at Toki Site, a level transition of organically bonding tritium concentrations of pine needles at Toki Area.

(iii) Neutron measurements

It is also important to develop an accurate evaluation method of neutron dose by fusion reaction. Passive personal neutron dosimeters have been developed by the collaboration with the Univ. of Tokyo for measurement of dose from external neutron exposure at various nuclear facilities. In this year, research was focused on energy responses and angular responses.

(iv) Non-ionizing radiation monitoring and management

Leakage of static magnetic field and variable frequencies of electromagnetic fields are concerned in a magnetic fusion plasma experimental facility. Although high power electromagnetic waves are utilized for plasma heating in LHD, electric and magnetic field strength around the LHD hall were less than the occupational regulation level proposed as guide line by the ICNIRP. Measurement and analysis of burst electromagnetic fields in LHD has been performed as collaboration with Nagoya Institute of Technology. The performance of the personal RF electromagnetic fields monitoring system was tested.

(v) Education and other activities

Some materials contain natural weak radio-active components, such as sinter (hot sprig deposit), chemical fertilizer, and dried seaweed. The method is proposed to make a disk-shaped radiation source by compressing and shaping the original material. These disks are used as easy hand-able weak radiation sources for educational use.

(Nishimura, K.)

List of Reports

1. “Application of Membrane Dehumidifier for Gaseous Tritium Recovery in LHD”, Asakura, Y. (NIFS)
2. “High-Sensitivity Tritium Gas Monitoring system Using Two-Parameters Pulse Height Analyzer”, Kawano, T. (NIFS)
3. “Tritium Water Monitoring System Based on CaF2 Flow-Cell Detector”, Kawano, T. (NIFS)
4. “Observation of Environmental Tritiated Hydrogen and Methane Concentration at Toki Site”, Tanaka, M. (NIFS)
5. “A level transition of organically bonding tritium concentrations of pine needles at Toki Area”, Uda, T. (NIFS)
6. “Personal dosimetry using dose-meters in neutron fields with wide energy range”, Iimoto, T. (Univ. of Tokyo)
7. “Measurement and Analysis of Burst Electromagnetic Fields in Fusion Facilities”, Wang, J. (Nagoya Inst. of Tech.)
8. “Performance test of personal RF electromagnetic fields monitor for area monitoring at magnetic confinement fusion facility”, Uda, T. (NIFS)
9. “Natural Radiation Sources Fabricated from 12 Brands of Chemical Fertilizers and New Educational Technique”, Kawano, T. (NIFS)