

## (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 2012 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  $\mu\text{Sv}$  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 radiophoto luminescence dosimeter (RPLD) and an electrical personal dosimeter (EPD). These results are opened on the NIFS Web Site and updated continually.

### (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 vacuum vessel. It is also important to grasp tendency of the environmental radioactivity before Deuterium experiments in LHD. The topics of research and developments are an evaluation of gaseous tritium recovery system using membrane type dehumidifier, research in tritium monitoring system, and environmental radioactivity measurement.

### (iii) 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. In addition to this, visualization technique of the leakage electromagnetic field was tried with a positional sensing system using the IR camera of a Wii-remote to measure the field distribution around the RF oscillator.

### (iv) Education and other activities

We have a training program on the radiation protection for new workers in NIFS. The fabricated radiation sources which were not legal radioisotopes were applied to experience-based radiation education courses held in the home for the first time. In this course, four radiation measurements were conducted. One was performed to evaluate background radiation and the other three were performed to assess the dependence of radiation counts on time, distance, and shielding thickness. To monitor the radioactivity in the experimental hall, an on-site radiation monitoring cart with high mobility has been developing. In this year, weight reduction of cart was tried without reducing its performance.

(Nishimura, K.)

### List of Reports

1. "Design and Evaluation of Gaseous Tritium Recovery System Using Membrane Type Dehumidifier in LHD", Asakura, Y. (NIFS)
2. "Development of Safety Active Sampler for Tritium Monitoring in a Fusion Test Facility", Tanaka, M. (NIFS)
3. "Shielding Effect on Tritium Water Monitoring System Based on  $\text{CaF}_2$  Flow-Cell Detector", Kawano, T. (NIFS)
4. "Effect of Air on Energy and Rise-Time Spectra Measured by Proportional Gas Counter", Kawano, T. (NIFS)
5. "History of Environmental Radioactivity in Soil at NIFS Toki Site: Comparison the Data between 1984 and 2012", Tanaka, M. (NIFS)
6. "Correlation between Leakage Electric Field around ICRF oscillators and Plasma Input Power by ICRF Heating System", Tanaka, M. (NIFS)
7. "Visualization of Leakage EM Field around RF Oscillators for Ion Cyclotron Resonance Heating", Kamimura, Y. (Grad. School of Eng., Utsunomiya Univ.)
8. "Work Study of Radiation Measurements Using Radiation Sources Fabricated from Chemical Fertilizer", Kawano, T. (NIFS)
9. "Weight Saving of On-Site Radiation Monitoring Cart", Kawano, T. (NIFS)