(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 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 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 analysis of LHD exhaust gas for the design of the gaseous tritium recovering system, research in environmental tritiated hydrogen and methane concentration, developments in a high-sensitivity tritium gas monitoring system and in a tritium water monitoring system.

(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 the estimation of the detection efficiency of the dosimeter by the Monte Carlo simulation with PHITS code and development the neutron detection with the CR-39 personal dosimeter more.

(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

We have a training program on the radiation protection for new workers in NIFS. In this program, potassium chloride is used as a radiation sources. It is useful to understand the existence of natural radiation source. To monitor the radioactivity in the experimental hall, an on-site radiation monitoring cart with high mobility has been developing.

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List of Reports

1. “Investigation of LHD Exhaust System”, Asakura, Y. (NIFS)
2. “Observation of Hydrogen, Methane and Carbon Monoxide in an Atmosphere by Trace Reduction Detector and Flame Ionization Detector”, Tanaka, M. (NIFS)
3. “Effect of Air Condition on Two-Parameter Spectra Measured by Proportional Gas Counter”, Kawano, T. (NIFS)
4. “On Quasi-peak of Spectrum Measured by Tritium Water Monitoring System”, Kawano, T. (NIFS)
5. “Dose Measurement Using CR-39 in Neutron Fields with Wide Energy Range”, Iimoto, T. (Univ. of Tokyo)
6. “Measurement and Analysis of Burst Electromagnetic Fields in Fusion Facilities”, Wang, J. (Nagoya Inst. of Tech.)
7. “Monitoring of Leakage Electromagnetic Field by Handy-type Personal RF Monitor around ICRF Oscillator”, Tanaka, M. (NIFS)
8. “Training in Laboratory Measurements for New Radiation Workers Using Potassium Chloride Radiation sources”, Kawano, T. (NIFS)
9. “Evaluating On-Site Monitoring Cart Conceptually Developed for Radiation Workplace”, Kawano, T. (NIFS)