2-4. Safety Management in Fusion Facilities and Environment

Researches and developments on the safety and environment are the major issues for fusion facilities. The variety of issues should be surveyed not only in the field of radiation safety management and radiation protection but also in the field of general safety science, health and environment. Topics of these activities during FY 2012 are summarized below. And it should be pointed out that some of these scientific investigations have been successfully carried out as collaboration with researchers of many universities, research institutes and companies.

(i) Hydrogen isotope separation and removal technology

Tritium treatment is a main issue for fusion facilities. Isotope separation is one of key technologies for the fueling cycle, tritium decontamination, and tritium removal from exhaust to keep environmental safety. To evaluate the hydrogen isotope retention in the fusion device is also important issue from viewpoint of fuel control and safety. Many researches and developments are carried out by the collaboration with many universities. These are research in the multi-column pressure swing adsorption system by Kyushu University, development on the hydrogen isotope separation and sensing using proton conducting oxide by IFRC in Kyushu University, hydrogen isotope separation on poresize-controlled mesoporous materials by HIRC in University of Toyama, research in hydrogen isotope combustion processes in atmospheric pressure plasma by Nagano National College of Technology, and study on an interaction of microwave with synthetic type-A Zeolite containing water.

(ii) Tritium measurements

Since the radiated energy of β-ray from tritium is small, it needs a special technique to detect tritium. Especially, detection of low level triated water vapor in the presence of other airborne radioactive species such as Rn is very difficult. It needs to remove the influence of Rn and to enrich tritium. The application of an electrochemical hydrogen pump using a proton conducting oxide that transports protons in oxides at high temperatures have been proposed as a tritium separator. The integration test of the commercial proportional counter and proposed tritium separator was conducted by the collaboration with ISL (Isotope Separation Laboratory) in Nagoya University. Tritiated water monitoring system using plastic scintillator and photon counter investigated by Ochanomizu University. This method has an advantage to reduce radioactive liquid organic waste. To improve the sensitivity, a new method using plasma has been examined.

(iii) Safety in environment

In order to assess the influence of tritium released from nuclear facilities to the environment, it is necessary to confirm the effect of tritium appearing overlapped on background tritium levels.

Since 2008, the tritium decontamination in heavy water system has been processed for the decommissioning in Fugen nuclear power plant. The vacuum drying method and through-flow drying method have been applied in this tritium decontamination. In this system, dehumidifier consists of many components. To reduce components of dehumidifier, the drying system of the hollow fiber membrane dehumidifier system has been studied in LHD was built and applicability of the built drying system was evaluated by using for the tritium decontamination of FUGEN nuclear power plant.

Discussion items were listed up for optimization on radioactive discharges from facilities using radioactive materials in order to establish safety strategy by the University of Tokyo. Definition of “discharge”, protection of public and environment, and dose criteria were discussed here. Application of the strategy, steps of optimization, how to control facilities of NORM, step-wise or graded approach, etc. would be also important keywords in the future.

(Nishimura, K.)

List of Reports

1. “Design Problems of Cryogenic Pressure Swing Adsorption System for Hydrogen Isotope Separation in Fusion Fuel Cycle”, Kotoh, K. (Kyushu Univ.)

2. “Hydrogen Isotope Separation and Sensing Using Proton Conducting Oxide”, Matsumoto, H. (IFRC, Kyushu Univ.)

3. “Hydrogen isotope separation on poresize-controlled mesoporous materials”, Taguchi, A. (Univ. of Toyama)

4. “Investigation of hydrogen isotope combustion processes in atmospheric pressure plasma”, Ezumi, N. (Nagano National College of Tech.)

5. “Interaction of Microwave with Synthetic Type-A Zeolite Containing Water”, Tanaka, M. (NIFS)

6. “Integration Test of the Tritium Monitor Using Proton Conducting Oxide as Membrane Separator”, Tanaka, M. (NIFS)

7. “Tritium measurement with high measurement efficiency by plastic scintillator-2”, Furuta, E. (Ochanomizu Univ.)

8. “Application of the Dehumidifier System by Hollow Fiber Membrane Separation for Tritium Decontamination”, Matsushima, A. (JAEA)

9. “Safety strategy and optimization on radioactive discharges”, Iimoto, T. (The Univ. of Tokyo)