§ 1. Investigation of Tritium Traceability and Safety Confinement in Facilities for D-D Burning in LHD

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Deuterium-deuterium experiments at the Large Helical Device (LHD) are being planed by the National Institute for Fusion Science (NIFS). Tritium will be produced by one of the two branches of the D-D fusion reaction during the experiments. A part of tritium produced in the vacuum vessel of LHD will be retained in the plasma facing components and structural materials, and the rest will be exhausted to the tritium recovery system via the vacuum systems. The produced tritium during the D-D experiment, however, could be only trace amounts, in contrast to that handled in nuclear facilities and tritium facilities for fusion reactor development. Therefore, to reveal tritium behavior inside of the vessel and establish tritium traceability, tritium recovery, and processing in the LHD facility could be more difficult.

The main purpose of the present investigation is to asses whether experiences, data-base of tritium handling and management accumulated in large fusion devices and tritium facilities for fusion reactor development, could be useful for performing safely D-D experiments at LHD.

The meeting for the investigation was held on October 3-4, 2002 at NIFS. Many researchers and students participated from Ibaraki University, the University of Tokyo, Toyama University, Shizuoka University, Nagoya University, Kyoto University, Osaka University, Kyusyu University; Kumamoto University, the Japan Atomic Energy Research Institute (JAERI), Institute for Environmental Sciences (IES), and some private companies. The total number of the participants was 42.

In the meeting, the latest data base of tritium behavior and traceability in the inner systems of fusion reactors, such as plasma facing components, tritium breeding blanket, tritium decontamination technologies, were presented and discussed.

The tritium retention behavior in the plasma facing components of JT-60U, JET, ITER, and TEXTOR was presented by Miya and Tanabe. They suggested that sources of tritium should be considered. to estimate the tritium retention. That is, contribution of each tritium, hot tritium from D-D nuclear reaction, energetic tritium from plasma edge, and thermal tritium, toward the retention in the plasma facing components should be estimated separately.

The data base of tritium behavior in solid state and liquid blanket systems were presented by Okuno and Fukada, respectively. As to the former, researches for each elementary process, such as interaction between tritium and defects, tritium migration in the solids, hydrogen isotopes exchange on the surface, and so on, have progressed significantly. Few researches, however, have been carried out from the viewpoint that the elementary processes described above could be a continuous process. Therefore, integration of the elementary processes could be an important subject to understand the whole tritium behavior in the solid state blanket system. As to the later, tritium-related research subjects for Flibe performed under the JUPITER II collaboration were presented.

Yamanishi suggested that tritium recovery from medium concentration of tritiated water should become to be the most critical issue in the tritium removal technology. In the meeting, however, it was agreed that tritium recovery system even for tritiated water with lower concentration should be developed intensively in the LHD, which will be expected to control strictly tritium from surrounding environment and residences.

As to tritium removal, Takeishi presented the work about cleanup of tritium contaminated material surface using water vapor. It was suggested that almost all tritium on the surface of an empty tritium cylinder removed effectively with water vapor. Shu presented also data bases of tritium removal from contaminated material obtained during decommission and decontamination of Tokamak Fusion Test Reactor (TFTR).

To measure concentration of tritium in atmosphere, Momoshima has developed tritium enrichment and measurement system. It could be useful for monitoring tritium concentration of atmosphere in around the NIFS Toki site.

Development of tritium removal systems for exhausted gases during D-D experiments in LHD was presented by Askura. It was agreed that this was appropriate to perform early and safely D-D experiments at LHD.

It was concluded through all of the presentation and discussion at the meeting that because LHD will be expected to control strictly tritium even with order of concentration of lower limit of regulation in performing safely the D-D experiments, more precise data bases of tritium behavior and traceability should be built up hereafter under closer collaboration between universities and NIFS.