§8. Tritium Inventory in the Large Helical Device

Watanabe, K. (Toyama Univ.)
Sakuma, Y., Yamanishi, H., Obayashi, H.

A series of discussion meetings on the tritium issues in the LHD experiments program has been organized.

1. Scopes of the Meeting

D-D experiments by the large helical device will produce tritium amounting to 12 Ci/year. A part of tritium will be removed by a tritium recovery system, but most tritium will be captured by the first wall, divertor plate, NBI armor and so on. The captured tritium should be removed to a level as low as possible before the maintenance operations of the LHD device. To decontaminate relevant materials and/or equipments, it is essential to know in advance the tritium inventory distribution in the system.

The aim of this discussion series is to evaluated the inventory distribution and/or to find problems on the evaluation as well as to develop techniques of safe tritium handling. Another subject of the meetingg is to analyze the present status of tritium-material interaction studies, data accumulation, and research and developments concerning on safe and economical tritium handling.

2. Meetings in this fiscal year

The first meeting was held on August 22 and the second December 19 in 1995. The topics of the first meeting were tritium inventory estimations in the LHD device, the tritium breeder and the fuel recycling systems for ITER. The subjects of the second meeting were fundamentals in atomic and molecular collisions, radiochemical processes in homogenous and heterogeneous reactions, isotope effects and molecular processes in biological effects of tritium.

3. Summaries of the meetings

It was shown that basic data of tritium behavior have been accumulated continuously for a number of fundamental phenomena and those phenomena are understood fairly well. On the other hand, there is a lack of data and of understanding of some tritium-material interactions, for example, tritium adsorption and/or capturing by metals and alloys with non-clean surfaces covered with contaminant carbon and/or partially oxidized surface layers. Similar lack of data and of understanding were found for a variety of other phenomena as well as materials such as tritium desorption and/or release from material surfaces, surface chemical reactions, kinetic isotope effects and radiological effects on relevant processes. Those phenomena are required to be studied in more detail under various conditions to understand tritium behavior in thermonuclear reactor systems as well as the environment.

Concerning the research and development of the tritium technology , it was recognized that the present day tritium technology is not perfect to establish public acceptance of tritium handling for thermonuclear fusion reactors from view point of tritium safety and economy. An important subject is to analyze accidental events and to develop reliable methods and/or technologies for preventing tritium release and processing recovered tritium. Other problems of importance are to simplify tritium processing and tritium removal systems for establishing more efficient, reliable and smaller size systems. In addition, there are needs of more precise and accurate evaluation of tritium inventory and of efforts to decrease tritium inventory in the reactor systems. To solve those problems, more progess and innovation should be required, in spite of the significant improvement of tritium handling techniques in the last ten year.

Concerning the LHD device, the most important parts should be the first wall, divertor, NBI armor, vacuum pumps and tritium removing systems. Although an amount of tritium will be 12 Ci/year, the majority of tritium is expected to be captured by the first wall and divertor plates. Most of the remainder tritium flows to the tritium recovery system through vacuum pumps such as cryogenic and turbomolecular pumps backed with oil-sealed rotary pumps. These necessitate to develop effective tritium recovering and waste handling techniques to assure safety of workers during the maintenance operations. In addition, there is a need to improve tritium removal efficiency of the tritium recovery system for accidental tritium release into a huge volume of the room.

The present discussion meeting suggested a quantitative analysis of the tritium inventory distribution in the LHD device based on the present day data base and extensive experimental studies which are required for the quantitative evaluation of the tritium inventory distribution. Research and developments of tritium decontamination techniques of the relevant materials and tritium removing system were also suggested as important issues to meet a severe restriction of tritium handling at the Toki-site.

It is worthwhile to note that the LHD device is a model machine to investigate tritium behavior in larger and more complex DT burning experimental machines such as ITER.