

§4. Development of Environmental Atmospheric Tritium Monitoring System at Toki Site

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Since the first plasma shot in March 1998, many plasma experiments have gone ahead using Large Helical Device (LHD) in National Institute for Fusion Science (NIFS). D-D experiment is planned in the second phase of the LHD program. In this experiment, it is estimated that maximum 370GBq of tritium is annually produced by D(d, p)T reaction in the deuterium plasma. Most of the gaseous tritium exhausted (>99%) must be eliminated by tritium removal system equipped for LHD. Although the amount of produced and effluent tritium by the D-D experiment is expected to be extremely low, it is important to evaluate the effects of effluent tritium on the environment around the facilities. So far, only a few measurements of environmental tritium for a year have been carried out, associating with Kyushu University¹⁾. The detailed variation of environmental atmospheric tritium has not been observed yet. Therefore, we try to establish the atmospheric tritium monitoring system at NIFS to monitor the effluent tritium level and comprehend the detailed variation of background tritium level in the environment.

At first, we estimated the amount of effluent tritium at the site boundary and how the tritium exhaust from the LHD building, using the meteorological data obtained at Toki site in 1987. The estimation was achieved by the similar manner described in the manual of safety analysis for nuclear reactors as possible. The distribution of wind direction is shown in Fig. 1 along with the map of Toki site. It was found that southwest and northeast winds were superior at Toki site and the effluent tritium should run away to the downstream of these winds in most cases. In this analysis, the annual mean concentration of atmospheric tritium derived from D-D experiment maximized at the ~1 km distance from LHD building and it was 22mBq/m³ in southwest. Therefore, we concluded that the site boundary of southwest and northeast were appropriate for sampling of atmospheric tritium.

On the other hand, the system for collecting atmospheric tritium was built. Schematic of the system is shown in Fig. 2. Using this system, the efficiency of collection has been examined. Atmospheric tritium consists of three different chemical forms, HTO, HT and CH₃T. Recently, Japanese law for radiation protection was revised along with the advisory of ICRP1990. Because the quality factors of these species vary significantly in this law, it is desired that all of three species should be monitored separately. In Fig. 2, HTO, HT and CH₃T are sequentially collected to the molecular sieve traps as tritiated water, where the latter two species are oxidized by the suitable catalysts. After the collection over a week, the sieve traps

are heated at 400°C for 3hr passing through N₂ gas and the evacuated vapors are collected in the cold traps. The water samples recovered from the sieve traps are determined by a liquid scintillation counter for tritium.

Although we don't obtain enough data set for establishing a routine monitoring of atmospheric tritium yet, we are planning to arrange and run the system at a few points in the site, taking into account of the meteorological factors discussed above.

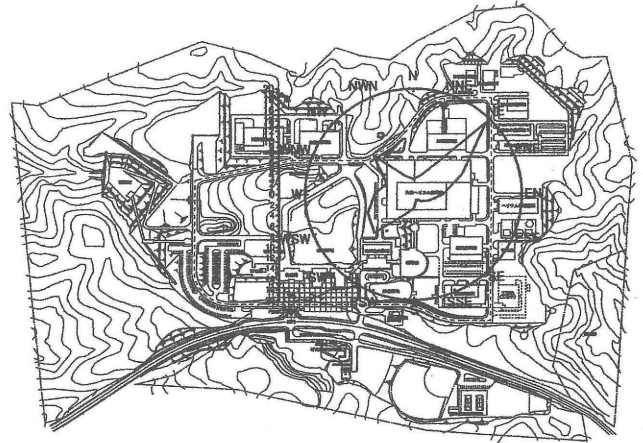


Fig.1 Distribution of wind direction at Toki site.

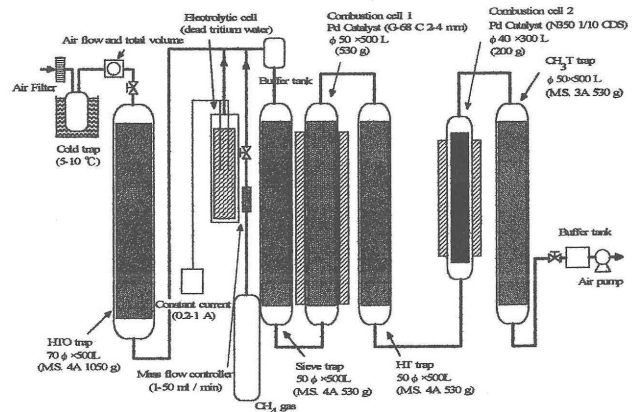


Fig.2 System for collecting atmospheric tritium.

Reference

- 1) Okai et al. The 5th low level counting conference using liquid scintillation analysis, 12-17 (1996).