§11. Testing of a Modular Unit of Cryosorption Pump for LHD-Neutral Beam Injector

Oka, Y., Kuroda, T., Kaneko, O., Takeiri, Y., Tsumori, K., Kawamoto, T., Asano, E., Akiyama, R., and Osakabe, M.

The neutral beam injector for the Large Helical Device needs a large vacuum system with pumping speed of ~1000 m^3/s to evacuate H_2/D_2 gases in the beam line. The cryosorption panel, instead of a cryocondensation panel, is considered to make the NBI vacuum system simple and less expensive owing to no use of the liquid helium (4.2K) systems. In order to develop the cryosorption pump for a long pulse period of 10 s, a modular unit of the cryosorption pump with the pumping speed of 103 m^3/s for H_2 was fabricated and tested in the negative ion source test stand in NIFS. Key issues for the design were to cool uniformly the charcoal surface with a reduced refrigerating power to ~15K against the heat load and to match with the requirement of a quickly heating up/cooling down the panel in regeneration. Radiation shield was composed of a 80 K LN_2 cooled baffle plate.

Figure 1 shows a schematic drawing of the modular unit of the pump with the LN_2 cooled radiation shield. The modular pump unit had a rectangular opening to scale it up simply for full scale panel. It is designed on the basis of R&D results of the cryosorption pump without the LN_2 developed by the NIFS for JIPP T-IIU-NBI for a short pulse (0.1 s).

Figure 2 shows the characteristics of the cooling-down time of the cryosorption panel. It can be seen that the panel is cooled-down within ~9 hrs after switching on the systems. This means that the pump can get ready for evacuating the gases during the nights after the regeneration, and start NBI from the next morning along with LHD-experimental senarios.

It was observed that major performances of the pump, for example, pumping speed for hydrogen as a fuction of the gas pressure, the ultimate pressure of the vacuum vessel, and the temperature rise of the panel etc agreed satisfactorily with the design values for the pulse period of 10 s..

As the testing of the modular pump units for a long pulse satisfied the requirement of the main pump of the beam line, the cryosorption pump system with the LN_2 cooled radiation shield was decided as the main pump for the LHD-NBI, instead of a traditional cryocondensation pump.

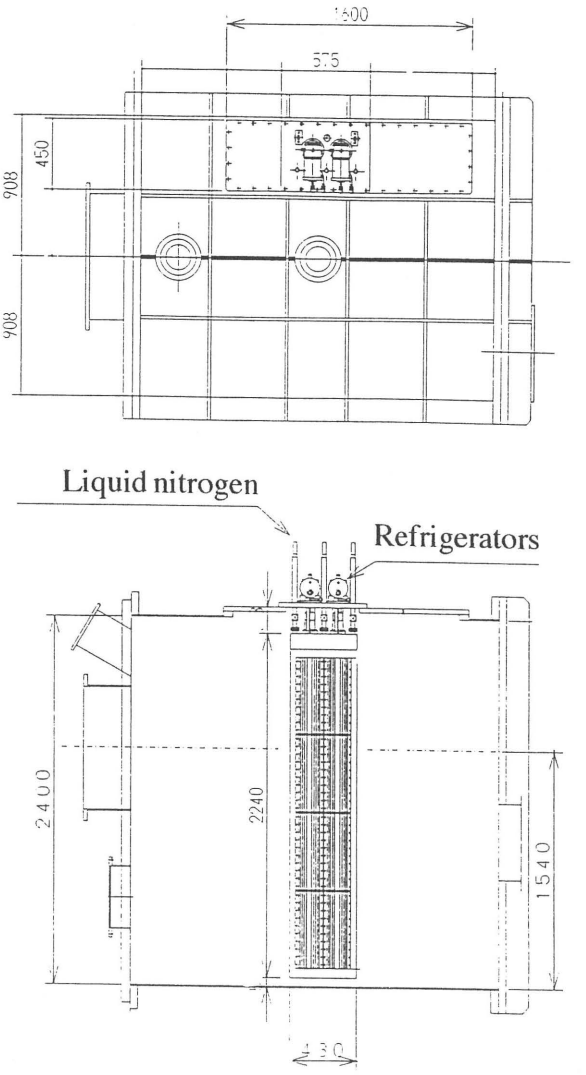

Fig. 1. A schematic drawing of a modular unit of cryosorption pump with a LN_2 radiation shield for a long pulse period.

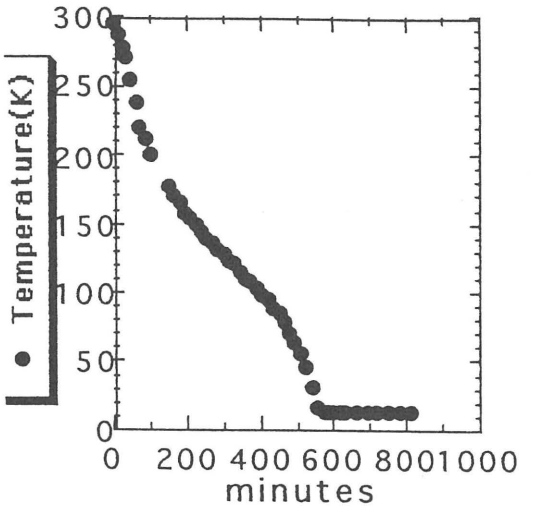

Fig. 2. Temperature of the cryosorption panel as a function of the time after switching on.