# 13. Division of Deuterium Experiments Management

The deuterium experiment was successfully started on LHD from March 7th, 2017. Objectives of the deuterium experiments are (1) to realize of high-performance plasmas by confinement improvement and by the improved heating devices and other facilities, (2) to explore the isotope effect study, (3) to demonstrate the confinement capability of energetic particles (EPs) in helical system and to explore their confinement studies in toroidal plasmas, and (4) to proceed the extended studies on Plasma-Material Interactions (PMI) with longer time scales.

The agreement for the environmental conservation and the LHD deuterium experiment was concluded between NIFS and the local government bodies of Toki-city, Tajimi-city, Mizunami-city and Gifu-prefecture in March 2013. After that, the preparation for the deuterium experiment has been carried out.

The Divison of Deuterium experiments management was founded to establish the safety management system and to consolidate experimental apparatus related to the deuterium experiments. To accelerate the preparation for the deuterium experiments, a taskforce named, 'deuterium experiment preparation taskforce' was established under this division. Main jobs of this taskforce were (1) the establishment of manuals to operate LHD and peripheral devices safely during deuterium experiments, (2) check and modification of the regulations related to proceed the deuterium experiments safely, (3) the upgrade of LHD itself, its peripheral devices and the interlock systems for the safe operation during the deuterium experiments, (4) upgrade and optimization of heating devices and diagnostic systems for the deuterium experiments, (5) remodeling the LHD building and related facilities, and so on. These jobs are proceeded with the cooperation with the LHD board meeting and the division of health and safety promotion. In addition, the necessary tasks related to the safety evaluation committee founded by NIFS and those related to the safety inspection committee for the national institute for fusion science (NIFS) founded by local government bodies are proceeded in this division.

Fig. 1 The memorial photograph of the ceremony for the first deuterium plasma discharge

As a preparation for the deuterium experiment, the Integrated Radiation Monitoring System (IRMS) was installed as a part of central interlock system of the LHD. The IRMS monitors all of the signals from environmental radiation monitoring detectors as well as the signals from neutron detectors in the torus hall. It also monitors the status of doors at the boundary of radiation controlled areas and the personnel access to the areas.

The calibration of neutron flux monitors was performed as a preparation for the deuterium experiment during November, 2016. On LHD, three sets of neutron flux monitors. The flux monitor consists from a pair of a fission chamber and a proportional chamber using either $^{3}$He or $^{10}$B. In the calibration experiment, a $^{252}$Cf neutron source was circulated in the vacuum vessel of LHD using a trolley system based on a toy train. In addition to the calibration of neutron flux monitors, the calibration of neutron activation system and the neutron profile monitor was also performed.

The legal inspection as a radiation emitting facility was also performed in the fiscal year (FY) of 2016. Most of the inspection was finished during the calibration experiment of the neutron flux monitors. As a part of the inspection, the shielding performance by the radiation shield wall was evaluated using the neutron emitted from the deuterium plasmas in LHD during March, 2017. The inspection was proceeded without any problems and the approval as a legal radiation facility was issued on March 29, 2017.

The cooperation to the safety inspection committee for NIFS is an important task to the division of the deuterium experiments management. The environmental neutron dose monitoring at NIFS and the tritium concentration monitoring in the environmental water around the NIFS has been performed by the committee since 2015. In 2016 FY, these monitoring activities were performed twice as scheduled under the cooperation with the division of the deuterium experiment management.

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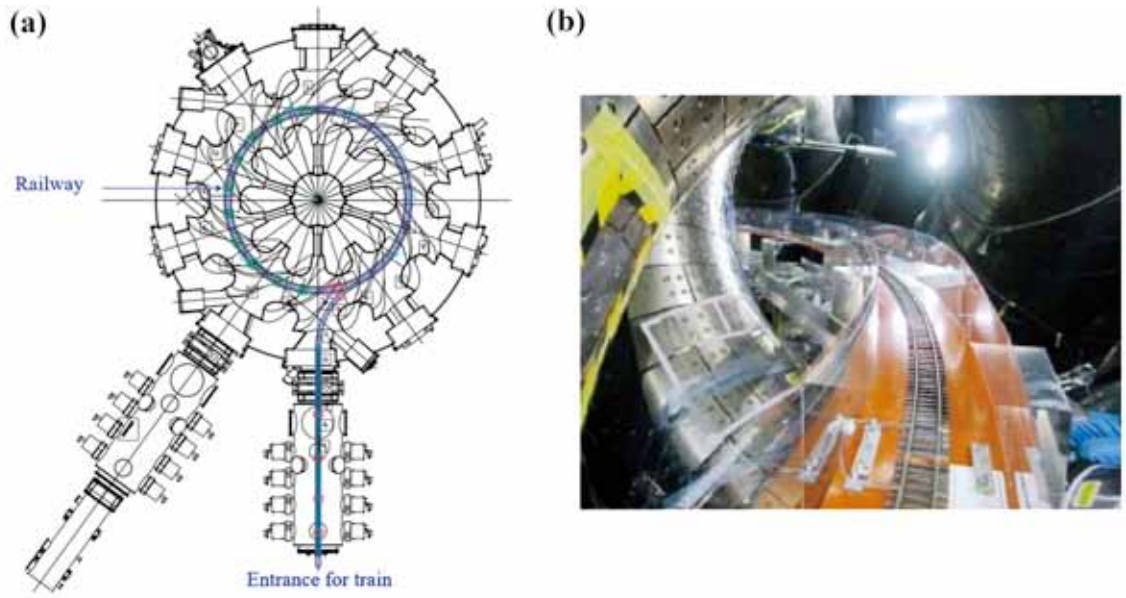


Fig. 2 (a) A schematic drawing of the railway of the trolley system for the neutron calibration experiment and (b) a photograph of the railway.