

Overview of Recent Japanese Activities in Fusion Technology

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After ITER/EDA, Japanese activities in fusion technology have been mostly devoted to R&Ds towards DEMO reactors. The paper intend to overview these activities.

With respect to the test blanket module development, solid breeder blankets with ferritic steel structure cooled by helium and water are being developed by JAERI in cooperation with universities and NIFS. While solid breeder blankets with SiC composite structure cooled by high temperature helium gas, liquid LiPb breeder cooled by helium, molten salt self cooled blankets and liquid Li self cooled blankets are under development by universities and NIFS in cooperation with JAERI.

In terms of the superconducting magnet development, JAERI has performed a basic research for the Fusion Power Demonstration Plant, aiming at realization of toroidal filed higher than 13 T. Innovative superconductors, such as Nb₃Al and High Temperature Superconductor (HTS), are candidates for this application. As an intermediate step, 1.5-m diameter coil using Nb₃Al conductor has been built and successfully operated at 46 kA in the background field of 13 T, which is the first demonstration of Nb₃Al applied to a large-scale magnet. A 60-kA HTS current lead has also been developed.

In the R&D of negative ion based NBI technologies, a H⁻ beam of 110 mA has been stably accelerated up to 0.9 MeV, which corresponds to the current density of 80 A/m². A long pulse beam injection of 17 s has been performed with 1.6 MW at 360 keV from one ion source in the JT-60 N-NBI. A beam power of 13.1 MW at 180 keV has been injected from three injectors in the LHD N-NBI.

In the radio-frequency heating technology, development of 170GHz ITER gyrotron has been progressed to achieve a 500kW for 100 sec operation in JAERI RF test stand. In JT-60 experiment, 2.8 MW power was injected into plasma for 2.8 seconds at 110 GHz. Long pulse injection for 756 sec with 72 kW was achieved in LHD ECH experiment at 84 GHz. In the test of a remote steering antenna for ECH, efficient transmission of 95% was successfully obtained at high power of 500kW using JAERI 170GHz gyrotron RF source. In the ICRF, a new record of long pulse up to 150 sec was achieved with 500 kW injection into LHD plasma.

In the area of tritium processing technology, R&D has been focused on the blanket tritium recovery technology. Tests on interaction between a tritium recovery system and a fuel cycle system has started using an integrated model system. Development of advanced techniques for tritium removal or detritiation has also progressed together with the reliability confirmation study of present detritiation system.