RECENT RESULTS AND PLANNED UPGRADES FOR THE DIII-D TOKAMAK

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A major focus of the experimental program on the DIII-D tokamak is to better define the optimal design requirements and operating scenarios of future devices such as ITER. Using the flexible DIII-D plasma control system, several of the proposed ITER operating scenarios have been investigated. The so-called ITER baseline, advanced inductive, hybrid, and steady state scenarios have been demonstrated and performance metrics have been documented and scaled to the ITER device. Plasma control issues critical to ITER are being addressed as well, including ELM control, vertical position control, and advanced shape control using magnetic field coil feedback. The importance of the details of plasma profiles and how they influence the high-energy confinement H-mode have also been investigated employing feedback control of neutral beam and electron cyclotron heating (ECH) systems. Simultaneous stabilization of deleterious tearing modes and resistive wall modes has been demonstrated. DIII-D experiments have evaluated the use of massive gas injection and pellet injection in order to control the power flux to the walls and avoid the generation of runaway electrons during disruptions.

Several modifications to the DIII-D device are being planned for the near future to allow research to continue to address critical issues that arise as tokamak research advances into the regime of longer pulse lengths, fully non-inductive current drive, and higher performance operation. Improvements of the auxiliary heating systems of the tokamak are planned, including increasing the ECH power to 12 MW and extending the neutral beam power pulse length to 10 s. Important plasma current profile effects will be addressed by modifying two of the neutral beam injectors to allow up to 10 MW of off-axis heating. Also, a flexible array of feedback control coils will be installed inside the vacuum vessel to continue the investigation of the control of ELMs and other MHD phenomena. A description of these upgrades and a discussion of some of the important recent results will be presented.

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